

## Closed-Cell Spray Polyurethane Foam Insulation

A cost-effective solution for today's industry demands

*With the demand for improved energy efficiency, increasingly stringent code requirements and rigorous consumer expectations, the overall performance of building enclosures has received a surge of industry focus. One of the components receiving elevated attention in design is the selection of insulation materials.*

### Installed Insulation Costs Don't Tell the Whole Story

In selecting a product, there can be a tendency to place too high an emphasis on the "first" or "installed" costs. This is understandable given defined budget limitations for most projects. However, installed costs don't tell the whole story. When selecting an insulation product, one should consider not only how its attributes impact performance, but also the cost benefits that multiple functionality has on a project. Often, insulation products with multiple functionality can eliminate additional costs associated with products that are more one dimensional in performance. When evaluating the insulation layer as a system, one must consider the additional layers required for the insulation system to work properly. These include the use of vapor control, air sealing and overall insulation thermal performance, as well as impacts on other building areas such as HVAC systems, framing and structural enhancements, to name a few. As we transition thinking to whole system design, a comparison of cost and performance of "systems" rather than individual "components" provides a clearer cost picture. This can help determine which product is better suited for a specific project rather than looking at each individual insulation layer as a discrete purchase.



### Spray Polyurethane Foam - Growing in Popularity

With an emphasis on "whole system design," spray polyurethane foam (SPF) insulation use continues to grow in popularity. This is an indication that awareness about the benefits of spray foam, and often associated cost savings, has started to take root.



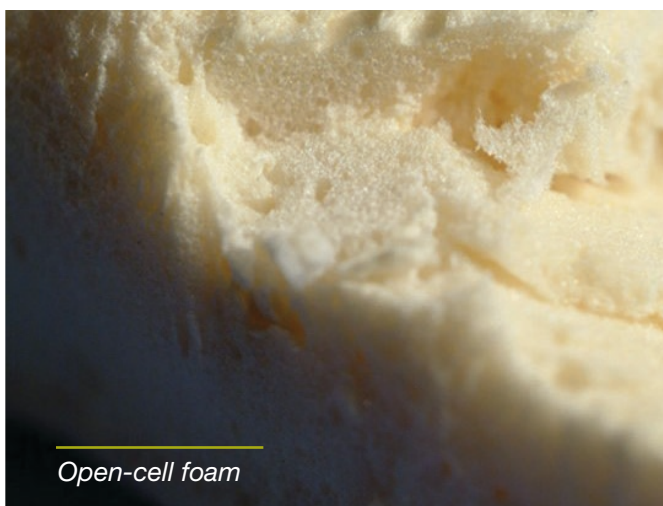
Spray foam insulation is commonly recognized as providing higher performance, versatility and insulation value over more traditional products, such as fiberglass and cellulose.

Because it expands to fill the cavity, SPF better accommodates irregularities in materials and conforms around piping, outlet boxes and other wall penetrations. As the foam quickly expands, it fills cracks and gaps that normally occur in a wall system. Because of its excellent adhesion properties, SPF does not slip down or settle in wall cavities, like cellulose and fiberglass. Also, it does not compress in the cavity like fiberglass, which reduces thermal performance. Because it provides an air seal by conforming to the cavity and adhering to the surfaces, SPF is not subject to convective air loops that further reduce wall system performance. These performance benefits should be considered when selecting insulation for a project and assessing the true costs of product selection.

There are generally two different types of spray polyurethane foam insulation used in the market. These are commonly known as open-cell SPF or closed-cell SPF. Alternatively, they are also known as low or medium density foams respectively. Both are easily installed through the use of qualified and trained contractors.



