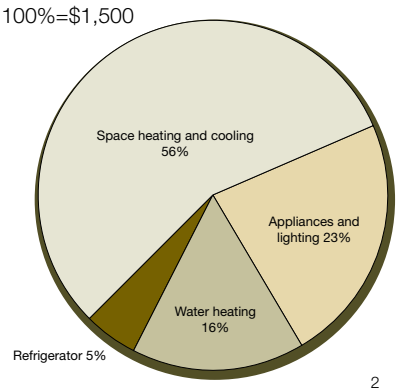
Honeywell Enovate® Blowing Agent

Residential Closed-Cell Spray Foam Insulation Facts

Honeywell

The Importance of Insulation

Insulation helps create a living space that is comfortable, healthy and energy efficient



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Air Flow

- Keep unconditioned air from leaking in
- Keep conditioned air from leaking out
- Prevent drafts within the structure

"Today, it is estimated that in residential and small commercial buildings, over 50% of the energy loss is associated with heat transfer and air leakage through building envelope components."
ORNL [1]

Heat Flow

- Keep heat in during winter
- Keep heat out during summer
- Maintain uniform temperature

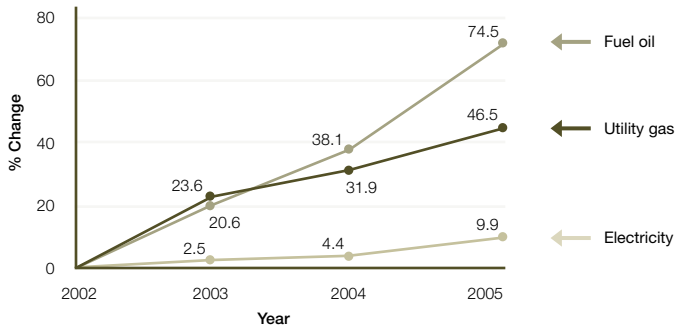
"Heating and cooling (space conditioning) account for 50 – 70% of the energy used in the average American home."
DOE

Water Flow

- Bulk
- Air
- Vapor

"Of all environmental conditions, moisture poses the biggest threat to structural integrity and durability, accounting for up to 89% of damage in building envelopes."
M.T. Bomberg [3]

Consumer Price Index - % Change from 2002



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1. Oak Ridge National Labs www.eere.energy.gov/consumer/tips/air_leaks.html
2. Department of Energy www.energystar.gov
3. Building Envelope and Environmental Control: Part 1- Heat, Air and Moisture Interactions by M.T. Bomberg and W.C. Brown, Originally published in "Construction Canada" 35(1) 1993, p. 15-18
4. Source: U.S. Department of Labor, Bureau of Labor Statistics, Average Price Data www.bls.gov

The Building Envelope

- Insulation, working together with the roof, wall and foundation assemblies (as well as the related sub-elements of each assembly), forms the building envelope

- Among other functions, the building envelope must:
  - Keep wind and unconditioned air out
  - Keep the conditioned air in
  - Prevent drafts

- Air movement (into and out of the house) has many detrimental effects:
  - Moisture within air impacts the long-term performance and structural integrity of the building
  - Introduction and distribution of pollutants and microbes
  - Thermal heat transfer [1]

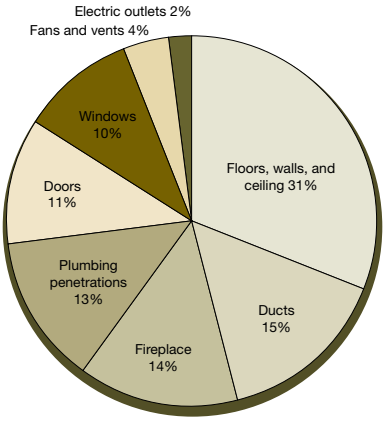
- To address these concerns, many building scientists have concluded that houses should be as tight and seamless as possible [2]

- The American Lung Association also recommends that homes need to be as tight as practical [3]

- Random natural infiltration should be minimized and controlled mechanical ventilation should be employed [4]

