

ECOLOGIC ENERGY SOLUTIONS, LLC

High-Performance Spray Foam Insulation



The Science of Spray Foam Insulation: Your Questions Answered

Written by EcoLogic

Open-Cell Foam

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Closed-Cell Foam

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Commercial

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Residential

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Energy Star Testing

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Energy Audits

•

Thermal Imaging

•

Thermal Coatings

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by 40-70%!



Investment in Your Wallet

EcoLogic is your first line of defense against today's rising energy costs. Whether you are building or remodeling your home, spray foam insulation by EcoLogic can dramatically reduce your energy cost by up to 70%. The payback period to recoup the initial investment to upgrade to foam is as little as two years. The return-on-investment can amount to tens and even hundreds of thousands of dollars throughout the years you live in your home. Even better, spray foam eliminates the need for soffit/ridge vents and will reduce your HVAC size and expense.

Spray foam's magic lies in its incredible ability to air seal. Applied as a liquid, spray foam instantly expands to fill in every nook and cranny, creating a tight building

envelope. This is extremely important given the fact that the U.S. Dept of Energy estimates that air leakage accounts for 40% of the energy used to heat and cool our homes.

Investment in Your Health

Spray foam will never disintegrate and breakdown into harmful dust accumulation like fiberglass. And spray foam does *not* carry a cancer warning label like fiberglass. Further, spray foam is safe to use around environmentally and chemically sensitive individuals. Best of all, spray foam helps prevent mold and mildew from occurring. Because of its incredible ability to air seal, warm-moist air will not travel through the wall and ceiling cavities to condense on cold surfaces – the primary culprit in mold growth. *Spray foam provides controlled ventilation, not uncontrolled air-infiltration.*

Investment in Your Comfort

Spray Foam excels at absorbing sound from both inside and outside the home. In addition, cold, moist, and drafty spots will be eliminated. The result is a quiet, even tempered house even during the harshest weather conditions. Our customers compare spray foam to the *quiet and warm feeling of a snow capped roof during a snowfall.*

Investment in the Environment

An investment in spray foam is an investment in sustainable energy conservation. Besides dramatically reducing your homes energy consumption, EcoLogic offers spray foam derived from soy-based polyols and recycled plastics. Not only are you helping the environment, you are helping to reduce our dependence on foreign oil.



"Energy efficiency, in particular, has emerged as a top priority for consumers... When asked to list their top 12 influences in buying a home, consumers responding to a National Association of Home Builders survey last year put energy efficiency at No. 2, behind quality of living space. Five years ago, energy didn't even make the same survey."

Wall Street Journal, Feb 12, 2009

EcoLogic Advantage *"There is No Substitute for Experience"*

Not all spray foam companies are created equal! Regardless of the type of foam you choose, a poor applicator will result in an unsatisfactory job, with voids, gaps, messy overspray, and even a decrease in performance. EcoLogic has assembled the most skilled, knowledgeable, and professional team in the industry. Your job will be overseen by our Operations Manager, John D. Graves, a veteran and "legend" in the foam industry with over 18 years of experience. We are proud to offer the most advanced commercial-grade equipment and foam products available. Your job will be completed efficiently, cleanly, and all at a competitive price.

Table of Contents

We are pleased to provide you with the following frequently asked questions prepared by EcoLogic. These answers are the compilation of years of research and real world experience. We have attempted to consolidate the responses to the answers and questions we receive most often from builders, architects, and homeowners. Please keep in mind that much of the information and recommendations given pertain to the New England climate and normal conditions. As with any insulation system, it has to be designed and installed correctly for each building's unique application and operating parameters.

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1. Q. What is Spray Foam?

A. Spray foam is a complete insulation and air barrier system that insulates and air seals walls, floors and ceiling cavities against air movement; including spaces around electrical outlets, baseboards, and where the walls meet windows and doors. Applied as a liquid, the foam instantly expands up to 120x its original size to fill in every nook and cranny. Spray foam is a polyurethane plastic predominately made from petroleum or recycled petroleum based products. Certain foams are partially made from soy and other agricultural contents.

2. Q. What are the Advantages of Spray Foam?

A. Since spray foam is an approved air barrier, outside air cannot seep through walls causing drafts, cold spots, dampness, and other discomfort. It also means that moisture laden air cannot enter the walls and condense on cold surfaces causing mold, mildew and premature decay. Spray foam insulation is also recognized for its incredible ability to absorb sound. Moreover, it is not uncommon for homes with foam to experience more than a 50% reduction in heating/cooling consumption compared to a similar house with fiberglass. This is because of spray foam's unique ability to create a custom air seal and retain its R-value in extreme weather conditions.

Did you know that the U.S. Department of Energy estimates that air leakage accounts for as much as 40% of the energy used for heating and cooling. A house that leaks air is a house that leaks money!

3. Q. Why is Spray Foam Better Than Fiberglass?

A. According to the US Department of Energy, *"The most common insulation, fiberglass, does not stop air leakage. In older homes, dirty fiberglass is a telltale sign of air movement (it simply collects dirt like a filter)." If insulation cannot air seal, then it cannot truly insulate. Creating an air-tight structure is the absolute key to achieving the greatest insulation results. Most factory-made insulation suffers a reduction in performance due to its inability to prevent air-movement. Fiberglass has a real-world R-value far below what is stated. In tests conducted at Oak Ridge National Laboratory, commonly installed fiberglass batting was found to have an R-value that was typically 28% less than what the manufacturer claimed. In addition, because of its lack of air barrier qualities, when exposed to a real-world environment with wind, moisture, and cold climate, tests show the effective R-value of fiberglass diminishes by more than 50%. However, foam's ability to stop air leakage is only a fraction of its benefits, convection suppression is another important characteristic – see question 8. CONCLUSION: Fiberglass insulation is a poor investment; *Spray Foam Insulation literally pays for itself and puts money in the bank.**

It is interesting to note, applications that demand truly effective insulation use foam – i.e. the space shuttle, freezers, refrigerators, etc. Thanks to foam insulation, new Energy Star refrigerators are capable of running on only 75 watts of electricity! Refrigerators insulated with only 1.5" of foam use 40% less energy than those with 3" of fiberglass.

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What to Look For When Choosing a Foam Applicator

Experience means everything! Regardless of the type of foam you choose, a poor applicator will result in an unsatisfactory job, with voids, gaps, messy overspray, and even a decrease in performance. The installation of spray foam is a highly technical process, literally being manufactured on site. When you choose EcoLogic you will receive experienced and skilled sprayers, along with a knowledgeable sales force that will design a system that is right for you. With the EcoLogic, your job will be completed efficiently, cleanly, and all at a competitive price.

4. **Q. What is the Difference Between Open & Closed-Cell Foam?**

A. **Open-cell foam** is the most common form of spray foam insulation and can range in density from 0.5lb per cubic ft to 1.2lb per cubic ft, with R-values ranging from R-3.6/inch to R-4.5/inch. The two leading brands of 0.5lb open-cell foam are Sealection500 and Icynene. 0.5lb foam is the least expensive of the various spray foam options. When applied, 0.5lb foam instantly expands more than 100x to fill in every nook and cranny. All open-cell foams excel at absorbing sound, creating a quiet and comfortable home. Many people equate the 'feeling' of open-cell foam to the quiet and warmth of a snow-capped roof in the wintertime. Open-cell foam is generally applied to the above ground walls, underside of the roof in an unvented attic, and wherever sound attenuation is desired. In the event of a roof leak, water will pass through open-cell foam with gravity, thereby allowing the roof leak to be detectible. Higher density open-cell foams, 0.8lb to 1.2lb, are often used when increased R-value is desired in shallow cavities, or when it is preferred that the cavity is left shy.

