PLATINUM POWERED INSULATION

PLATINUM

# Graphite Polystyrene (GPS) Rigid Insulation

High Performance Thermal Innovation

# AIA Guidelines

- Insulfoam is a Registered Provider with The American Institute of Architects Continuing Education systems. Credit earned on completion of this program will be reported to CES Records for AIA members. Certificates of Completion for non-AIA members are available on request.

- This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using distributing, or dealing in any material or product.

- This program qualifies for 1.0 HSW LU credit.

**Provider #K031**
**Course #108od**

# Copyright Materials



The data contained in this publication is based on our current knowledge and experience. In view of the many factors that may affect processing and application of our product, this data does not relieve processor from carrying out their own investigations and tests. Neither does this data imply any guarantee for certain properties nor the suitability of the product for a specific purpose. It is the responsibility of the recipient of our products to ensure that any proprietary rights and existing laws and legislation are observed. (August 2016)

# Learning Objectives

After completing today's course, you will be able to:

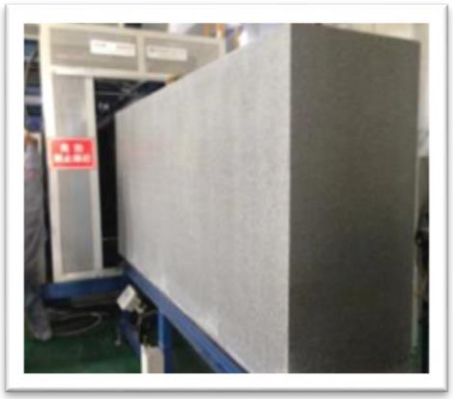
- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation and how that contributes to occupant comfort.
- Understand the **benefits** of GPS compared to other rigid insulation materials.
- Discuss how the **moisture management** properties of GPS contribute toward the drying strategy of the wall.
- Explain **suitable applications** for GPS insulation.

# Learning Objective #1

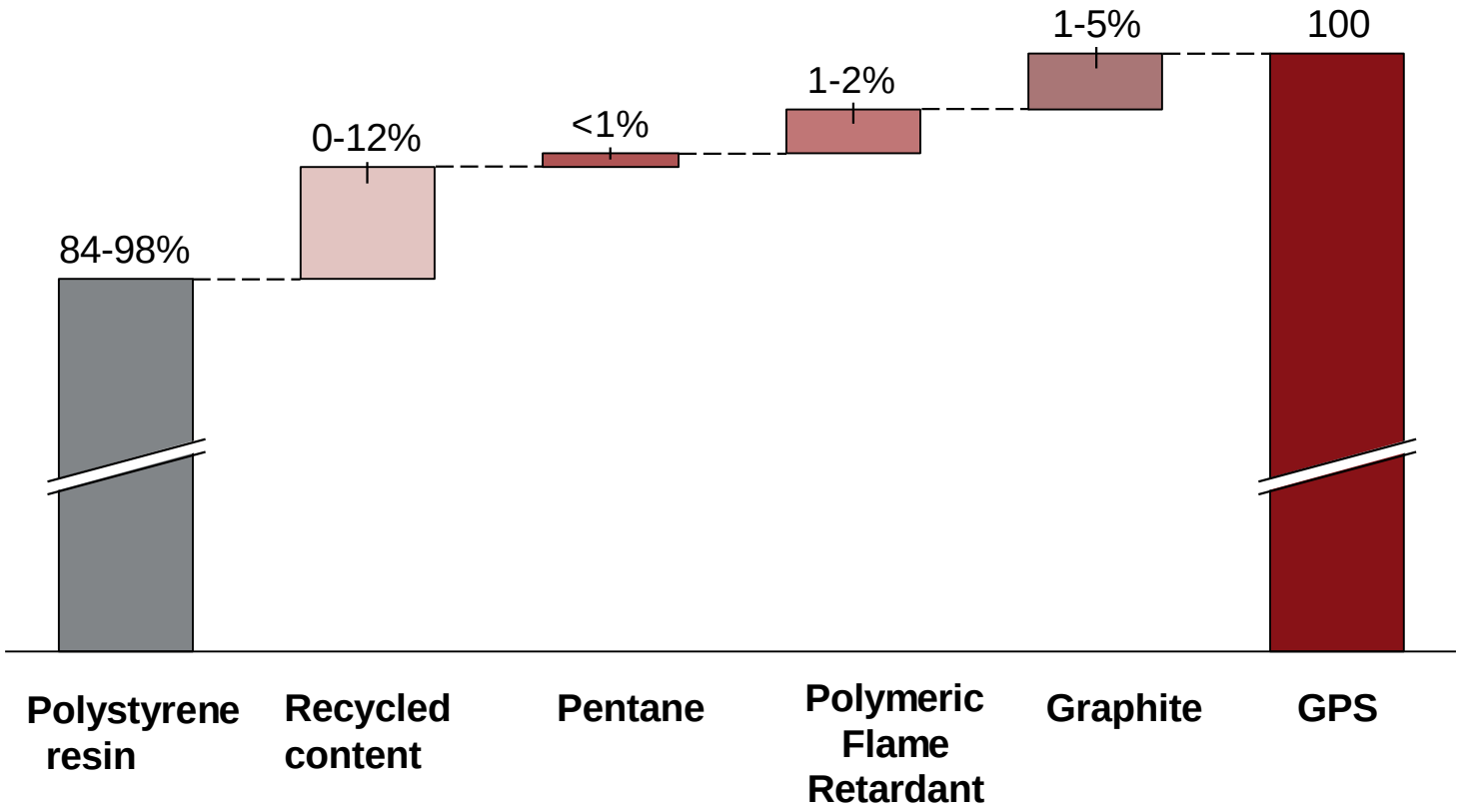
- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation and how that contributes to occupant comfort.
- Understand the **benefits** of GPS compared to other rigid insulation materials.
- Discuss how the **moisture management** properties of GPS contribute toward the drying strategy of the wall.
- Explain **suitable applications** for GPS insulation.