1. Joseph Lstiburek, Ph.D. , P. Eng. , Building Science Corporation
2. Arnie Katz, Director, Affordable Housing, Senior Building Science Consultant www.advancedenergy.org/buildings/about/specialists/arnie_katz.html
3. American Lung Association www.healthhouse.org/build/TopTenQuestionsbooklet.pdf
4. www.buildingscience.com

Current Issues with Insulation & Air Control



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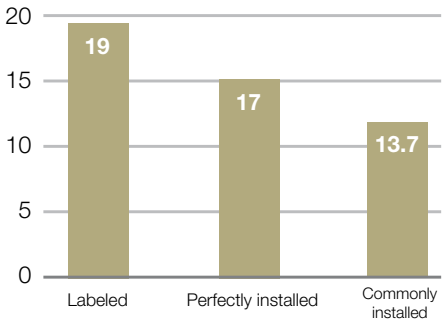


2 28% loss of R-value found in "commonly installed" insulation

How Does the Air Escape?

- Air moves in and out of your home through every hole, crack and seam
- About one third of this air infiltrates through openings in your ceilings, walls and floors

Traditional Fiberglass Insulation

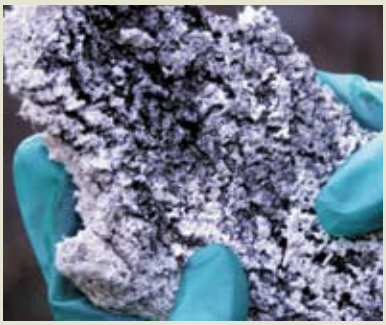
- Even small voids in irregular framing or at the end of the batt of 1-2% of the insulation area can result in a 25-40% loss of R-value* [3]

Traditional Air Control

- A typical 2,500 sq. ft. home has more than ½ mile of cracks and crevices [4]
- These usually occur in:
  - Poorly fitted and flashed doors and windows
  - Plumbing/electrical outlets
  - Gaps in drywall and wall plates
  - Rim/framing joists
- With an average 8 mph wind, your home could lose up to 30% installed R-value [5]
- Most insulation materials do not block air and require an air barrier (an incremental cost when comparing installation costs) [6]

1. Department of Energy
   www.eere.energy.gov/consumer/tips/air_leaks.html
2. Oak Ridge National Laboratory; Fiberglass Batts-Labeled vs. Installed Performance; Consumer Update: Insulation Effectiveness Bulletin
3. Kansas State University, Engineering Extension, Residential Insulation
4. Air Barrier Association of America, 9 Frequently Asked Questions, May 2005
5. E. I. du Pont de Nemours and Company, Tyvek,
   www.construction.tyvek.com/en/constrSystems/homeOwners/index.shtml
6. Joseph Lstiburek, Ph.D. , P. Eng. , Building Science Corporation

The Importance of Moisture Control



"Controlling moisture is key to preventing mold growth...When present in large quantities, mold can cause health problems, including allergic reactions, asthma episodes and respiratory problems." [1]

"Controlling rain and ground water are the most important factors in the design and construction of durable buildings and for the control of mold." [2]

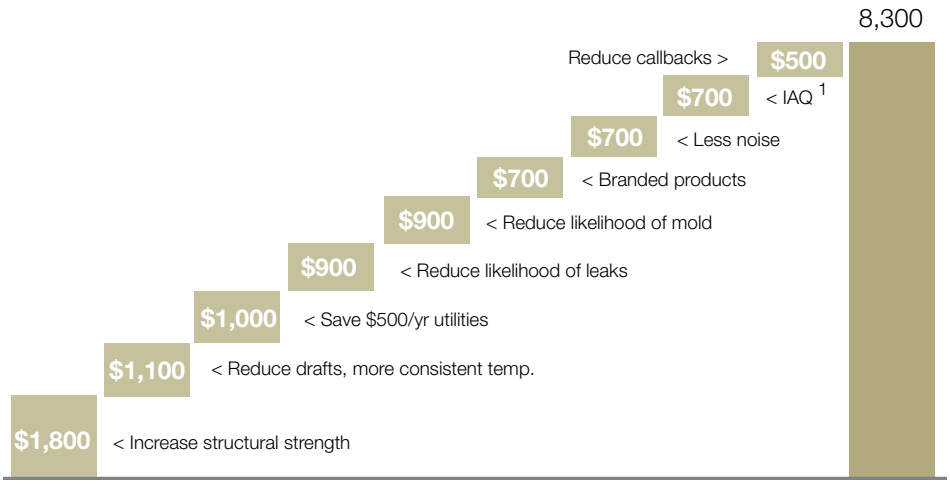
FEMA Technical Bulletin 2-93 [3]

- Closed-cell foam is the only type of insulation classified as an "acceptable flood-resistant material" by FEMA.
- "Flood-resistant material" is defined as any building material capable of withstanding direct and prolonged contact with floodwaters without sustaining significant damage.
- Batt or blanket insulation types and all other insulation types are classified as "unacceptable".