Closed-cell foam, often referred to as rigid-foam, has a density that can range from 1.7lb per cubic ft to 2.2lb per cubic ft and an R-value varying from R-5/inch to R-7/inch. These foams have a lower vapor permeability than open-cell foams and in most cases qualify as a class II vapor retarder. Closed-cell foam is used wherever there is significant moisture or vapor drive; for instance, below grade foundation walls (basement walls), indoor swimming pools, wine cellars, freezers, etc. Closed-cell foam is also used when trying to maximize R-value in shallow cavities. Further, closed-cell foam can dramatically add to structural integrity due to its high density and compression strength. Closed-cell foam comes in two forms, water blown and 245fa blown. The water blown variety traps air inside the closed cells in order to create insulation value. The 245fa blown foam uses a lightweight gas developed by Honeywell to fill the closed cells, creating a higher R-value.

5. **Q. Are Some Foams Made From Soy, Are They Better?**

A. Soy and other agriculturally derived foams have gained tremendous popularity over traditional petroleum based foams as the demand for 'green' building products increases. Agricultural foams help support renewable resources and the American farmer. These foams derive *some* of their polyols from agricultural resources rather than solely from petroleum. Agricultural polyols have been in use for a long time, and are used to make everyday plastics from lawn chairs, car seats, to foam insulation. *However*, the total content of agricultural polyols can vary greatly from one spray foam manufacturer to another. Even with these agricultural contents, the majority of the foam is still made from petroleum or recycled plastic contents. It is most important to select a brand based on reputation and quality; agricultural contents do not necessarily ensure a better product. *Buyer beware, some manufacturers use an insignificant quantity of agricultural polyols in order to tout their product as 'green.'*

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6. **Q. I've Been Told To Use a Hybrid Insulation Method With a Combination of Foam and Fiberglass, Are There Any Concerns With This System?**

A. Many insulation companies in the Northeast have been promoting hybrid insulation systems, often referred to as “flash and batt”, which incorporate a thin layer of closed-cell foam followed by a layer of traditional fiberglass batt insulation. We advise builders and homeowners to proceed with caution when selecting one of these hybrid systems. The potential exists for moisture and condensation problems if the system is not designed and installed correctly.

Foam and fiberglass each relate to the properties of thermal conductivity, convection, water, vapor, and air in very different manners. The way they interact with these physical properties necessitates different design approaches for each type of insulation. But when combining the two forms of insulation, one must consider a whole host of variables and how they will interact – effective R-values, vapor barriers, vapor permeability, dew points, air-permeability, longevity, etc. The design and proper installation of such a system can often be confusing and the desired results elusive to achieve.

Since fiberglass is air permeable, warm indoor air will pass through the fiberglass and come into contact with the thin layer of foam. If the foam is not thick enough, and does not have adequate thermal resistance (R-value), a dew point may occur on the surface of the foam and condensation will form. Moreover, since closed-cell foam is a vapor retarder, hybrid systems naturally place the vapor retarder on the wrong side of the wall (vapor retarders are supposed to be placed on the warm side of the wall). Worse yet, if kraft-faced or foil-faced fiberglass is used, the result is a moisture sandwich or double vapor barrier assembly. While a proper flash-and-batt system can be designed, the execution meeting these design parameters is nearly impossible to achieve. Either the foam is applied too thin or too thick. Too thin and the risk for condensation occurs, too thick and the fiberglass batt must be compressed to fit into the cavity (thus rendering much of the fiberglass useless). These are just a few of the potential drawbacks of the flash-and-batt system. Please call for more information.

| Foam Comparison Chart | | | | |
|--------------------------------------|------------------------|------------------------|--------------------------------|--------------------------|
| Foam Types | 0.5lb Open-Cell | 0.8lb Open-Cell | Closed-Cell Water blown | Closed-Cell 245fa |
| Vapor Barrier | No | No | Yes | Yes |
| Sound Absorption | Excellent | Good | Moderate | Moderate |
| Roof Leak Detectible | Yes | Yes | No | No |
| R-values/Inch | 3.6-3.8 | 4.0-4.5 | 5.0-6.0 | 6.0-7.0 |
| Cost | Least Expensive | Moderate | Moderate/High | High |
| Air Barrier | Yes | Yes | Yes | Yes |
| Below Grade Walls | No | No | Yes | Yes |
| Increase Structural Integrity | Some | Some | Significant | Significant |
| Available in Soy-Based | Yes | Yes | Yes | Yes |

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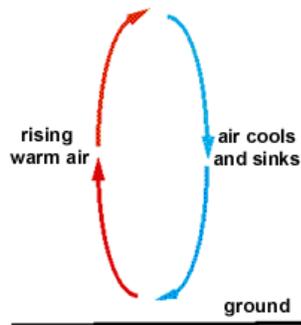
7. Q. Are There Health Concerns With Spray Foam?

A. Beyond superior energy savings, spray foam insulation creates a safe, non-toxic, and healthy home. *And unlike fiberglass insulation, it does not carry a cancer warning label.* EcoLogic's spray foam is completely safe and non-toxic and does not contain any Urea Formaldehyde, CFC's or HCFC's. In fact, our open-cell foam has obtained the seal of approval by the Environmental Choice Program of Canada. Further, several of our foam products have obtained the coveted GreenGuard certification for Children & Schools, recognizing its overall health and safety. Spray foam is generally safe to use around environmentally and chemically sensitive individuals. This is important given the increased rate of allergies today. And spray foam will not breakdown and contribute to harmful dust accumulation like other insulation such as fiberglass and cellulose. In addition, because spray foam is a true air barrier, it prevents pollen and spores from entering the home and warm moist air from coming into contact with cold surfaces, eliminating many of the conditions that cause toxic mold and mildew. This is why the ALA's (American Lung Association's) model healthy home uses spray foam.



8. Q. Why Do I Need Spray Foam if I Do a Good Job Air-Sealing With Tyvek and Caulk?

A. Even a tight home with fiberglass will suffer a dramatic loss in performance and comfort because of convection currents that take place inside the porous fiberglass. A home with fiberglass in the walls or roof will permit convection currents and air movement inside the cavity, thereby creating a surface wall temperature that is either



colder or hotter than the interior temperature of the home. As the temperature differential between the inside

and outside increases, the convection currents inside the fiberglass will speed up, literally transferring the heat into or out of the house. The result is a home that does not 'feel' quite right - either too cold or too hot. This is caused by radiant heat transfer taking place between the occupant and the surface



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of the wall or ceiling. Think of a cold winter day when you are sleeping next to a poorly insulated wall; the room may be warm, but the cold wall pulls the heat right out of your body. Simply from a comfort perspective, spray foam in the walls will yield outstanding results – particularly when the cavity is fully filled. (See question 23 for additional information)

9. Q. Will Spray Foam Break Down, Sag or Settle Over Time?

A. No, spray foam will not break down or settle over time like other insulation such as fiberglass and cellulose. However, if the foam is left exposed to UV light then it will disintegrate over time.