# Manufacturing Process

- Resin is brought in in large metric ton bags that are subjected to a pre-expansion process
  - Resin is allowed to stabilize
  - Then vacuum molded in a computer controlled 18 to 24 foot mold.
- Blocks allowed to stabilize again, prior to cutting to finished sizes.



# What Is In the GPS Foam



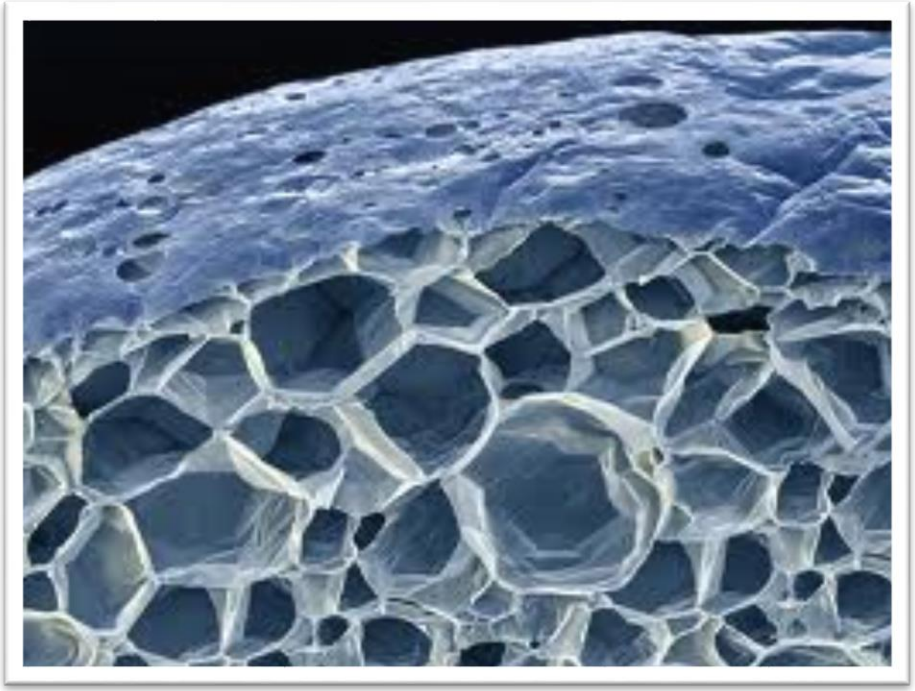

- The polystyrene resin is the same basic chemistry used to create extruded polystyrene.
- Polystyrene is fully recyclable.
- Non ozone-depleting blowing agent used to create and expanded resin
- A non HBCD polymeric flame-retardant is used, allowing materials to meet building code requirements for flammability.
- Graphite added to aid in the increase in R-Value

# GPS

- GPS is a unique material used, in its final form, as ‘rigid thermal insulation’ in the construction industry.
- The material attributes a distinctive silver-gray color to high-purity graphite contained within the polymer matrix of the rigid foam.
- The graphite particles both reflect and absorb radiant energy, thereby increasing the materials insulation capacity, or R-Value, while retaining all of the performance benefits inherently found in standard rigid foam.
- This is why GPS rigid thermal panels are up to 20% thinner than other rigid insulations.

