Article Outline

- North American Governments Agencies have Opinions on the Value of Proper Attic Conditioning of Residential Attics
- Ideal Conditions of Attic Space
- Why it is Important that Attics Have Proper Ventilation
- Why Mechanical Ventilation is Superior to Passive Ventilation
- Why Controllability of Ventilation (Mechanical) is Ideal
- Benefits of Mechanical Ventilation
- Introducing mechanical Solar Attic Fan Ventilation
- Additional Benefits of Solar Attic Fan Ventilation
- Distinguishing Great Solar Attic Fans From the Not So Great

Article

Excerpt from: US Department of Energy's Top 4 Areas to Address to Save Energy & Money at Home

Since 2000, U.S. homes have ballooned in size -- on average becoming 30 percent larger. Yet despite this fact, newer homes only consume 2 percent more energy, according to EIA data. While some of this can be attributed to more homes being built in warmer regions like the South, a lot of it is thanks in part to improved energy efficiency.

From more efficient appliances to better building materials, advances in residential technologies are helping homeowners save energy, and many of these technologies can trace their roots back to the Energy Department. Through investments at the early stages of technology, tougher appliance standards and collaboration with researchers at our National Labs and private companies to develop energy-saving technologies, the Energy Department is helping lay the foundation for more efficient homes. Explore the top four Energy Department inventions that are helping homeowners save energy and money -- you might even find some of the innovations in your home!

It should be noted that the number one overall recommendation from the Energy Department is focused on attic air-tightness…

1. LOOSE-FILL FIBERGLASS INSULATION

Hidden in walls, attics and floors, insulation helps keep homes comfortable with little thought from the homeowner. In 1992, private insulation manufacturer Energy Savings Solutions, Inc., reached out to Oak Ridge National Laboratory to find ways to improve loose-fill fiberglass insulation -- one of the most common types of attic insulation. After discovering that in cold climates this type of insulation resulted in heat losses of up to 50 percent, Oak Ridge researchers provided the guidance necessary to substantially improve the insulation's performance.

Oak Ridge's findings sparked an industry-wide reformulation of loose-fill fiberglass insulation, leading manufacturers to redesign their products for better fiber dispersion. The findings also had an impact on state building codes. Minnesota rewrote its energy code to require manufacturers to label insulation based on the coldest expected winter conditions. Today, nearly 75 percent of homes use this type of improved loose-fill fiberglass insulation, and researchers estimate the changes have helped consumers in cold climates save 5-10 percent on heating costs.

Looking to the future of building envelope technologies, the Energy Department is working to develop new more efficient insulation that can be added to existing homes and buildings. One such project with Industrial Science & Technology Network, Inc. focuses on using nanotechnology to develop cost-effective, environmentally friendly foam insulation that is more efficient than current technology. If successfully commercialized, the company estimates the technology could save $8 billion a year in heating and cooling costs.

Excerpt from Home Advisor's True Cost Guide

Blown-in insulation is one of the most common ways to insulate the attic, crawl space, or walls of a home. The average cost is about $1,346, with most homeowners spending between $875 and $1,897, but this is dependent on whether the work is done by the homeowner or by a professional. Most home improvement stores can supply rental blower units, but many homeowners find the option of a hired installer easier due to the large size of the job. Blown-in insulation increases the comfort of your home by neutralizing humidity and drafts and usually brings the largest return on investment.

http://www.homeadvisor.com/cost/insulation/install-blown-in-insulation/

Consider for a moment that North America experiences extreme cold in the winter and in many parts of the continent, extreme heat and humidity in the summer months. It would then make sense that homeowners would focus on making their houses more energy efficient and comfortable. In Canada the National R-2000 housing program was developed with the idea that standards be in place to predefine technical requirements to ensure the highest levels of air tightness and efficient thermal barrier to help prevent unnecessary heat loss and heat gain. In addition, the air tightness requirements also ensure very low moisture transfer into the building structure. When these attributes are coupled together with regional building code requirements, an air-tight home with adequate roof (attic) ventilation will ensure the durability of the roof and building, and provide maximum occupant comfort.