1. American Lung Association
   www.epa.gov/mold/cleanupguidelines.html
2. www.buildingscience.com
3. Fema Technical Bulletin 2-93 "Flood-Resistant Materials Requirements for Buildings Located in Special Flood Hazard Areas in accordance with the National Flood Insurance Program.

Home Buyer Needs Analysis

How much would you be willing to pay to:



About the Research

- 1,000 new home buyer respondents of 12,000 surveys sent
- Representative profile of U.S. new home buyers
- Strong demographics correlation with NAHB (e.g. age, income, purchase price, geography) and U.S. census data

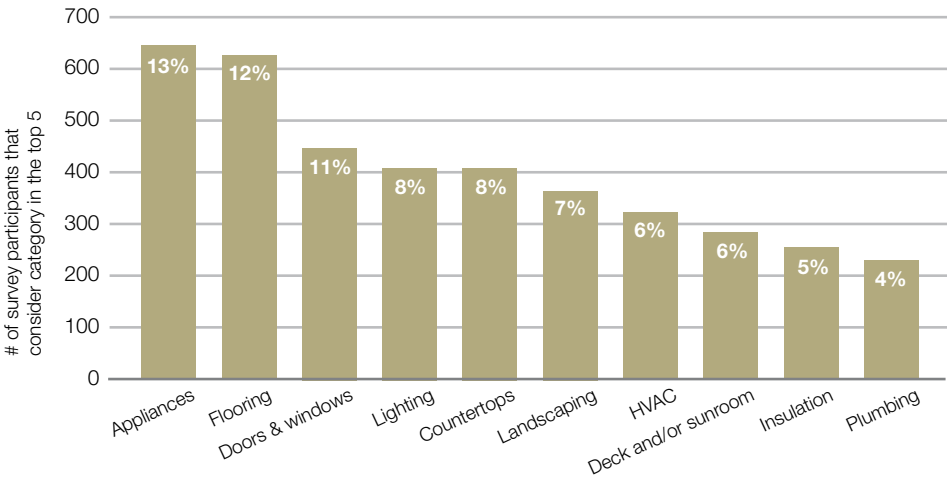
> ***"I wish the temperatures in my home were more consistent."***
>
> **-Survey Respondent**

1. Indoor Air Quality
   Source: Honeywell 2005 Residential Home Buyer Survey

Home Buyer Spending Analysis

Top categories for upgrade dollars

Appliances, flooring, doors & windows, lighting and countertops were the most common categories for upgrade dollars. Insulation was listed as the ninth most likely category for upgrade dollars.

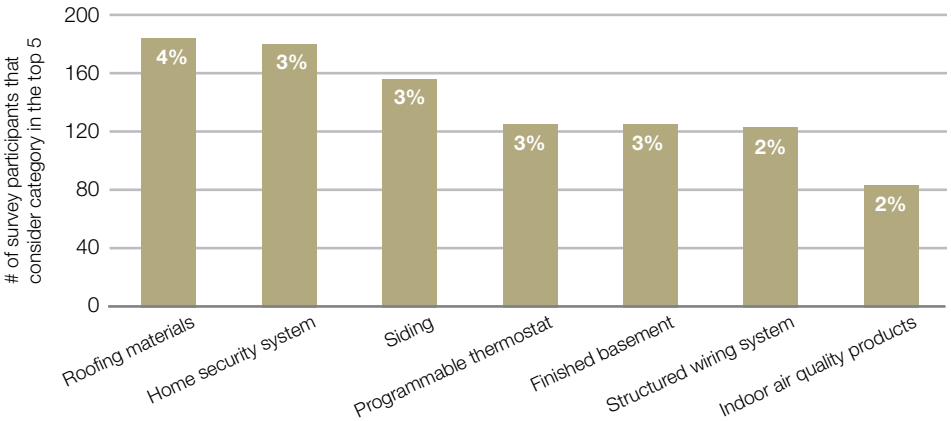


Homes > $500,000: top upgrade dollar spending was for countertops, flooring and doors & windows.