# GPS

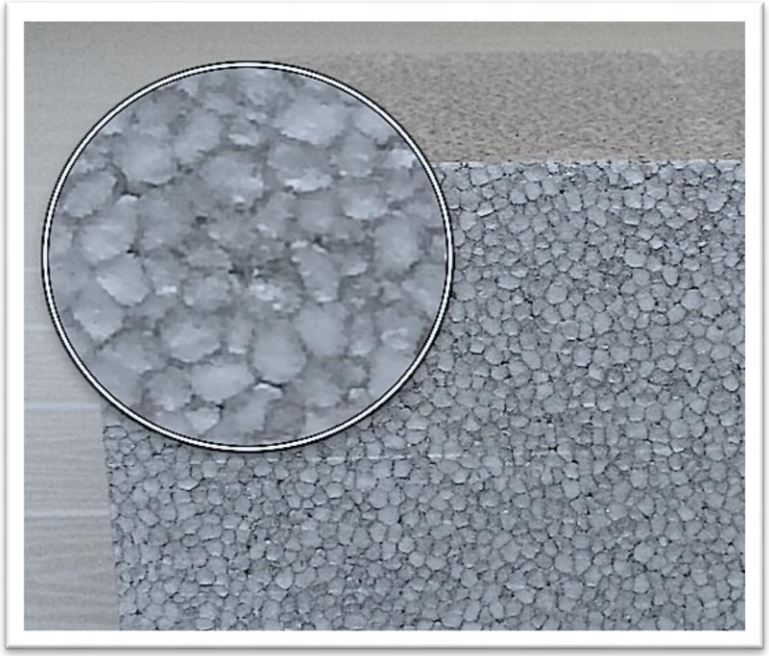
GPS is manufactured from resin pellets that each contain numerous micro cells within each pellet.



Close up of graphite contained within the polymer matrix

# Graphite: How It Improves GPS

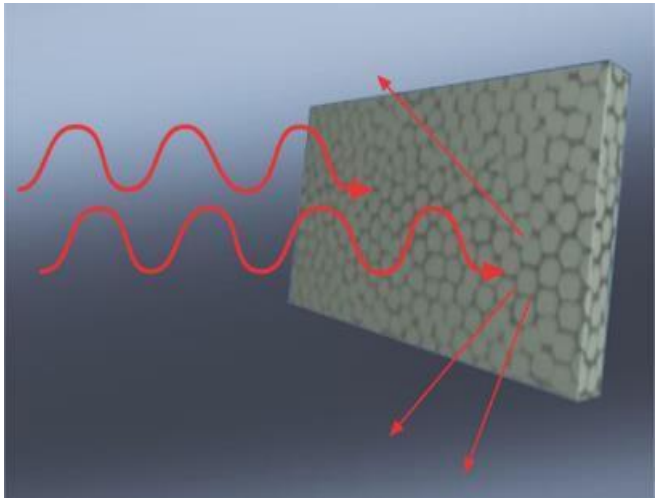
- Graphite is the most stable form of carbon – safe and chemically inert
- Thermal Performance
  - Reflects radiant heat energy
  - Reduces thermal conductivity
  - Increases R-Value

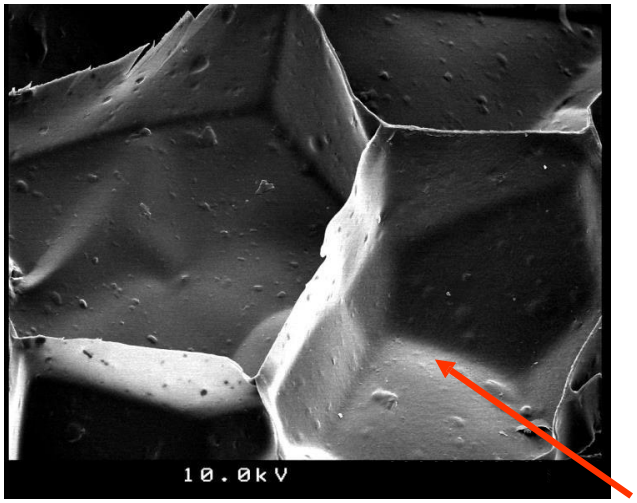


# Foam Chemistry Basics

## It’s all about the Graphite

Most rigid insulations perform by reducing conduction and convection components of heat loss. The IR-Absorbers/Reflectors in GPS address energy loss through the third component of heat transfer, radiation, hence the R-Value is increased.