*Closed-cell foam*



*Open-cell foam*

### Comparing Closed-cell to Open-cell SPF:

Closed-cell spray polyurethane foam (ccSPF) is more rigid, denser, and provides a higher level of insulation performance for a given thickness. In addition, it is water resistant, provides vapor control, is an air barrier material and can enhance the structural integrity of a building. These ccSPF attributes provide for added flexibility in design because it can be used in interior cavity and exterior applications. In fact, ccSPF is one of only a few products available that can be used to meet the continuous insulation requirements in the code. In addition, it can be used on the exterior as a roofing system that provides moisture protection, air sealing and insulation performance. Alternatively, open-cell spray polyurethane foam (ocSPF) is spongy in nature, can absorb water and has a lower insulating value, similar to traditional fiberglass and cellulose products.

## Closed-Cell Spray Polyurethane Foam: Multiple Functionality Drives Cost-Effectiveness

When selecting insulation products, ccSPF is among the most thermally efficient and highest performance insulation systems available on the market. This alone can provide significant flexibility in the design of a wall system. When further consideration is made for the air sealing performance, air barrier properties, moisture control and structural enhancements ccSPF provides, one may realize a higher performance, cost-effective system without the additional components required for fiberglass or cellulose systems. A system approach when comparing insulations contributes to a more informed product selection. Here are a few cost comparison considerations when selecting ccSPF for a design:

### Insulation performance

Although wall systems are designed to a specified total R-value required, the higher insulating performance of ccSPF offers design flexibility, in particular where space restrictions apply. With higher insulation requirements in the code, ccSPF can help you achieve and/or exceed higher insulation values (R-19) with 2x4 framing. For comparison, products such as fiberglass, cellulose and ocSPF often require a 2x6 wall framing system to achieve these levels of insulating value. This substantially adds to the overall wall design costs.<sup>1</sup>



*ccSPF can reduce framing material costs.*

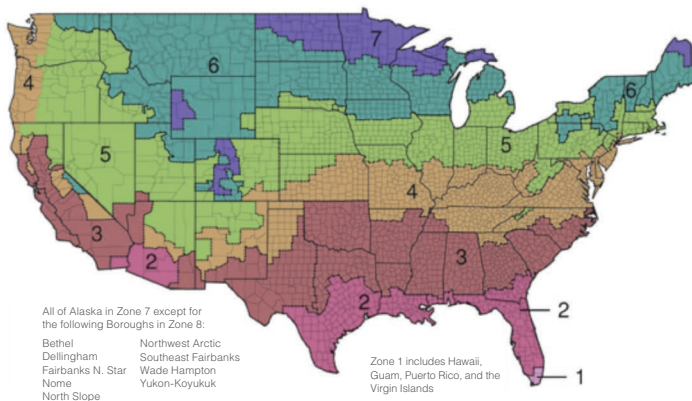
In fact, some ccSPF products can achieve as high as R-24<sup>2</sup> within a 2x4 cavity space which would alternatively require 2x8 framing for the other insulation materials. The additional lumber costs associated with these products (framing and trim) are often not considered, yet have a significant impact on overall system costs and can add up to thousands of dollars in a typical home. When selecting ccSPF for a typical home, a builder may even realize 40-50 additional square feet of usable area offering enhanced value to the builder and prospective owner.



### Air Tightness

The 2012 codes require all buildings to be air sealed and introduces air tightness testing. A typical wall system can have miles of cracks and gaps that reduce the air tightness of the home or building. Air tight buildings perform better because they enable insulation to perform as designed, but also translate to better air quality control, comfort and temperature regulation. Both types of SPF insulations provide enhanced air sealing by expanding during installation into the various cracks and crevices within a wall system. However, ccSPF is the only insulation recognized as an air barrier material at 1" thickness.<sup>3</sup> It also has stronger adhesion properties which can translate to higher performance of the air barrier system.

Alternatively, fiberglass and cellulose wall systems require comprehensive air sealing prior to installation because even small amounts of air infiltration can significantly reduce insulation performance. For a typical 2,800 square foot home, the costs associated with this air sealing can often exceed \$700 on average<sup>4</sup> and may require a larger HVAC system to compensate for the insulation inefficiency.<sup>5</sup> In fact, a recent study<sup>6</sup> indicated that SPF sprayed walls provided superior air sealing over traditional materials like fiberglass and cellulose. In this study, ccSPF walls were found to reduce air infiltration by as much as 96% over traditional materials.