Insulation upgrades make the "top-ten" list for options spending

> 50% of the participants were highly satisfied with the upgrade options that they purchased

Categories with lower spending upgrade dollars

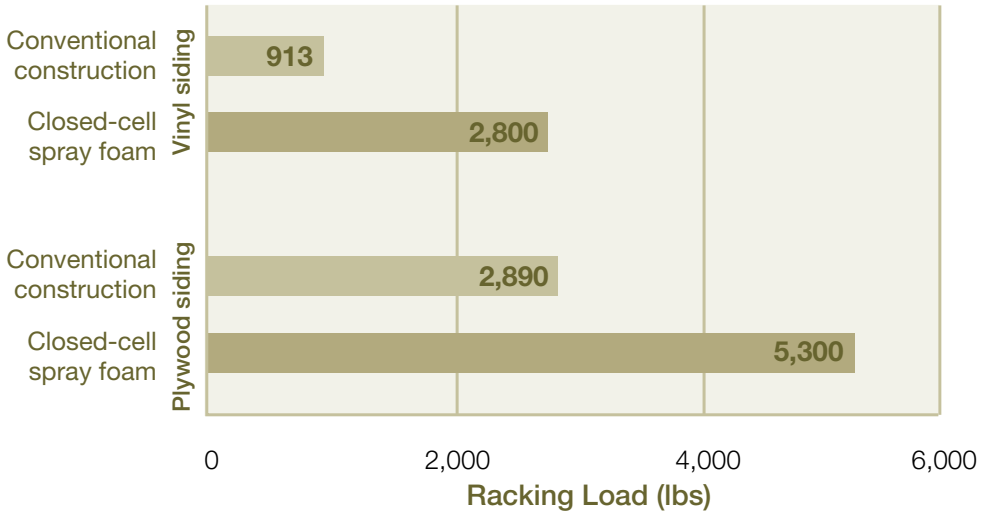


Source: Honeywell 2005 Residential Home Buyer Survey

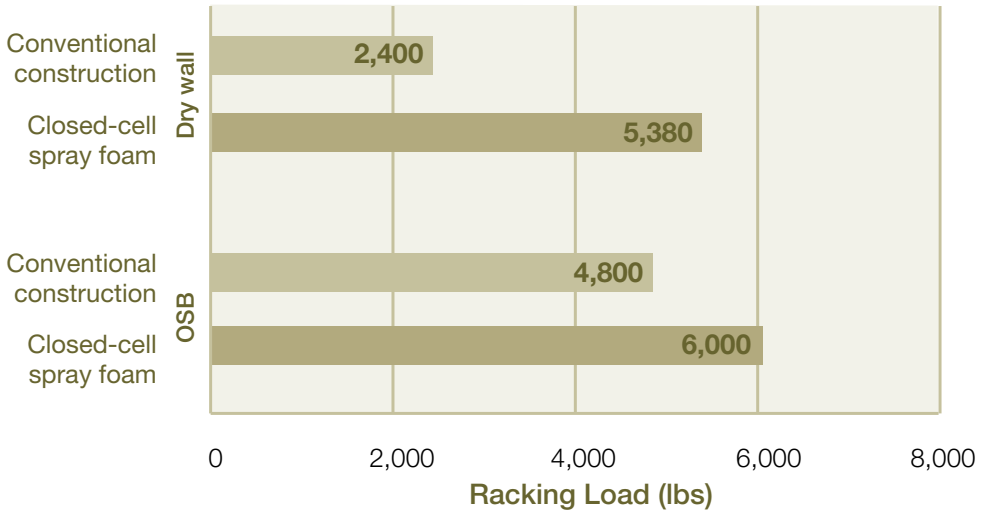
Structural Strength

"During a design racking event like a hurricane, there would be less permanent deformation of wall elements and possibly less damage to a structure that was braced with SPF [spray polyurethane foam] filled walls." [1]