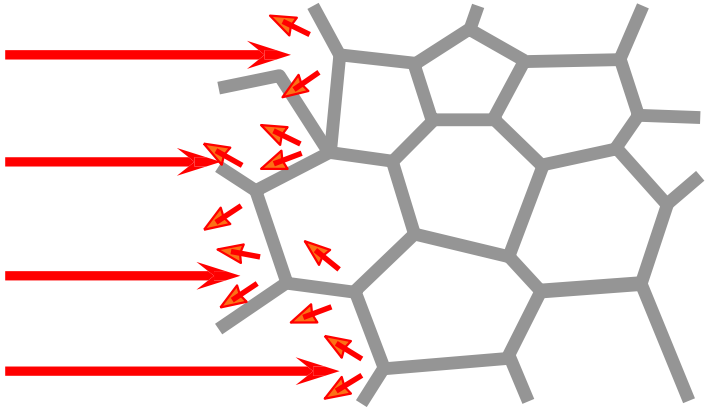



IR-Absorber

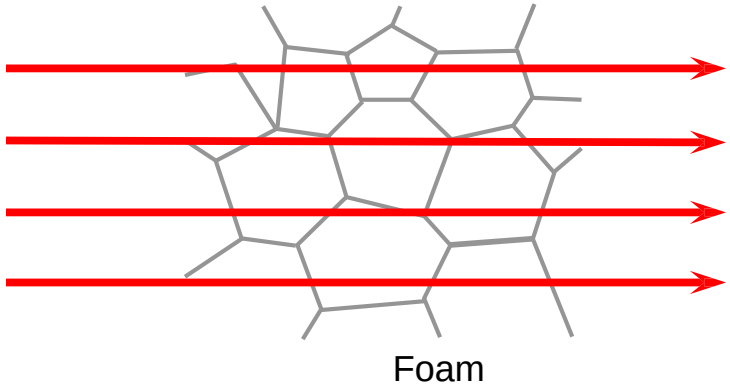
**R-Value = GPS** Matrix + Cell gas + Radiation

# Influence of Foam Density

**High density**
**⇨ thick membranes**
( ≥1.6 lbs/ft³)




**Low density**
**⇨ thin membranes**
(< 0.95 lbs/ft³)



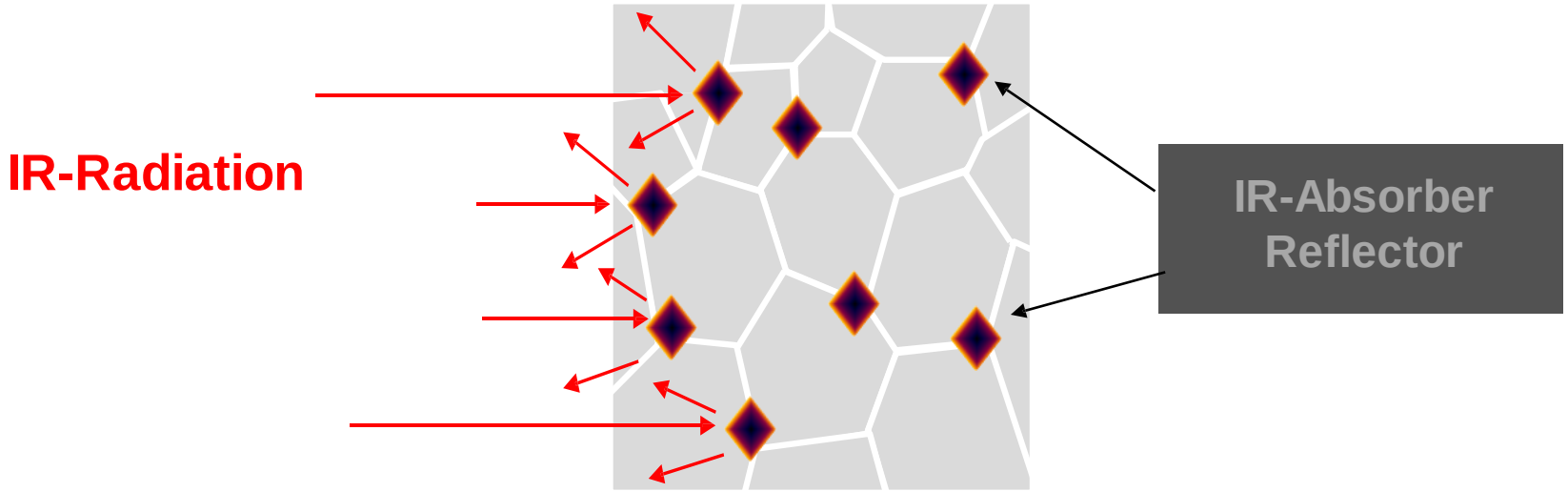
# Reduction of Thermal Transfer by IR-Radiation

The goal is to use a rigid insulation that provides needed physical properties and uses less plastic while providing maximum insulation performance.

This minimizes the use of raw materials. Graphite allows for the increased R-Values at lower densities.

**Target:**

Reduction of the Radiation in case of low foam densities.