*ccSPF is effective in all climate zones.*

### Vapor Control

Vapor control is an essential part of moisture mitigation and impacts building durability. CcSPF meets ICC code requirements for a Class II vapor retarder.<sup>7</sup> Traditional vapor control layers, such as 4-6 mil poly, are installed on the "warm in winter" side of the insulation. In climate zones 5 and above, additional vapor control measures are required under the ICC model codes when using fiberglass, cellulose or ccSPF. The problem with vapor control layers in a mixed or warm climate is that they are on the wrong side of the wall for much of the year and therefore, are listed as optional in zones 4 and below. This doesn't mean vapor control is not beneficial, just that it is difficult to design properly in zones

4 and below. Because vapor control is inherent to ccSPF, it can be effective in all climate zones and is never on the wrong side of the insulation layer (when properly installed). When vapor control is required for fiberglass, cellulose or ccSPF, this can cost an additional \$500 as part of overall system design.<sup>8</sup> In warm and mixed climates where a vapor control layer becomes optional, additional ventilation may be required to avoid condensation issues. Since no additional vapor control is required when using ccSPF, it is the ideal choice regardless of climate zone.



*ccSPF is uniquely suited to flood prone areas.*

### Water/Moisture Resistant

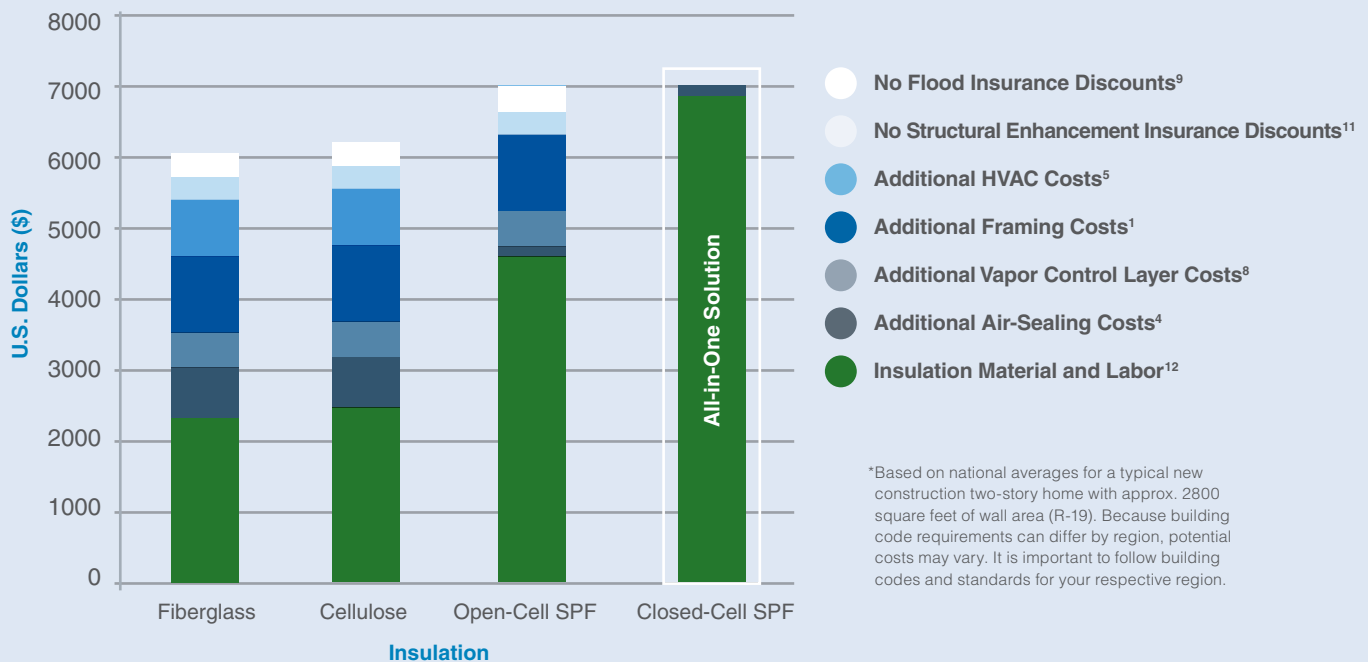
In addition to providing vapor control, ccSPF is inherently moisture resistant. This makes it uniquely suited for flood prone areas or as a secondary moisture control layer. For crawl spaces, ccSPF offers the best balance of properties for an insulation layer due to its thermal performance and moisture control benefits. In fact, ccSPF is the only FEMA approved insulation material for extended moisture contact. In areas prone to flooding, storm surges or other forms of severe weather, ccSPF may enhance the moisture resistance of a building. This can reduce the potential for moisture-related damage and may even reduce insurance premiums. For a similarly constructed home with less moisture resistant insulation, insurance premiums can easily exceed an additional \$325 on an annual basis.<sup>9</sup>