10. Q. What is the R-value of Spray Foam?

A. Open-cell foam has an R-value that can range from R-3.6/inch to R-4.5/inch. While these stated R-values are similar to those of fiberglass, the effective R-value is much greater.

This is because the required R-value test does not take into consideration real world conditions such as air-movement, humidity, convection currents, and extreme temperature changes. Spray foam maintains its R-value in most weather conditions,

"It is important to note that R-value of a material does NOT include any resistance to heat flow by air leakage."

Insulating Guide by Chris Mathis

while fiberglass and other porous insulation experience a decrease in performance. Closed-cell foam has a much higher R-value than that of open-cell foam, between R-6/inch to R-7/inch.

11. Q. Is it True that the R-value of Closed-Cell Foam Diminishes Over Time?

A. Closed-cell is made up of millions of tiny cells filled with a blowing agent developed by Honeywell called HFC-245fa. Gases other than air in the cells, known as "captive blowing agents," can increase the thermal resistance of the foam. However, the 245fa agent leaks out of the cells over time and is replaced by air, thereby decreasing the R-value. This phenomenon is known as "thermal drift" and applies to all foams that incorporate captive blowing agents. This thermal drift can be ongoing for years, even decades. While closed-cell foam is required to state an aged R-value, the foam is only aged 90-180 days prior to testing. Many years later the final aged R-value can be much lower than what was intended. Many studies have been conducted to determine what the resulting R-value is after a number of years, but the results can be difficult to ascertain because so many variables come into play. In short, in the absence of an accepted method to determine this aged R-value, the National Roofing Contractors Association believes that users should select an R-value of about 5.5 per inch when calculating thermal performance for closed-cell foam. This is well below the stated R-values provided by most manufacturers. This creates a quagmire when designing a flash-and-batt system and determining its long-term performance. (Open-cell foam simply uses water as the blowing agent and the cells are filled with air to create its insulating value – thus always ensuring a stable and continuous R-value).

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12. Q. What are the advantages of applying spray foam directly to the underside of the roof? Doesn't my attic need ventilation?

A. Attics were traditionally vented to remove excess moisture and reduce heat build-up. New research suggests that venting attics may actually make the situation worse and greatly add to our energy costs. Because warm air rises, vented attics create a stack or “chimney” effect that continuously pulls moist air from crawl spaces and basements into the attic,

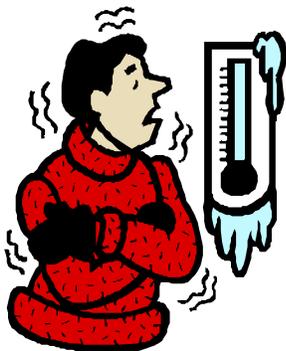


contributing to a greater moisture load. Further, during the night the colder air rapidly cools the roof which can cause condensation to form. And to make matters worse, radiant heat during the day heats up the roof and easily passes into the attic generating excessive temperatures which then pass into the living space below.

We can solve all of these moisture and heat build-up problems by applying spray foam directly to the underside of the roof deck and sealing off the attic from the outside environment. By sealing off the top of the house we eliminate the “chimney” effect that would otherwise occur. We further prevent the hot moist air by day and the cold air at night from continuously venting in and out of the attic - stopping moist air from entering the attic all together is the best way to control moisture related problems. A conditioned attic also greatly reduces our cooling loads during the summer and heating loads during the winter. Additionally, since spray foam is an excellent thermal barrier, ice damming during the winter is prevented since heat is not easily transferred to the roof causing snow to melt.

Of significant importance, an unvented attic reduces the stress load on HVAC systems and ductwork which may be located inside an attic. A vented attic exposes heated or air-conditioned air to extreme temperatures, dramatically reducing the efficiency.

13. Q. What Temperature Will My Attic Be With Spray Foam?



A. Tests conducted at Oak Ridge National Laboratory, funded by the US Department of Energy, showed that a vented attic with fiberglass on the floor was found to have an attic temperature of 108° when the exterior temperature was 110° and interior temperature 70°. Under the same conditions, an unvented attic with spray foam applied to the underside of the roof had an attic temperature of less than 78°. *In fact, the Manual J Residential Load Calculations (page 351), used by HVAC installers, recognizes the benefits of a conditioned attic with foam by basing load calculations on the following extreme conditions: When the outside temperature is -20°F then the unvented attic temperature is 57°F, when outside temperature is 115°F then the attic temperature is 81°F.*

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14. Q. Will My Roof Shingles Overheat With an Unvented Attic?

A. No. Modern tests have demonstrated that shingle temperature is primarily a function of shingle color and solar heat gain, not attic ventilation. In fact, most attics greatly exceed outdoor air temperature during the summertime. A good analogy is that of a black car parked in the sun on a hot day; no matter how much the interior of the car is air-conditioned, the top of the car will still be scalding hot from solar heat gain. In tests conducted in Nevada, funded by



the U.S. Dept of Energy, unvented attics with spray foam showed an increase in shingle temperature that never exceeded 7°F more than the vented attics - well within the manufacturer's recommended limits. In the Northeast, the shingle temperature change is even less significant, especially if you have shading.

15. Q. Am I Allowed to Apply Spray Foam to the Underside of the Roof Without Ventilation?

A. Yes. Section R806.4 of the 2006 International Residential Code specifically permits unvented attics with certain provisions; namely, that an *air-impermeable* insulation is applied to the underside of the roof with an appropriate r-value necessary to maintain the monthly average temperature of the surface of the foam above 45°F in order to prevent a condensing surface. The condensing surface is on the face of the foam and not the roof sheathing because the foam bonds to the sheathing creating a single cohesive, air-impermeable assembly. (Please note, fiberglass and cellulose do not qualify as air-impermeable. This also means there are certain limitations when combining fiberglass over the foam in an unvented roof). The code defines an air-impermeable insulation as having an air-permeance less than 0.02L/s-m² (both open and closed-cell foam qualify).

16. Q. Will Open-Cell Foam Cause Moisture Problems?

A. It's important to understand that neither open nor closed-cell foam will result in moisture problems in common building assemblies if the insulation system is designed and installed correctly (see Vapor Barrier Requirements in Question 17). The code recognizes both open and closed-cell foam as meeting the requirements of a true air-barrier. Since most vapor is transported with air-flow, an air-barrier will eliminate the vast majority of vapor movement. However, in conjunction with this principal, it is essential that adequate R-value or thermal resistance be achieved to prevent a dew point and condensation on the surface of the foam. This required R-value is discussed in the latest supplemental code criteria from the 2006 IRC. The research shows that an R-20 of open or closed-cell foam in a roof deck is necessary to prevent a condensing surface in our climate zone (under normal operating conditions).

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Since open-cell foam is more water permeable than closed-cell, many people incorrectly assume that open-cell foam will result in moisture problems. Open-cell foam has been successfully used for over two decades with nearly a perfect track record. While open-cell foam is not appropriate for all applications, in general it provides excellent cavity insulation in most conditions and climates. *It is simply a fallacy that open-cell foam will wick moisture out of the air or will wick water like a sponge.* Water will only penetrate through the foam with pressure (i.e. submersion, flooding, gravity, sub-grade hygric pressure, etc). In fact, in 96 hour water submersion tests, 0.5lb open-cell foam was found to have a water absorption rate of approximately 25% - no more than typical plywood. Further, 0.8lb foam has a water absorption rate of 2.53%, below that of plywood and OSB. Can you imagine the water absorption of fiberglass batts! Many building science experts agree that the water absorption of insulation is *irrelevant*. In fact, many argue that the water absorption and distribution characteristics of insulation can be beneficial to the structure.