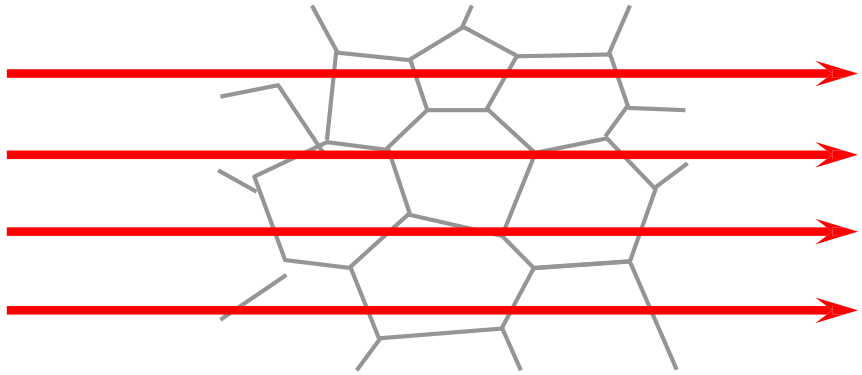



**Solution:**

Incorporation of small quantities of highly effective Infrared-Absorbers/Reflectors into the Polymer.

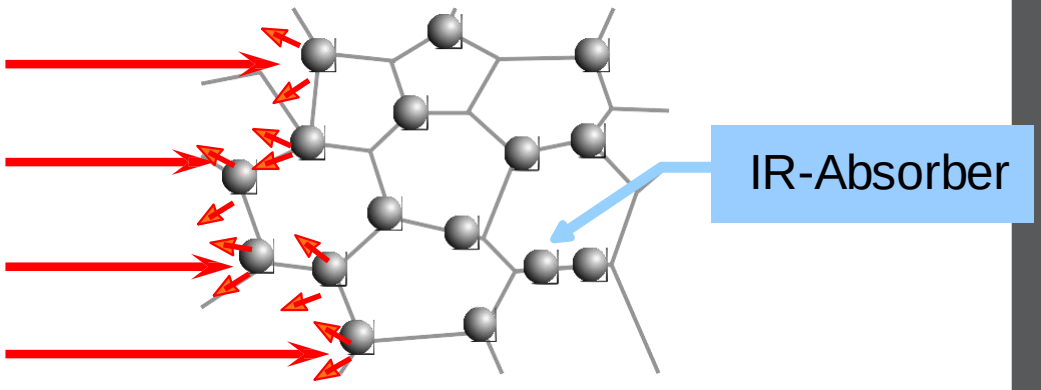
# Reduction of Heat Conduction by IR-Radiation