### Structural Enhancements

As mentioned, ccSPF cures as a rigid foam that provides enhanced structural properties to a building. In fact, studies reveal that using ccSPF in a framed wall system can increase the structural integrity of a building by as much as 200%.<sup>10</sup> Likewise, a study at the University of Florida revealed that use of ccSPF in roofing systems enhanced the structural integrity of the roof during a severe weather or wind event. Protecting the roof system during a hurricane or other severe weather event is essential not only to safeguard building contents, but most importantly, its occupants. A home without structural enhancements may have an increase in wind policy premiums of \$315 or higher on an annual basis.<sup>11</sup>

## Close Insulation Package Cost Gaps with ccSPF

(based on R-19 performance)\*



## Considerations When Comparing Insulation Costs

In an attempt to assess total “insulation package costs,” the RSMeans database was used to compare national averages for various products commonly used in wall system design. Because local labor costs and design criteria can vary widely between regions, national averages were evaluated for the purpose of this comparison.<sup>12</sup> As part of the assessment, we considered insulation used, air infiltration control, framing, weather resistive barrier, vapor control, structural sheathing and let-in bracing, since these are essential to wall system performance and use can vary depending on the insulation selected.

Taking overall wall design into consideration, the chart above compares insulation package costs for common wall insulations. The assessment is based on a 2,800 square foot home and national averages. It provides a platform for considering the potential benefits subject to local market and construction practices.

## Using a Wall System Design Approach for Insulation Comparisons

If a product decision is based simply on installed costs, it is not surprising that some might elect to use traditional insulation materials, such as fiberglass and cellulose. However, taking a wall system design approach provides a clearer picture when selecting insulation. It is important to look beyond the cost of the insulation and the labor to install it. As the chart indicates, fiberglass and cellulose appear to cost significantly less than open-cell and closed-cell spray foam if you only consider the material and related labor costs. However, the “total insulation package” costs for fiberglass and cellulose increase substantially when you factor in the extra costs for additional components needed to ensure the wall system meets minimum code requirements. These added components can include air sealing, vapor control, premium framing materials, and HVAC sizing, among others. When these “extras” are considered, the cost differences become relatively small. This is sometimes overlooked by designers, contractors and owners during product selection.



## Increased Value and Peace of Mind

When you consider the various components required to make your wall system perform as intended, the initial cost of the insulation becomes less relevant. A growing number of architects, builders and homeowners are choosing ccSPF because they value quality and want the peace of mind of “all-in-one” functionality. As we’ve seen, ccSPF provides excellent thermal performance, moisture control, air barrier properties and structural support. This eliminates many additional steps (and related costs) required when using fiberglass batt, cellulose, ocSPF or other systems. More steps means that more trades must be coordinated to achieve an effective wall design. Not only can this increase the risk that something can go wrong, it increases the complexity, the time and potentially the cost to identify the problem and correct it.