“Unvented attics require water/moisture control. Water moves in (or out) of buildings three main ways. The greatest amount of moisture is moved as bulk water (rain or any kind of water flow). Less moisture is moved by moist air such as with infiltration. The least amount of moisture is moved by moisture migration through materials.”
2006 IRC Commentary

Joseph Lstibureck, Phd, considered one of the foremost building science experts, writes in a letter we obtained from him: *“Where spray foam is applied directly to the cavity side of exterior sheathing, the water absorption of the spray foam is irrelevant...In fact, it could be argued that just the opposite characteristic is desirable in this location – some water absorption is in fact beneficial as it allows the material to act as a “hygric” buffer that allows some liquid phase water redistribution. For example, in roofing applications, wood roof decks traditionally outperform steel decks from a condensation control perspective for this reason. The key material and system characteristics for a cavity insulation are convection suppression, thermal resistance, air impermeability and vapor resistance - not water absorption.”* Joseph goes on to write that water absorption only becomes relevant where foam will come into contact with concrete and masonry.

17. Q. Do I Need to Use a Vapor Barrier with Spray Foam?

A. According to code requirements, a vapor barrier is required to be used with open-cell foam, but is not necessary with closed-cell foam. A vapor barrier, for the purposes of satisfying code, is a retarder with a permeance rating of 1.0 or less. In the Northeast, the vapor barrier is required to be placed over the interior side of the insulation (the warm side of the wall). This is because vapor typically follows heat flow – heat flows from warm to cold. Since the Northeast is predominately a heating climate, we try to stop or slow the migration of vapor through the wall or roof cavity at the interior surface. Recently, however, a significant amount of building science has been devoted to studying this vapor issue. Many researchers believe the use or

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misuse of vapor barriers may play a significant role in the cause of moisture related problems. There is a debate whether a vapor barrier is necessary with open-cell foam.

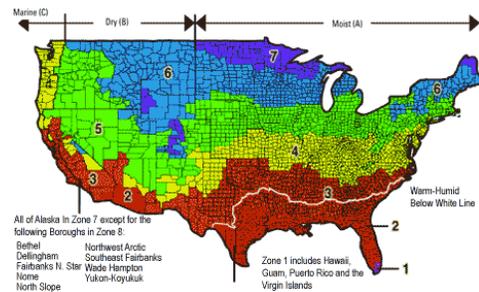
Vapor Retarders

Class I: > 0.1 perm (impermeable)
 Class II: >1 perm (semi-permeable)
 Class III: >10 perm (semi-permeable)

“Incorrect use of vapor barriers is leading to an increase in moisture related problems. Vapor barriers were originally intended to prevent assemblies from getting wet. However, they often prevent assemblies from drying.”
 Joseph Lstiburek Phd, Building Science Corp

The latest science has separated the classification of vapor barriers into three categories: Class I, Class II, and Class III. Open-cell foam is considered a class III vapor retarder at normal thicknesses (sometimes as low as a class II retarder at greater thickness); while closed-cell foam is considered a class II vapor retarder. Further, the latest International Residential Code breaks the climate zone map for the U.S. into 7 zones. For instance, Connecticut is Zone 5, Westchester is Zone 4.

Vapor barrier requirements will vary depending on type of building assembly, use of the building, and climate zone. Some advanced computer modeling has shown that a vapor barrier may not be required with open-cell foam in typical wall assemblies in climate Zone 5 (since open-cell is already a Class III retarder). However, every wall and roof assembly is different and will have different requirements. With spray foam, vapor migration becomes less of a concern since most vapor is transported with air flow, not through diffusion. This is why the latest code language is primarily concerned with an air-impermeable insulation being applied to the roof-deck and does not discuss vapor permeability (the IRC explains this in its code commentary). Both open and closed-cell foam meet the requirement of an air-barrier.



As such, open-cell foam does retard the transfer of vapor both through air-movement and diffusion. In fact, The U.S. Dept of Energy issued a vapor barrier journal paper that provides vapor barrier guidelines for specific climate zones. Our climate zone, zone 5, requires a class III vapor retarder on either wall or roof cavities. Even basic 0.5lb open-cell foam will satisfy this requirement. Plus, southwestern CT is on the cusp of zone 4, which does not require any vapor retarder according to the D.O.E. guidelines. Moreover, studies conducted by the University of Waterloo, based on field testing and hygrothermal WUFI modeling software, concluded that an additional vapor retarder is necessary over open-cell foam only in climates above 7200°F heating degree days - well north of CT. (However, an additional vapor retarder is recommended in areas where the relative humidity will be maintained above 50% - i.e. wine cellars, indoor swimming pools, etc).

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Confusion with the vapor barrier requirement often results in double vapor barrier assemblies – never recommended. For example, if the outside of your roof has a polypropylene waterproof underlayment with a vapor permeance rating under 0.05 perms (class I vapor barrier) and you then install a vapor barrier over the inside face of the insulation. Further, by installing a flash-and-batt insulation system in the rafter bays with FSK or kraft-faced paper, a double-vapor barrier situation is present. If excessive vapor becomes trapped within the fiberglass, it can lead to unusual hygrothermal behavior and a dew point may occur. This is even more likely if heat producing air-handlers will be trapped behind insulated knee-walls and attic areas – the heat build-up and moisture loads in these areas can lead to extreme conditions. For instance, if these enclosed areas reach a temperature of 80°F with 50% relative humidity, then the dew point level would be 60°F! Remember, the code criteria requiring an R-20 minimum of air-impermeable insulation to the roof-deck is based on maintaining the surface of the foam above 45°F. This condensing temperature is based on normal attic conditions - 75°F interior temperature at 35% relative humidity. If the attic will be operating outside of these ‘normal’ parameters then additional measures will need to be taken. See the dew point chart below for more information.