**Low density**
**⇨ thin membranes**
(< 0.95 lbs/ft³)



Foam

**Incorporation of IR-Absorber**
(< 0.95 lbs/ft³)

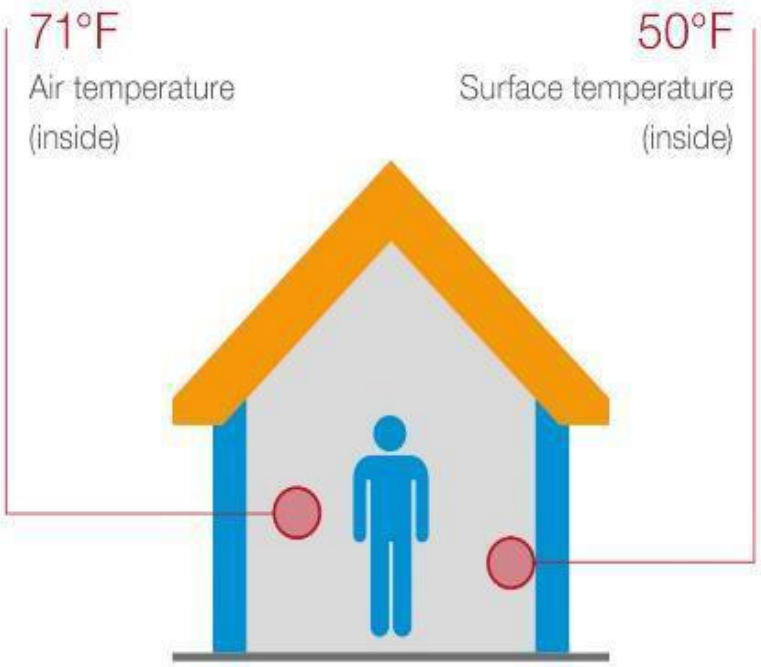



Foam

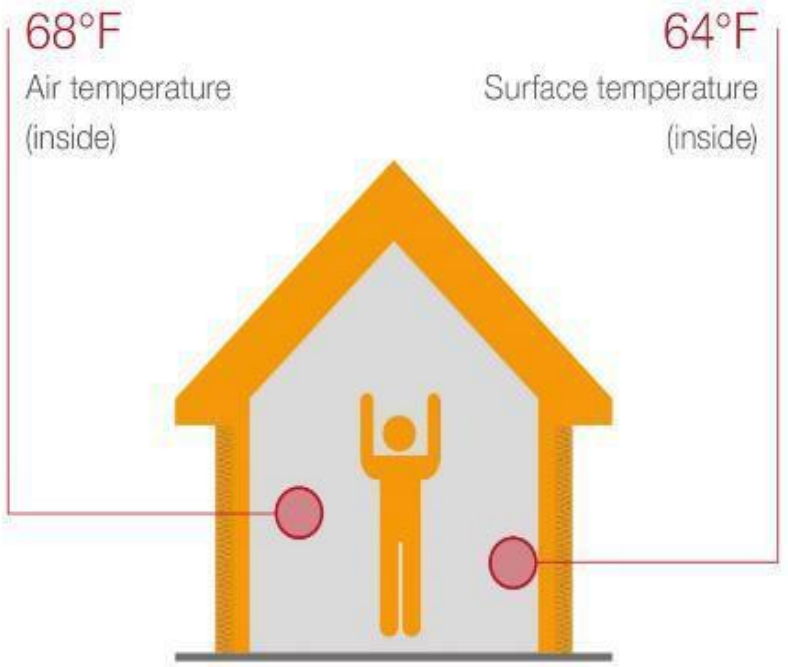
# Thermal Insulation Matters!

**Thermal comfort – a comparison:**

Building **WITHOUT** thermal insulation




Building **WITH** thermal insulation




Source: Forschungsinstitut für Wärmeschutz e.V. München, FIW

# Indoor Air Quality Characteristics for GPS Foam

## Allowable Emission Levels and Measurement

- Products are measured for chemical and particle emissions, as they are tested to simulate actual product use. Most building materials and furnishings are required to meet allowable emission levels within 7 to 14 days of installation.

- All products are tested in dynamic environmental chambers following guidance of:
  - ✓ ASTM Standards D-5116 and D-6670
  - ✓ US Environmental Protection Agency's (USEPA) testing protocol for furniture
  - ✓ State of Washington's protocol for interior furnishings and construction materials
  - ✓ California's Department of Public Health Services (CDPH) Standard Practice for Specification Section 01350
  - ✓ ISO 16000 environmental testing series
  - ✓ ANSI/ASHRAE Standard 62.1-2007
  - ✓ World Health Organization
  - ✓ LEED for New Construction (LEED-NC) and LEED for Commercial Interiors (LEED-CI)

# Learning Objective #1: Summary

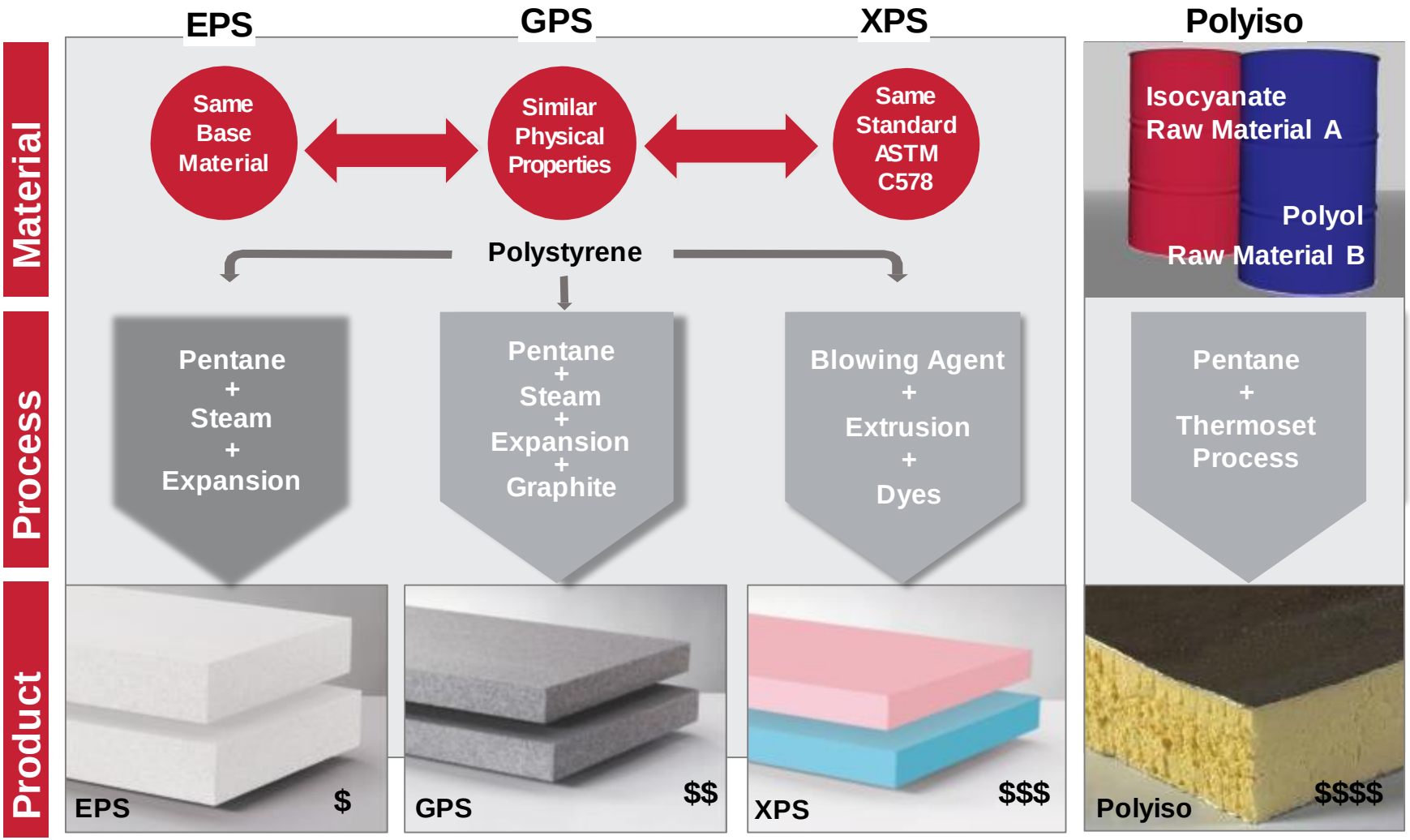
- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation and how that contributes to occupant comfort.
  - Primary raw material is Polystyrene.
  - High purity graphite embedded in polymer matrix.
  - Graphite acts as IR absorber and reflector.