Average Maximum Racking Load (structural resistance to wind) Supported by 16" On-Center Spruce-Pine-Fir 2x4 Stud Framing [1]



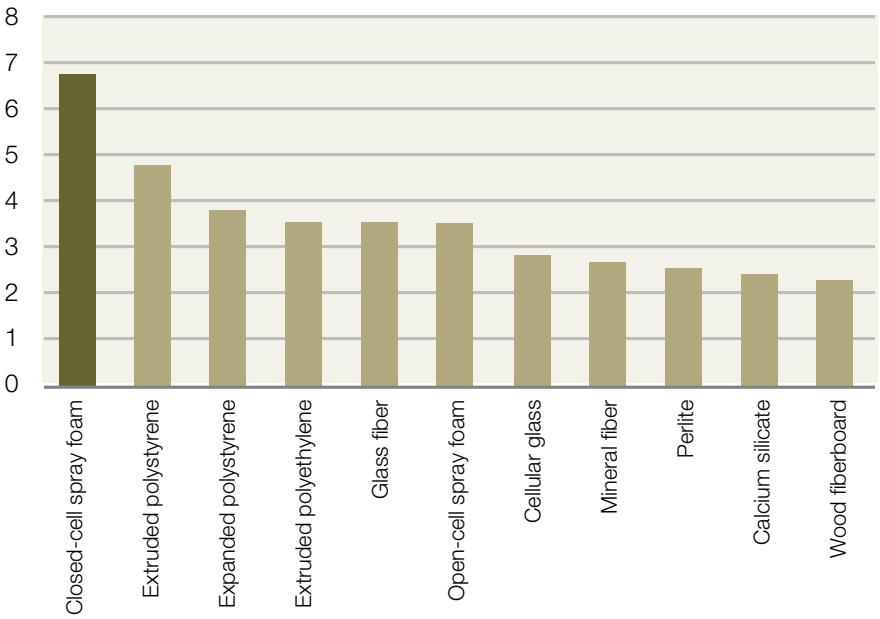
Maximum Racking Load (structural resistance to wind) for SPF vs Conventional R-19 Batts Supported by 24" On-Center 20-Gauge Light Structural Steel Framing [2]



1. National Association of Home Builders, Testing and Adoption of Spray Polyurethane Insulation for Wood Frame Building Construction, May 25, 1992
2. Test results are reported in a letter from Bob Dewey, Mechanical Engineer, NAHB Research Center to Mason Knowles, The Society of the Plastics Industry, Inc. Spray Polyurethane Foam Division, November 18,1996

Thermal Insulation/Draft Reduction

Typical R-values of Insulation Materials [1]



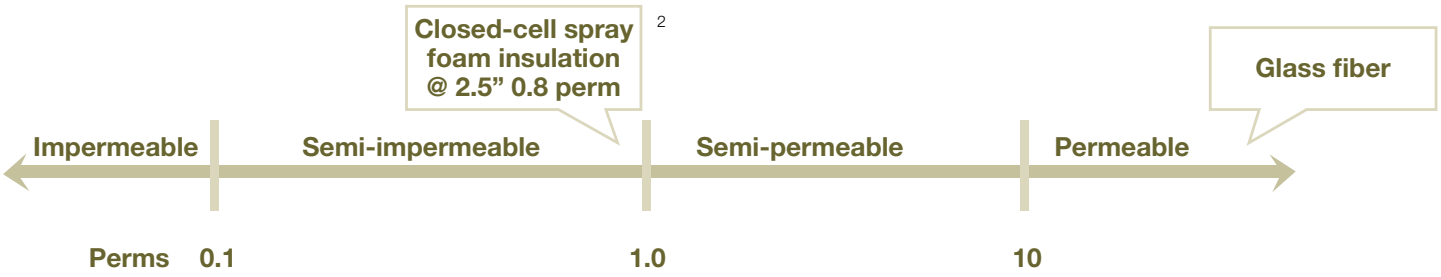
- Closed-cell spray foam provides the highest R-value of available insulation materials
- Closed-cell spray foam also provides the best defense against all six mechanisms of heat transfer
- Unlike other insulation materials, closed-cell spray foam seamlessly fills regular and irregular spaces [2]