Natural Resources Canada, the Canadian federal agency that addresses energy efficiency standards (akin to the US Department of Energy), suggests that for any home that may be subject to high heat gains or heat losses caused by the attic, that the best solution is to seal any air leaks in the ceiling and to add more insulation to the attic floor. Under these requirements, additional ventilation may not be needed. That of course is the perfect scenario. And yet, you will be hard pressed to find a rooftop anywhere in North America that doesn't have multiple vents on it. Most home contractors will tell you that complete airtightness is a myth and is unachievable. Imagine what it is like in older homes that have endured extreme and constantly

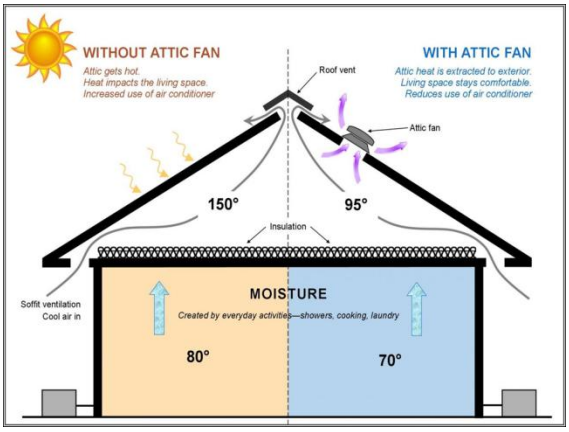
changing weather conditions for long periods. Attic spaces are especially affected by weather conditions. Roof shingles curl up and lose their ability to seal. The wooden trusses and under-structure of an attic suffer from long periods of neglect and cause homes to leak air.

Why Every Home Should Have Mechanical Attic Ventilation

If you are like most homeowners you are not sure if your attic is properly insulated, and even if it is, is it airtight? You are not sure if you should spend the $1346 to have new insulation blown in. If you are like most homeowners you will likely pay for at least one roof reshingling project in your lifetime, and possibly as many as four. A roof replacement often comes unexpectedly after a rough winter of snowfall and ice damming or an extended, unseasonably hot drought period. The cost of a roof replacement will run you anywhere from $5,000 - $8000, on average. Aside from the sticker shock it is sometimes especially painful when you weren`t planning for that expense. Left un-remedied, a damaged roof will cause bigger problems within the home that will cost exponentially to repair.

Depending on what part of the country you reside in, the roof on your home will have a different life expectancy. You would certainly think that this is partly due to the differing weather conditions a roof would face, day in day out, in different regions of the continent. But did you know that the life expectancy of a roof is highly dependent on having adequate ventilation in the attic?

Poor ventilation causes a build-up of heat in the attic that is generally 25° F - 70° F warmer than the ambient temperature in the house. This is caused by a trapping of the air in the attic in response to inadequate ventilation. As we all learned in our science classes in school, we know that `hot air rises'. Hot air is created mostly from the thermal effect on a house from prevailing weather conditions. When it is spring, summer or fall and the sun is shining, a roof will absorb the sun`s rays with great intensity. The temperature inside the house, even when controlled (via air-conditioners and furnaces) adds to the heat build-up in the attic. As the warmer air rises to a second floor you will experience a `wall of heat` resulting from the compressed air in the attic acting as a downward barrier. When you are walking up a staircase to a second floor the temperature change is easily felt. You will likely also feel an increase in humidity. This makes for a very difficult night of sleep unless of course you crank up the air-conditioner the whole night through to combat the heat build-up in the attic. That gets expensive. Many people like to sleep with the windows open all night to provide relief from heat and humidity. However this strategy doesn't relieve the attic`s heat build-up and you will experience the same conditions night after next. The `open window` strategy is not fixing the problem.



Most homes that were built before 1985 will have either a gable vent on either side of the house or maybe even a conventional passive attic vent. More recently, homes are being built with what are now considered conventional passive attic vents that are sitting on the roof itself. There are also ridge vents which are more common on single story homes in southern climates. In all cases the ventilation is insufficient as it is passive. Easy to explain….there is minimal air movement and evacuation of the air from the inside of the attic to the outside of the roof. This is because the conventional vents on 99% of homes are passive and only provide an opening from the attic to the outdoors. The rate of heat buildup in an attic each day outpaces the amount of air that escapes the attic. On really hot days you would be lucky if any air escapes the attic at all as hot air in the attic will only rise if the air above it is significantly cooler.