**This all contributes to more thermal resistance using fewer raw materials and a comfortable environment.**

# Learning Objective #2

- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation for achieving maximum occupant comfort.
- Understand the **benefits** of GPS compared to other rigid insulation materials.
- Discuss how the **moisture management** properties of GPS contribute toward the drying strategy of the wall.
- Explain suitable applications for GPS insulation and discuss inherent benefits.

# Closed Cell Rigid Insulations: EPS, GPS, XPS, ISO



# Rigid Insulation R-Value Comparison

| Property | Units | EPS | GPS | XPS |
|---|---|---|---|---|
| Compressive Resistance ASTM D1621 | Pounds/square inch (psi) at yield of 10% deformation | 10 | 10 | 15 |
| Thermal Resistance @75°F ASTM C518 | Per inch of thickness in °F•ft²•h/BTU @ 75°F | 3.85 | 5.0 * | 5.0 ** |
| Density | lbs/ft³ | 0.90 | 0.90 | **1.30** |
| Relative material requirement to reach R-5 | | **+ 24% Thickness** | baseline | **+ 30% Density** |

*Actual thickness 1.06”

** R-Values decreases with time

# GPS Rigid Insulation Properties Overview

| Property | Unit | GPS* | | | | |
|---|---|---|---|---|---|---|
| ASTM C578 Classification | | Type I | Type VIII | Type II | Type II+ | Type IX |
| Compressive Resistance | at yield of 10% deformation in psi (min) | 10.0 | 14.0 | 15.0 | 20.0 | 25.0 |
| Thermal Resistance (R-Value) | °F·ft²·h/BTU (°C·m2/W) @ 75°F | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| | °F·ft²·h/BTU (°C·m2/W) @ 40°F | 5.2 | 5.2 | 5.2 | 5.3 | 5.3 |
| Water Vapor Permeance | Max perm (ng/Pa·s·m²) | 4.0 | 3.1 | 3.1 | 3.1 | 2.5 |
| Water Absorption by Total Immersion | Max volume % absorbed | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| Flexural Strength | psi (min) | 25.0 | 32.0 | 39.0 | 40.0 | 50.0 |
| Density | lbs./ ft³ (min) | 0.90 | 1.15 | 1.35 | 1.45 | 1.80 |
| Flame Spread | Index | 5 | | | | |
| Smoke Development | Index | 25 | | | | |

* Nominal 1" (Actual 1.0625")

# GPS & Sustainability

**Resource Efficient**
- Expansion and molding processes use steam  in relatively low-energy processes
- Pentane, the foaming agent is often captured and re-used for steam generation
- Water from manufacturing process is collected and re-used many times

**Recyclable and Recycled Content**
- 100% Recyclable – can be re-formed into another product
- Can contain post-industrial and post-consumer recycled content

**Environmentally Friendly**
- No land degradation due to quarrying for raw materials, no release of phenol during production
- Does not contribute to deforestation or the destruction of plant life
- Does not contain CFC, HCFC, HFC or formaldehyde
- Inert, stable and does not produce methane gas or contaminating leachates