Air Temperature in Degrees Fahrenheit

| Air Temp °F | % Relative Humidity | | | | | | | | | | | | | | | | | | |
|----------------|---------------------|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | 100 | 95 | 90 | 85 | 80 | 75 | 70 | 65 | 60 | 55 | 50 | 45 | 40 | 35 | 30 | 25 | 20 | 15 | 10 |
| 110 | 110 | 108 | 106 | 104 | 102 | 100 | 98 | 95 | 93 | 90 | 87 | 84 | 80 | 76 | 72 | 65 | 60 | 51 | 41 |
| 105 | 105 | 103 | 101 | 99 | 97 | 95 | 93 | 91 | 88 | 85 | 83 | 80 | 76 | 72 | 67 | 62 | 55 | 47 | 37 |
| 100 | 100 | 99 | 97 | 95 | 93 | 91 | 89 | 86 | 84 | 81 | 78 | 75 | 71 | 67 | 63 | 58 | 52 | 44 | 32 |
| 95 | 95 | 93 | 92 | 90 | 88 | 86 | 84 | 81 | 79 | 76 | 73 | 70 | 67 | 63 | 59 | 54 | 48 | 40 | 32 |
| 90 | 90 | 88 | 87 | 85 | 83 | 81 | 79 | 76 | 74 | 71 | 68 | 65 | 62 | 59 | 54 | 49 | 43 | 36 | 32 |
| 85 | 85 | 83 | 81 | 80 | 78 | 76 | 74 | 72 | 69 | 67 | 64 | 61 | 58 | 54 | 50 | 45 | 38 | 32 | |
| 80 | 80 | 78 | 77 | 75 | 73 | 71 | 69 | 67 | 65 | 62 | 59 | 56 | 53 | 50 | 45 | 40 | 35 | 32 | |
| 75 | 75 | 73 | 72 | 70 | 68 | 66 | 64 | 62 | 60 | 58 | 55 | 52 | 49 | 45 | 41 | 36 | 32 | | |
| 70 | 70 | 68 | 67 | 65 | 63 | 61 | 59 | 57 | 55 | 53 | 50 | 47 | 44 | 40 | 37 | 32 | | | |
| 65 | 65 | 63 | 62 | 60 | 59 | 57 | 55 | 53 | 50 | 48 | 45 | 42 | 40 | 36 | 32 | | | | |
| 60 | 60 | 58 | 57 | 55 | 53 | 52 | 50 | 48 | 45 | 43 | 41 | 38 | 35 | 32 | | | | | |
| 55 | 55 | 53 | 52 | 50 | 49 | 47 | 45 | 43 | 40 | 38 | 36 | 33 | 32 | | | | | | |
| 50 | 50 | 48 | 46 | 45 | 44 | 42 | 40 | 38 | 36 | 34 | 32 | | | | | | | | |
| 45 | 45 | 43 | 42 | 40 | 39 | 37 | 35 | 33 | 32 | | | | | | | | | | |
| 40 | 40 | 39 | 37 | 35 | 34 | 32 | | | | | | | | | | | | | |
| 35 | 35 | 34 | 32 | | | | | | | | | | | | | | | | |
| 32 | 32 | | | | | | | | | | | | | | | | | | |

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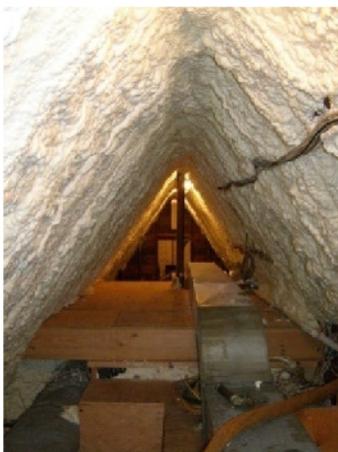
Keep in mind the majority of vapor migrates with air movement. Since open-cell foam is an air-barrier, it prevents the movement of moisture-laden air (vapor) to cold surfaces, which stops condensation. Under conditions with significant vapor drives, a vapor barrier or closed-cell foam is recommended (such situations include wine cellars, indoor swimming pools, steam rooms, etc). In addition, open-cell foam should never be used where it may come into direct contact with liquid water, such as basement foundation walls. Because of the ongoing vapor barrier debate, many local code officials do not require a vapor barrier – but it is important to

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check with them beforehand. If a vapor barrier is required, it can be satisfied through a number of methods which can include: a film of poly over the foam, radiant foil, or vapor barrier paint applied directly to the foam or sometimes to the sheetrock.

18. Q. Will My Home Be Too Tight? Doesn't My House Need to Breathe?

A. Yes, a house requires a certain amount of ventilation to maintain good quality indoor air, to expel moisture, and for the health of the overall structure. However, you want controlled ventilation, not uncontrolled air infiltration. Modern building science has attributed a whole host of problems and failures to uncontrolled air infiltration. Often the underlying cause of these failures is due to a “leaky” building envelope that allows moisture-laden air to pass through the cavity and condense on cold surfaces.



A house insulated with fiberglass has anywhere from 0.5 to 0.6 natural air changes per hour (meaning 50-60% of all the air in the house is replaced every hour). A *tight* house using spray foam has approximately 0.1 to 0.15 air changes per hour. No matter how tight we make a house, doors and windows still leak air. Therefore, a house built with spray foam still breathes, just at a more controlled and practical rate. This is important because the Department of Energy estimates that air-leakage accounts for up to 40% of energy costs.

Building a tight house allows us to have better control over the artificial indoor environment that we create. We can control where, when, and the quantity of fresh air that is introduced into the home. This leads to greater control over the quality of the air and the moisture loads in the air. Furthermore, because of increased allergies, people are finding the need to separate themselves from the smog, pollen, mold, and spores prevalent in outdoor air. Spray foam, coupled with proper mechanicals and ventilation, creates an extremely sophisticated indoor environment with unparalleled levels of control. Mechanical

“A home built to the American Lung Association® Health House® guidelines is constructed airtight to improve energy efficiency and prevent unplanned moisture movement. Although many stories in the media attribute indoor air quality problems to houses being built too tightly; the reality is that homes need to be as tight as practical...Moist air leaking out in cold weather can condense on wall and attic surfaces, creating mold growth and...structural decay. This is a direct result of the home not being tight enough. Moist air leaking into a home in hot humid weather can have the same effect...Air leaking into a home from an attached garage has been shown to be a significant source of Carbon Monoxide.”

American Lung Association

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ventilation should be introduced to help achieve an acceptable level of air quality.

19. Q. Should I Install Mechanical Ventilation with Spray Foam?

A. Yes. In general it is recommended that some sort of mechanical ventilation be installed to maintain a controlled exchange of fresh air into and out of the house. The most desirable method in our climate zone is to install an HRV (heat recovery ventilator). These systems extract the energy from the air leaving the house and diffuse it into the air entering the house, thereby eliminating much of the energy penalty associated with ventilation. Another reason HRV's outperform traditional exhaust fans is because it controls the exact location of air exhaust and air intake. Basic exhaust fans depressurize the house, forcing air infiltration through all sorts of unwanted points of penetration, potentially leading to condensation problems. Popular makers of HRV's include Fantech, Venmar, Broan, and Lennox.

20. Q. How Much Ventilation Is Needed?

A. Ventilation requirements are outlined in ASHRAE Residential Ventilation Standard 62.2. Whole house ventilation requirements for a typical house ranges between 45 to 75 cubic feet per minute (cfm); larger houses have a higher rate. The chart to the left is a rough guideline for whole house ventilation requirements. You can also use a simple formula for determining ventilation rate: $CFM = [(0.01 \times \text{total square footage}) + 7.5 \times (\# \text{ of bedrooms} + 1)]$. For a 3200 square foot home with four bedrooms, that would mean $(0.01 \times 3200) + (7.5 \times 5) = 69.5$ cfm. If you can determine the natural air changes per hour (ACH) through air infiltration, then you can reduce the ventilation requirement by that amount. A

| Floor area (ft ²) | Number of bedrooms | | | | |
|-------------------------------|--------------------|------------|------------|-----|-----|
| | 0-1 | 2-3 | 4-5 | 6-7 | >7 |
| <1500 | 30 | 45* | 60 | 75 | 90 |
| 1501-3000 | 45 | 60* | 75* | 90 | 105 |
| 3001-4500 | 60 | 75* | 90* | 105 | 120 |
| 4501-6000 | 75 | 90 | 105 | 120 | 135 |
| 6001-7500 | 90 | 105 | 120 | 135 | 150 |
| >7500 | 105 | 120 | 135 | 150 | 165 |

= most likely ventilation requirement



blower door test is required to assess a home's natural ACH.