Conventional Passive Rooftop Vent

Gable Vent

Mechanical attic ventilation has been around for a few years. Mechanical vents (fans) are traditionally motor driven fans that require electricity to operate. Electricity costs money. Installation of a mechanical vent system in a home can also be expensive. Mechanical vents will adequately move out or evacuate the compressed hot air in an attic. Most mechanical vents are turned on by homeowners on a reactive basis when experiencing warm temperatures and high humidity and are left on indefinitely, again using excessive amounts of electricity. Once somebody invents a programmable humidity sensor that can moderate and automate the use of a mechanical vent, they would be less expensive to operate. Wind turbines address the issue of providing mechanical ventilation without the use of electricity. However, wind is unreliable. In other words, it only works when there is sufficient breeze. Nonetheless a wind turbine will move

air out faster, when it is in operation. A wind turbine will often move air out of the attic when it isn't necessary or desired, say overnight. Suffice it to say it is not a controllable solution.

Mechanical Attic Ventilation via Wind Turbine

Controllability

The controllability of hot attic air has a number of positive aspects: First, the evacuation of attic air on a timely, regular basis will extend the lifespan of the roof shingles. As roof shingles are kept cooler and dryer over longer periods of time they won`t expand and contract as much and won`t curl or disintegrate, at least until the manufacturer's life rating of the shingles. Once roof shingles begin to curl, one can expect some damage to various parts of the rooftop and its under-structure in the attic such as the vapour barrier, trusses and surface plywood. The wood will begin to show warping, cracking and weakness. A dry attic is always ideal. An attic cannot be dry if it is continually over heated. A roof will begin to leak as the shingles get left too long without replacement. It is suggested that instead of getting 12-15 years out of the roof shingles, perhaps we are talking about stretching that to 20 - 25 years and deferring those unexpected replacement costs….with proper mechanical ventilation.

Second, a properly ventilated attic will reduce or eliminate the development of mold, mildew and rotting within the attic, which can eventually breathe its way into the home.

Third, proper mechanical ventilation of an attic will provide for superb home comfort. As the attic air would be conditioned to be the same temperature as the outdoor temperature, there is no wall of heat being trapped in the living space of the home. Alas! Lower temperatures in the home will prevail as desired and the upper floors will naturally be cooler. This eliminates the need to crank up the A/C or open all the windows to have a comfortable sleep.

Fourth, studies have proven that proper mechanical ventilation used at the optimal time in response to weather conditions will result in positive financial impact. Air-conditioner usage/operating times can be greatly reduced without sacrificing the desired temperature in the home. This delivers financial savings via reduced electric (power) bills. The best financial savings are achieved during peak electricity demand times (generally during traditional business hours, Mon-Fri from 8:00AM – 6:00PM) when utility electric rates are at their highest.

So far we have discussed the merits of proper attic ventilation with the most obvious solution being `mechanical attic ventilation'.

Mechanical Attic Venting in summary:

- Provides controllability
- Protects roof materials, extends lifespan of roof shingles and defers major capital costs
- Eliminates mold, mildew and rot in attic space
- Improves home comfort
- Lowers energy bills

Mechanical Attic Ventilation via Solar Attic Fans

Now imagine how mechanical attic ventilation can be improved upon by utilizing a renewable form of energy (the sun) to power an attic fan. Solar Attic Fans deliver all the desired results and conditions of mechanical ventilation without the need to be connected electrically to the house and operate more reliably than a wind turbine.

Benefits of a Solar (mechanical) Attic Fan:

A Solar Attic Fan will run anytime there is direct sunlight upon it. This means it would never be running at night or on cloudy days. Ventilation is most desperately needed when sunlight is directly hitting the roof. Of course this occurs during the daytime when air-conditioners are being used most frequently and are overcooling the home to compensate for the 'wall of heat' on upper floors and in attic spaces. Solar Attic Fans are in operation on the most optimal basis and have a direct correlating effect on the draw of air-conditioners. Studies have shown that on houses that utilize Solar Attic Fans approximately 300 - 400 kilowatt hours of electricity can be saved over the summer months. Solar Attic Fans can reduce electricity costs by up to $100 in the summer months on average. A homeowner's carbon footprint is positively affected by Solar Attic Fans on two fronts. There is no electrical connectivity with a Solar Attic Fan and there is a more targeted and synchronized reduction in the air-conditioner demand.