1. Honeywell Analysis
2. Reference available upon request.

Moisture Control

	1. Rain & ground water	2. Air infiltration	3. Vapor diffusion
How do you control	- Properly designed and constructed drainage planes - Use of repellent materials (building paper, house wrap, foam insulation) in the construction	- Seamless, continuous air barrier	- Vapor retardant materials - Optimal placement can change (from outside to inside or vice versa) depending on climate and weather differences
Closed-cell spray foam advantage	"SPF [spray polyurethane foam] can be applied within a building envelope to control heat, air and moisture transport by providing continuous and effective air barriers, rain screens, weather barriers, and thermal insulation... SPF also limits water movement within the building envelope since the water cannot flow within the SPF's closed cells, even if a hole is made in the SPF." (Mason Knowles, SPFA)	"SPF is an effective air barrier and weather barrier because of its ability to seamlessly fill irregular spaces and provide water resistance" Mark Bomberg, Ph.D, PE National Research Center of Canada, Construction Practice: Building Envelope and environmental Control	- Semi-impermeable, allows for controlled breathing and drying - Uniformity and consistency enables it to resist passage of vapor equally well in all directions (from David Frane, Journal of Light Construction) - Minimizes dew point problems and condensation (Mason Knowles, SPFA)

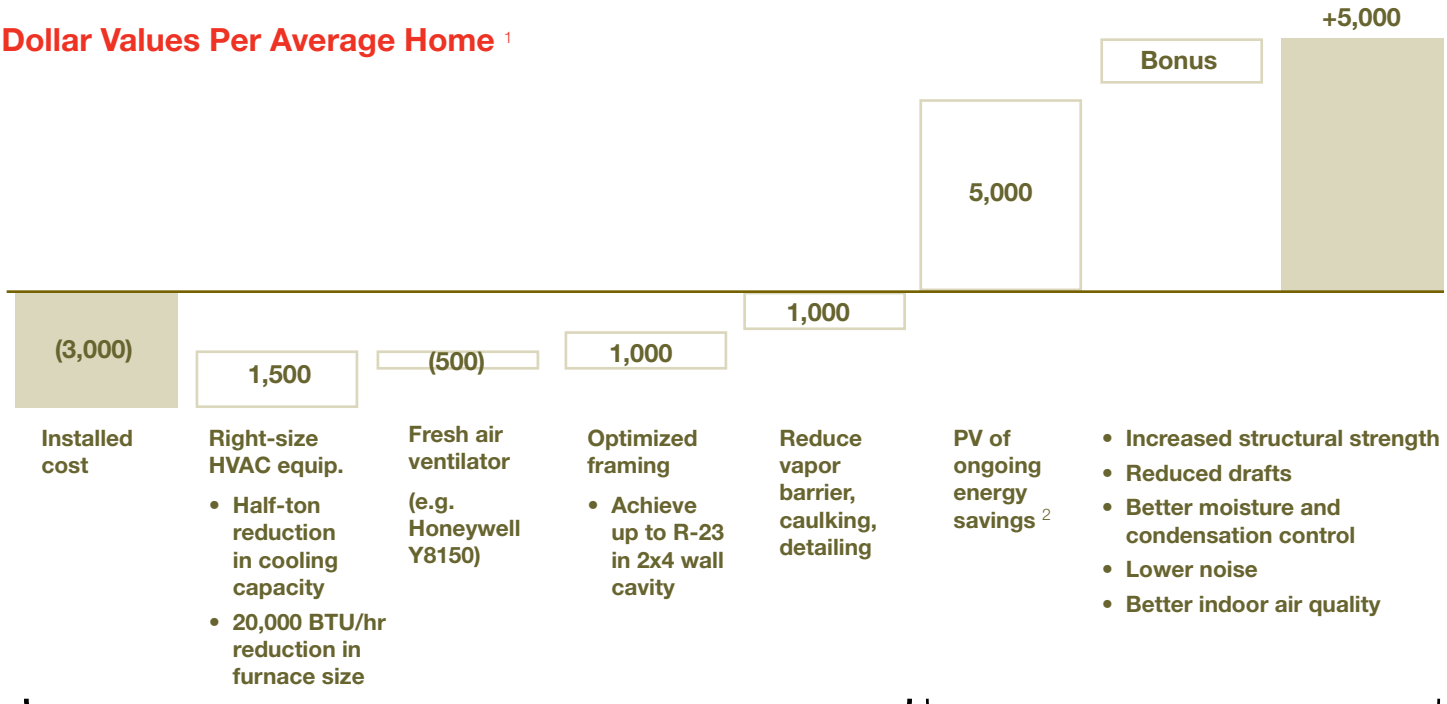
Classes of Materials Based on Permeance [1]