There are several methods you can use to provide the necessary ventilation, such as a supply fan, exhaust fan, or a combination. Simple exhaust or supply fans can be installed and sized to provide the necessary quantity of fresh air. However, these basic fans can result in a significant energy loss and can lead to unwanted humidity levels. HRV's (heat recovery ventilators) or ERV's (energy recovery ventilators) are a more sophisticated method combining both exhaust and supply air without a significant energy penalty. These systems recapture the energy of the outgoing air and diffuse it back into the incoming air. In addition, ERV's can help to reduce the amount of moisture gain associated with incoming fresh air. Moreover, these ventilation systems can be attached to an air filter, adding greater control and quality to the incoming fresh air.

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21. **Q. What's the Difference Between an HRV and ERV? Which Should I Choose?**

A. An HRV (heat recovery ventilator) is primarily designed for heating climates while an ERV (energy recovery ventilator) is designed for cooling climates. While the basic mechanisms are the same for both, an HRV uses an aluminum core as the thermal transfer mechanism and an ERV uses a cellulose core. The cellulose core of the ERV allows it to not only transfer the energy but also to remove moisture from warm outdoor air entering the house. In other words, an ERV helps redirect the humidity from the intake air and send it back outside, reducing the moisture burden on the A/C system and creating a dryer indoor environment. An HRV's aluminum core does not transfer any moisture; it will exhaust moisture just like a traditional exhaust fan and will allow moisture to enter in the summertime. An HRV's core will last forever; an ERV's core will have to be replaced every 3-5 years. In northern climates where humidity is not a significant concern, an HRV is preferred.



22. **Q. Do I Need to Adjust the Size of My HVAC System for Spray Foam?**

A. Yes, properly sizing HVAC systems in well-sealed and well-insulated homes leads to greater comfort, reduced initial expense, lower operating costs, longer equipment life, fewer callbacks, and healthier indoor air quality. One key step in properly sizing the HVAC system is using the industry standard, Manual J. Manual J software calculates heat loss from the house through walls, ceilings, leaky ductwork, and infiltration through windows, doors, and other penetrations. Manual J also helps calculate heat gain into the house from sunlight, people, lights and appliances, doors, walls, and windows. It is common to reduce the size of an HVAC system by more than 30% through proper design based on insulation and air-infiltration rates - that can mean significant cost savings on the equipment. A typical house with fiberglass has an ACH (air changes per hour) rate of 0.5-0.6, meaning 50% to 60% of the indoor air is exchanged with outdoor air every hour. Typical homes with spray foam have an ACH rate of 0.1 to 0.15, meaning 10% to 15% of the indoor air is exchanged every hour.

While over sizing equipment on the heating side leads to a loss in efficiency, over sizing on

the cooling side can result in moisture problems. Air conditioners cool a house first, then dehumidify it. If an HVAC unit is too large, it will short cycle. It will turn on, cool the house down, and turn off again before removing much humidity from the air. Frequent starting and stopping increases energy consumption, makes the home uncomfortable and clammy, and contributes to mold and indoor air quality problems. Often, a house with spray foam can be sized with one ton of cooling for every 1,000sf of living space. *Consult with EcoLogic for further assistance on this issue.*

"A right-sized system combined with proper air sealing creates a healthier house. Together, the two will maintain a comfortable humidity level, reduce the occurrences of allergy-causing mold and help keep dust and pollen outdoors. The health ramifications are significant."

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23. Q. Is it True That I Will Not Be Able to Pass a Wire through a Wall with Foam?

A. There is a common misconception propagated by fiberglass companies that a full open-cell foam cavity will make snaking a wire through the wall impossible. They argue that fiberglass or a flash-and-batt system (combination of both foam and fiberglass) will allow the wire to be easily passed through. This is not entirely true. Firstly, a properly installed flash-and-batt system should not incorporate a kraft-face, so the snake will easily become entangled in the fiberglass. The snake will often pull much of the fiberglass out of the cavity like cotton candy. Whereas in an open-cell foam cavity the use of a snake drill will allow a tidy hole to be burrowed through the soft foam without much disturbance. Many electricians feel it is easier to snake a wire through open-cell foam than through fiberglass.

24. Q. Is it Best to Fill the Wall Cavity Completely, or Leave it Somewhat Shy?

A. In general it is best to completely fill the wall cavity. This full cavity approach does cost a little extra in labor and material, but it provides the best results. When the cavity is only partially filled with foam, like in a flash-and-batt (foam and fiberglass system), the sides of the studs will be left slightly exposed. Since the studs act as a thermal bridge, the exposed sides of



the stud will transfer heat into and out of the now only partially filled cavity, thereby bypassing the foam and reducing some of its benefits. Leaving more stud surface exposed is similar to the effects of a radiator, exposing a large amount of surface area in a short space to increase heat transfer. Further, what will result are convection currents inside the wall cavity that will actually accelerate the thermal bridging. Even if the remainder of the cavity is filled with fiberglass, the heat transfer will cause

convection currents inside the porous fiberglass. In short, by fully filling the cavities we are reducing the exposed surface area of the stud. This is why people usually find that a fully filled cavity with foam “feels” warmer and better insulated. Moreover, a fully filled cavity of air-impermeable insulation may help to slow the spread of fire by limiting the transport of oxygen necessary to fuel the fire.

25. Q. How Significant is Thermal Bridging through Studs and Rafters?

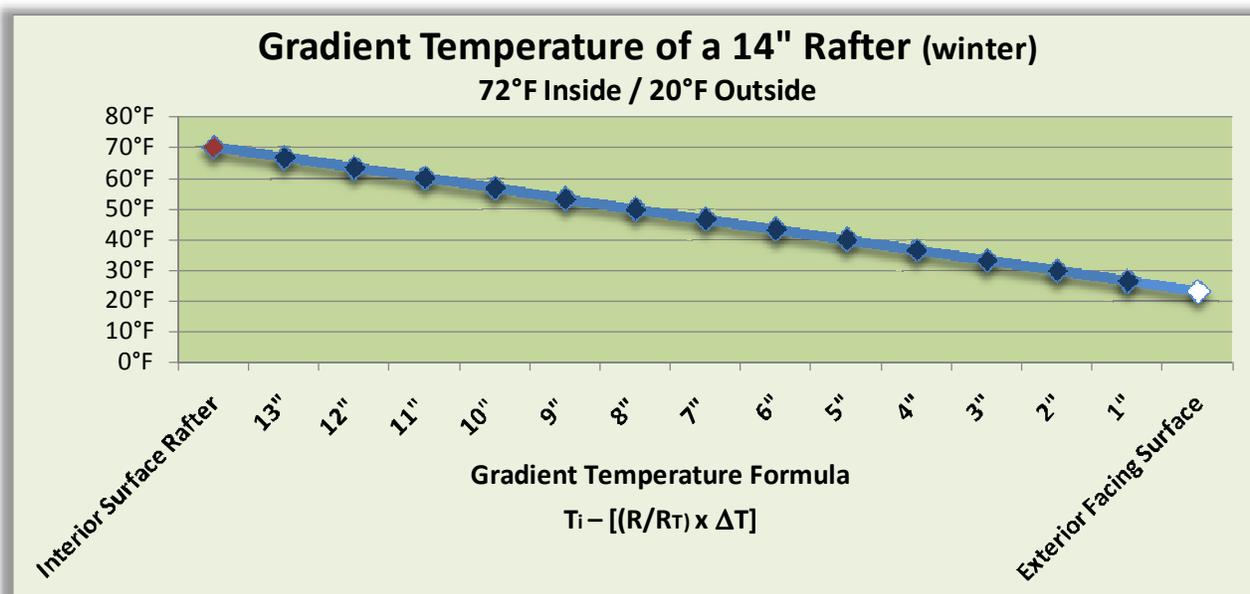
A. We believe there is a significant advantage to reducing the thermal bridging associated with rafters and studs. One of the advantages of open-cell foam is the ability to virtually fill the rafter bay and eliminate much of the exposed wood surface (closed-cell foam is often cost prohibitive with this approach). Rafters and studs are relatively poor insulators and will contribute to heat loss, convection currents, and a decrease in comfort. Basic temperature