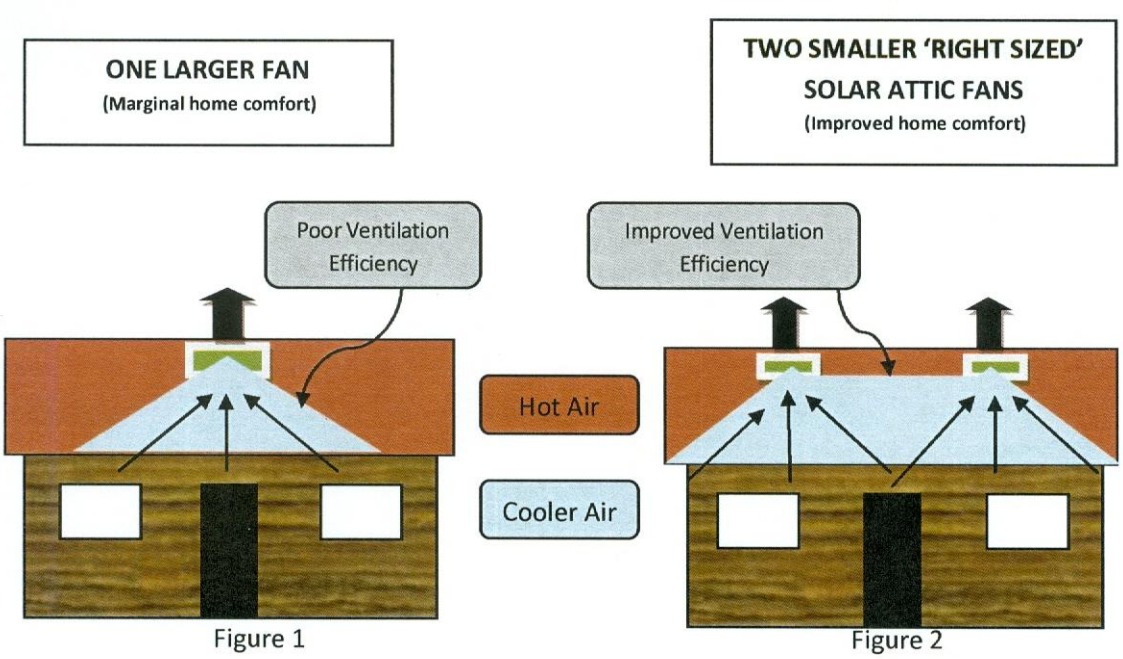
Not All Solar Attic Fans are the Same

There are several Solar Attic Fan manufacturers in North America. Retail product costs range from $159 to $549. This seems like a wide variation of consumer cost to achieve what some would believe to be the same effect. Much of the product price variation would depend on the sizing of fan capacity to the square footage of an attic. Some Solar Attic Fans are more expensive because they are larger and produce only a higher output of air movement, which may be an overkill if not right-sized to the specific home. The lesser expensive Solar Attic Fans tend to be modular in approach and smaller, but right-sized (approx., 400 CFM), enabling the homeowner to determine if one or more units is required to deliver the right effect. Most Solar Attic Fans were designed for new builds in which case a hole must be cut into the roof. Ironically it is the older home that requires an attitude adjustment for the attic ventilation and therefore a retrofitable Solar Attic Fan would be an ideal solution where a unit could simply fit into an existing attic orifice.