1. Joseph Lstiburek, Ph.D., P. Eng.
2. Reference available upon request.

Closed-Cell Spray Foam Benefits

Dollar Values Per Average Home [1]



- **Higher installed cost per square foot for closed-cell spray foam insulation may be offset by savings in other areas**
- **Builders have a potential upsell opportunity based on benefits for homebuyers**

Upsell Potential

LEED® Credits Opportunity [3]

Credit	Points
Wall, floor, ceiling, crawl space insulation	1-2
Air infiltration	1-2
Local sources	3
Overall home Energy Star performance	16

LEED® Performance Levels

Certified	30 Points
Silver	50 Points
Gold	70 Points
Platinum	90 Points

Closed-Cell Spray Foam Features

- Structural strength
- Air infiltration control
- Moisture/condensation control
- Thermal insulation (R-value)

Closed-Cell Spray Foam Benefits

- Energy savings
- Improved indoor air quality
- Improved comfort (draft reduction)
- Problem solving tool
  - Ice dam
  - Rim joist
  - Pipe freeze
  - Tub enclosures
  - Unvented attics
  - Unvented crawl space
  - Leaky windows
  - Foundations
  - R-23 using 2x4 framing

1. Honeywell Estimates - Figures may vary depending on markets and building practices
2. Present Value (PV) assumes average utility bill reduction of $30/month ($360/year) at 7% interest rate
3. Leadership in Energy & Design, www.USGBC.org

Energy Comparisons

Case study #1

Sacramento, CA
Comparable single story 2,400 square foot homes
Several addresses apart on same side of street
Gas and electric bills Feb to Dec, 2003

Traditionally insulated home:

- Utility bills
  - $2,239 electric
  - $477 gas
  - $2,716 total
- Monthly average utilities
  - $247
- Average utility prices
  - Gas $0.95 per therm
  - Electric $0.17 per kWH

Closed-cell spray foam insulated:

- Total gas and electric
  - $1,107 electric
  - $306 gas
  - $1,413 total
- Monthly average utilities
  - $128
- Average utility prices
  - Gas $0.93 per therm
  - Electric $0.13 per kWH

Closed-cell spray foam energy savings:

- 48% reduction in utility bills
  - $118 per month average savings
  - $1,422 per year; $42,645 over 30 years
- How much extra financing could you afford on a 30 year mortgage with an extra $118 per month?
  - $19,758 at 6%
  - $17,805 at 8%

Case study #2

Roanoke, VA
2,240 square foot ranch
Liquid propane gas heat
Low fuel consumption got supplier's attention
Monitored propane usage Aug '00 to Jul '01

Ten similar homes with traditional insulation:

- Total propane consumption
  - Average was 769 gallons

Closed-cell spray foam insulated:

- Total propane consumption
  - 321 gallons

Closed-cell spray foam energy savings:

- 58% reduction in propane usage vs. average of ten comparable homes
  - 30% savings vs. next best home
  - 74% savings vs. worst home
- Estimated savings
  - $896/yr with propane at $2 per gal
  - Mortgage value of $12,444 at 6%

Case study #3

Atlanta, GA
Comparable residences 1,800 sq. ft.
Less than two miles apart
Similar occupancy

Traditionally insulated home:

- Monthly average utilities $143.76
- Cost of insulation $2,350

Closed-cell spray foam insulated:

- Monthly average utilities $89.64
- Cost of insulation $5,200

Closed-cell spray foam energy savings:

- 38% reduction in utilities
  - $54.12 per month average saving
- Added mortgage cost $2,850
  - $17.10 per month added mortgage payment at 6% interest
- Extra cash in homeowner's pocket $37.02 per month

Source: Available upon request.