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gradient calculations can determine the expected temperature of the rafter at any given point (see below). During the winter, the temperature of the rafter will gradually increase towards the interior surface since the r-value of the rafter is the greatest at that point. Therefore, eliminating thermal bridging of the rafter is least important at the interior surface, but increases with importance as you progress towards the exterior sheathing.

For example, filling a 14" rafter cavity with only 6" of closed-cell foam will leave nearly 8" of rafter surface exposed on each side. Additionally, filling the cavity with 4" of closed-cell foam and the remainder with 10" of fiberglass will not fully eliminate the effects of thermal bridging. This is because fiberglass is air-permeable and will not suppress convection currents. There is a misconception that the primary benefit of spray foam is stopping air leakage – this is only a fraction of the benefit. Spray foam inhibits convection currents – maintaining constant R-value and preventing air-movement within the cavity. Nevertheless, spray foam significantly outperforms fiberglass even in an air-tight building assembly because of its ability to suppress convection currents, maintain r-value and limit conduction. This is precisely why modern Energy Star refrigerators filled with foam use half the energy of older models filled with higher r-value fiberglass. Similarly, by nearly filling a cavity completely with foam, we are mimicking the benefits of SIPs (structural insulated panels) – little thermal bridging, no convection currents, constant R-value.

The diagram and calculations below exhibit the temperature gradient of a 2x14" rafter to demonstrate the heat loss and thermal bridging effects of a rafter at any given point:



The chart above demonstrates the temperature of the 14" rafter at various intervals assuming a 72°F interior temperature and a 20°F exterior temperature. The rafter surface area influences heat transfer in the same manner as radiator fins. The more surface area exposed the more thermal bridging taking place. If the rafter were completely exposed, the average

temperature of the rafter would be 46.5°F. If the rafter were filled with 4" of foam, the remaining 10" of exposed rafter would yield an average temperature of 53.2°F. Conversely, if the rafter were filled with 12" of foam, the average temperature of the exposed rafter would now be 66.61°F, thus eliminating the majority of the radiator effect.

With a few more calculations, you can extrapolate the total BTU heat loss associated with the total exposed rafter surfaces. These calculations are limited to the conduction mode of heat transfer; they do not take into consideration the heat transfer through convection and radiation which will further add to heat loss from the exposed rafter area.

26. Q. Does Foam Have to be Covered with a Thermal Barrier?

A. Thermal barrier or ignition barrier requirements for foam can be quite confusing both for builders and code officials. Every code official will interpret the code differently and will impose different requirements, so be sure to always consult with your local code official. However, in general the code does require some sort of thermal barrier in most instances.

Section R314 of the IRC code book requires that spray foam insulation meet specific fire ratings and be covered by a thermal barrier. All foams must achieve a flame-spread rating of 75 or below and a smoke-development rating of not more than 250 according to the ASTM E 84 standard. In other words, all foams must achieve a Class 1 fire rating. All spray foam insulation must be separated from the interior living space by a 15 minute thermal barrier - ½-inch sheetrock being the standard 15 minute thermal barrier. However, an approved material equivalent to a thermal barrier that meets the ASTM E 119 standard is allowed. This would include the use of certain thermal barrier coatings or paints.

According to Section R314.2.3, reduced thermal barrier requirements are allowed in attics and crawl spaces when the entry is made only for the service of utilities. In this instance, the foam shall be covered by 1 ½ inch mineral wool, 1 ¼ inch wood structural panels, ¼ inch hardboard, 3/8 inch sheetrock, or 0.016 inch thick corrosion-resistant steel. In addition, any material that meets the more stringent 15 minute thermal barrier requirements of section R314.1.2 may be used. The reduced thermal barrier requirements would not apply if the attic or crawl space will be used for storage. The building inspector may, at his/her discretion, decide whether or not the attic or crawl space will be used exclusively for servicing of utilities.

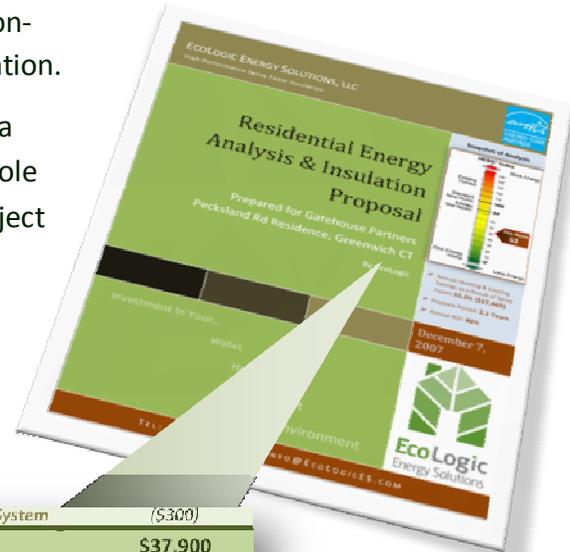
However, three spray foam products, Sealection500, Agribalance, and Icynene, have an ESR-1172 evaluation that allows the product to be left exposed in attics and crawl spaces under specific conditions.

27. Q. How Much Will I Save? What is the Payback Period?

A. Past case studies and experience shows that a properly insulated home with spray foam will reduce heating/cooling consumption by around 50% or more depending on several factors. Window fenestration, orientation, and HVAC sizing are just a few of the variables that will determine whole house performance. Through the use of energy modeling software, such as REM/Rate, you can closely predict the energy usage of a home with either spray foam or fiberglass. These programs can be used to estimate the return-on-investment or payback period by upgrading to spray foam insulation.

Approved by the U.S. Dept of Energy, the REM/Rate software is a highly-sophisticated program that takes into consideration a whole host of variables to provide a comprehensive analysis of the subject home’s energy consumption. Further, the program provides detailed information about energy costs, air-leakage, adequate HVAC sizing, Energy Star certification, environmental impact, and more.