Because SPF, and in particular ccSPF, provides multiple benefits, it is the preferred choice for today’s performance-driven requirements. It provides a one-step solution that results in buildings that are durable, quiet and energy efficient. Therefore, you may want to consider taking a system comparison approach when selecting your next insulation system. If you choose to specify ccSPF, be sure to request a system formulated with Honeywell Solstice® Liquid Blowing Agent, an ultra-low global warming potential foam blowing agent that delivers both environmental and performance advantages.

Selecting the right insulation can have long lasting effects on the operational costs, occupant comfort, sustainability and ultimately, the value of your home or building.

### Sources:

1. Framing package premium: Average lumber and labor costs to use 2x6 lumber for insulations listed vs. 2x4 lumber for ccSPF estimated at \$1,066.<sup>1</sup> Because building code requirements can differ by region, potential cost savings may vary. It is important to follow building codes and standards for your respective region.
2. The higher the R-value, the greater the insulating power. Ask your seller for the fact sheet on R-values.
3. When a minimum of 1” is applied, closed-cell SPF qualifies as an air barrier according to ASTM E-2178 which is the test used by the Air Barrier Association of America (ABAA) to define an air barrier.
4. Air seal package: Standard caulk and sealant package estimated at \$700.<sup>1</sup> With SPF, only minor air sealing is required i.e., around floor joists, windows and doors. Cavity penetrations and gaps are inherently sealed by SPF, reducing the air seal package cost by about 80%.
5. HVAC sizing: With traditional insulations, as much as ½ ton of added HVAC capacity may be required vs. SPF systems. The \$810 cost is based on increasing the size of the HVAC system from a SEER 16 3.5T to a SEER 16 4T system.<sup>1</sup>
6. BSC Thermal Metric Summary Report 9/23/13 [http://www.buildingscience.com/documents/special/content/thermal-metric/BSCThermalMetricSummaryReport\\_20131021.pdf](http://www.buildingscience.com/documents/special/content/thermal-metric/BSCThermalMetricSummaryReport_20131021.pdf)
7. Two inches of closed-cell SPF qualifies as a 1 perm vapor retarder according to ASTM E-96. Perm ratings vary by manufacturer; please consult manufacturer literature.
8. Vapor control layer: Standard vapor control layer estimate is \$500.<sup>1</sup> CcSPF is water resistant, eliminating the need for a vapor control layer.
9. Flood insurance discounts: CcSPF is the only insulation classified as an “acceptable flood resistant material” by the Federal Emergency Management Agency (FEMA) – Tech. Bulletin 2-93, and is the only insulation that qualifies for flood insurance policy savings. A modest \$325 was assigned for a 1 year policy savings representing a 30% contribution towards preferred National Flood Insurance Program (NFIP) rates on a \$150K policy.
10. NAHB Research Center for The Society of the Plastics Industry/Polyurethane Foam Contractors Division: Testing and Adoption of Spray Polyurethane Foam for Wood Frame Building Construction (May, 1992). [www.sprayfoam.com/spps/ahpg.cfm?spgid=74](http://www.sprayfoam.com/spps/ahpg.cfm?spgid=74)
11. Structural enhancement insurance discounts: Except for ccSPF, none of the insulations listed qualify under Florida OIR-B1-1655 as a secondary water barrier and enhanced roof to wall connection. This is a \$315 value assuming a 21% reduction on annual wind policy of \$1500.
12. Insulation material and labor costs:<sup>1</sup> For this assessment, a typical new construction baseline two story home with approximately 2800 square feet of wall area was used to evaluate a cost comparison. In addition, R-19 was used as the insulation requirement for the design and consistent with the 2012 IECC requirements.

<sup>1</sup>Based on RS Means national averages

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