Proper Capacity Fitting of Controlled Attic Ventilation

It is important that a Solar Attic Fan (or any mechanical ventilation device for that matter) be `right-sized'. That is to say that the Solar Attic Fan should not be over-ventilating as it can actually create a vacuum effect or negative air pressure in the home. It would be a modest level of negative air pressure and wouldn`t be noticeable to homeowners. However it could affect the pilot light on a gas burning fireplace or furnace. It seems the right amount of air movement from a Solar Attic Fan should be no more than 400 cubic feet per minute (CFM) per 1000 square feet of attic space. This would be a modular approach. Many models in the marketplace are rated at levels that exceed 400 CFM. Only one model found in the market place is rated below that level (at 180 CFM). Such a low level of air movement is questionable to have any meaningful effect. There are models in the marketplace that are rated at 1500 CFM and clearly should only be operating on larger homes with greater than 3000 square feet of attic space representing a very large house if it has two storeys or a 3000 square foot single storey (bungalow style) house. Most models are manufactured to operate as a single unit on a house in which case it is hit and miss when it comes to having the right-sized amount of ventilation. The modular approach would seem to make more sense as a homeowner can install the right number of smaller capacity Solar Attic Fans to fit their square footage.

And Biggest isn't always better!! By using two 'right-sized' modular Solar Attic Fans, for example, instead of one larger more expensive model, you may dramatically increase the efficiency of the air flow and total area affected. In Figure 1 (below), the air flow is more concentrated as opposed to the balancing that is achieved by using two fans as illustrated in Figure 2 (below). The benefits of the configuration illustrated in Figure 2 are A) less thermal transfer invading the house, resulting in decreased air conditioning costs and, B) more airflow passing over an increased area of roof sheathing, decreasing the likelihood for mold and static, hot pockets of air decreasing roof life.



Retrofitting vs. Cutting a New Hole in the Roof

Most Solar Attic Fans are not designed to be retrofitted into existing vent orifices and therefore need a new hole to be cut into the roof. The drawback of a non-retrofitable Solar Attic Fan is the risk that the installer doesn`t do a proper job of sealing the orifice once the fan is installed which can result in leakage. Nobody wants a leaky roof. Solar attic fans that can be retrofitted into the existing orifice are ideal as the same number of openings in the roof exist without the need to change the air pressure in the attic. Extra holes cut into the roof may cause a change in air pressure.

Purely Solar – Going Green - Part of the Smart Home Solution

Many Solar Attic Fans are connected to the electrical system of the house and would facilitate the fan running on an electrical current whenever the sun's rays are not evident. There is no need for that as the principal of a Solar Attic Fan is to operate only as the attic overheats, which is when the sun is in full force. A Solar Attic Fan that is purely driven by the sun`s rays is ideal. Why spend an extra $50 per year on your electric bill to drive a fan in your attic when the renewable resource of our sun will do it for you? A purely solar driven unit will decrease the homeowner's carbon footprint.

Another nice thing about a purely solar driven attic fan is there is no need for an electrician to hook-up the product to the breaker panel. That can be expensive. No municipal permits are required when installing a Solar Attic Fan.

Finally here is a checklist for the ideal featured for the ultimate Solar Attic Fan:

- ✓ A high quality fan and gasket assembly (and check the wattage of the fan);
- ✓ Ability to universally retro-fit into any roof or gable vent or soffit;
- ✓ 100% solar powered;
- ✓ Adjustable solar panel to maximize the sun's rays;
- ✓ Modular size fan capacity (approx. 20 watts) to enable right-sizing and multiple unit installation to properly address the attic square footage; and
- ✓ An exceptional warranty (20 years)

John Lambert
Vice President, Business Development
International Solar Solutions Inc.

Resources:

US Department of Energy

Natural Resources Canada (NRCan) Canadian Centre for Housing Technology & University of Ontario Institute of Technology Scientific Experiments

Seongchan Kim,Western Illinois University Macomb, Illinois - Measurement and Detailed Analysis of Indoor and Outdoor Environment Conditions and Energy Consumption of a Single Family Residence

Euysup Shim, Illinois State University, Normal, Illinois- Measurement and Detailed Analysis of Indoor and Outdoor Environment Conditions and Energy Consumption of a Single Family Residence

Kai Millyard Associates - Ontario Residential Insulation Analysis by Vintage

Building Knowledge Canada Inc.- Report on Depressurization Potential of Residential Solar Attic Vent

Lambert Smart Energy – Toronto Ontario