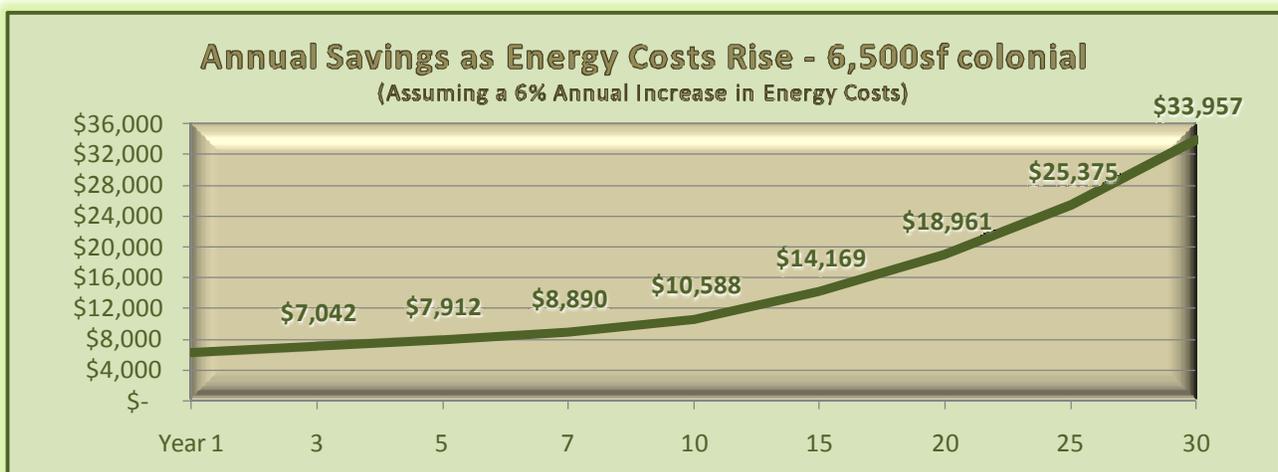
Our experience and research shows that the payback period from the cost to upgrade to spray foam ranges between 2-5 years depending on fuel cost and whether rebates or tax incentives are available.



Sample Energy Analysis Conducted by EcoLogic

| | |
|---|-----------------|
| Less: Rebate for Heating/Cooling System | (\$300) |
| Upgrade to Spray Foam | \$37,900 |
| <hr/> | |
| Initial Annual Energy Savings | \$17,469 |
| Reduction in Heating & Cooling Costs | 65.6% |
| Approximate Payback Period | 2.1 Years |
| Return-On-Investment - Year One | 46% |

The annual energy savings can become quite significant as the cost for energy continues to rise each year. Below is the yearly energy savings from a sample 6,500sf home:



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About EcoLogic Energy Solutions

Our mission is to help you save energy and money, build healthier and more desirable homes with greater marketability today and for the future. We encourage you to call us and learn more about how our valuable services can help you.

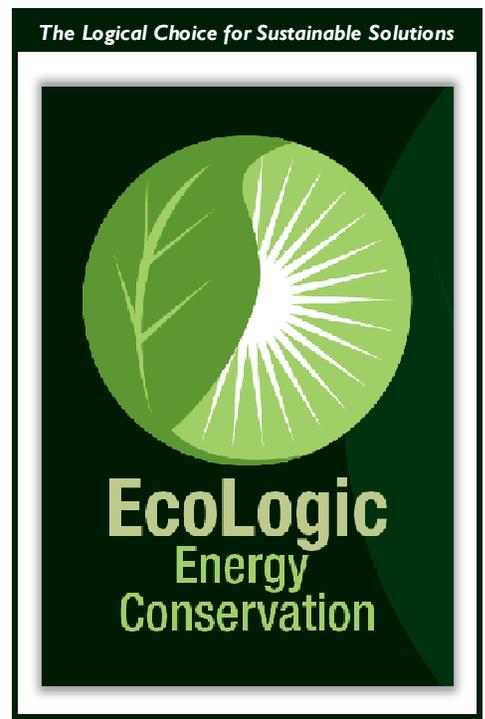
EcoLogic has assembled the most skilled, knowledgeable, and professional team in the industry. We are recognized by the highest-end builders in the region for the exceptional quality of our work. Not all spray foam companies are created equal. **The installation of spray foam is a highly technical process, literally being manufactured on site. Regardless of the type of foam you choose, a poor applicator will result in an unsatisfactory job,** with voids, gaps, messy overspray and even a decrease in performance. Your job will be overseen by our operations manager, John D. Graves, a legend in the foam industry with over 18 years of experience. With EcoLogic you can rest assured that your job will be completed efficiently, cleanly and all at a competitive price.

About EcoLogic Energy Conservation

Our latest division, EcoLogic Energy Conservation (EEC) provides an array of energy conservation services and solutions. Our goal is to help you reduce your energy consumption, save money, and create a more comfortable home, all while helping the greater environment.

EEC is headed up by Robert Matto, an energy conservation expert and certified HERS Rater (Home Energy Rating Specialist). Robert was the senior program coordinator for the Energy Star Homes Program in the State of Connecticut for nearly a decade. During that time Robert assisted hundreds of builders and homeowners achieve new levels of energy efficient design and construction. In addition, Robert has tested and certified over 5,000 homes to Energy Star standards as a sub-contractor for UI, CL&P, Northeast Utilities, Government Military Housing, HUD and other Government Agencies. He has enabled thousands of people to obtain significant rebates from the CT Energy Efficiency Fund to help implement energy efficient upgrades. Robert is an active lobbyist for energy conservation, helping educate our legislators so that they can make informed policy. He has also been a sought after speaker at numerous conservation seminars and a featured guest on public broadcasting.

Through EEC, Robert assists homeowners and builders implement energy efficient construction and upgrades, whether the home is in design phase or is decades old.



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ENVIRONMENTALLY SAFE

- Contains no ozone depletion chemicals, no formaldehyde or asbestos.
- No toxic substances are emitted. Passed the established off gassing tests.
- Approved by Environment Canada Environmental Choice™ Program (Canadian version of US-EPA).



| PHYSICAL PROPERTIES | | |
|---------------------|--|----------------------------------|
| ASTM | Description | Value |
| D 1622 | Density | 0.45 – 0.5 lb/ft ³ |
| C 518 | Thermal Resistance 2 days @ 76°F, per inch | 3.81 ft ² .h°F/BTU |
| | Thermal Resistance 90 days @ 76°F, per inch | 3.81 ft ² .h°F/BTU |
| E 283-04 | Air Leakage | |
| | 3.5" @ 75Pa (25 mph wind) | 0.001 L/s·m ² |
| | 5.5" @ 75Pa (25 mph wind) | 0.001 L/s·m ² |
| | 10" @ 75Pa (25 mph wind) | 0.002 L/s·m ² |
| | Sustained Wind Load for 60 minutes @ 1000 Pa (90 mph wind) | No Damage |
| | Gust Wind Load Test @ 3000 Pa (160 mph wind) | No Damage |
| | CGSB 51.23-92 | Off Gassing Test (VOC Emissions) |
| E 84 | Surface Burning Characteristics (6") | Class I |
| | · Flame Spread Index | 21 |
| | · Smoke Development | 216 |
| C 423 | Noise Reduction Coefficient (NRC) | 75 |

All tests were conducted by certified independent laboratories.



Approvals

Authorities having jurisdiction have evaluated **SEALECTION® 500** and confirm that it meets the intent of the North American Building codes. The following approvals were obtained:

- ICCESK #1172

- CCMC Evaluation #12697 –R

- Warnock Hersey Evaluation #193-7081

- New York State Uniform Fire Prevention and Building Code.

For additional information and installers in your area, please contact





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Investment in Your Wallet

Investment in Your Health

Investment in Your Comfort

Investment in Your Environment

Affiliated With



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