**Carbon Footprint, Energy and Emissions**
- Foaming agent, pentane, has Zero GWP
- Long-term stable R-Value help to reduce energy consumption
- Energy payback of 1-2 years depending on climate zone
- EPS is manufactured locally, minimizing energy for transporting foam over long distances

*** Energy and Greenhouse Gas Savings for EPS Foam Insulation Applied to Exterior Walls of Single Family Residential Housing in the U.S. and Canada by* Franklin Associates, Prairie Village

# Learning Objective #2 Summary

- Understand the **benefits** of GPS compared to other rigid insulation materials.
  - Thinner panels required.
  - Less dense panels required.

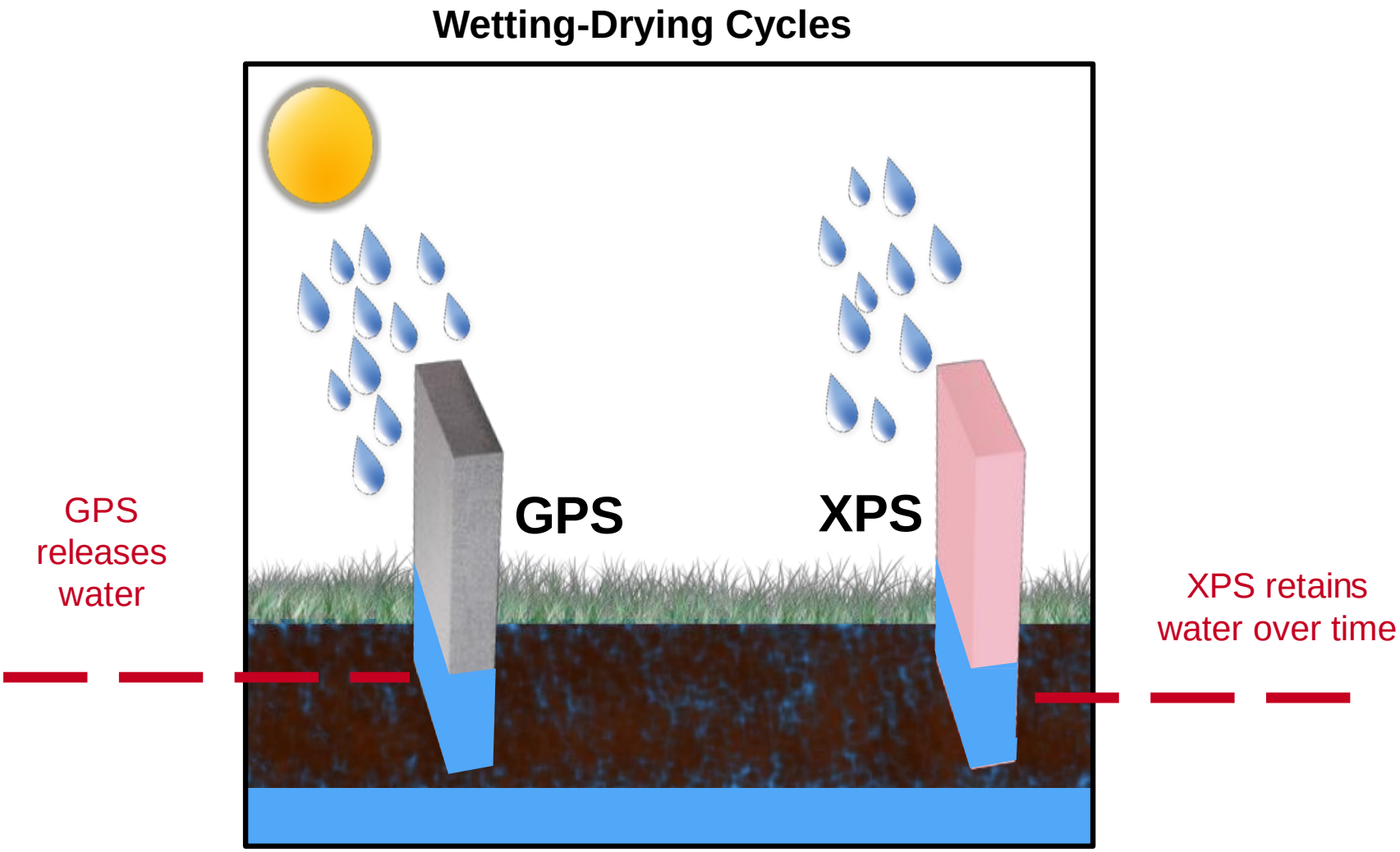
  **As a result:**

  - Fewer resources required to achieve same thermal results.
  - Fewer resources along with regional production generally means a cost savings as well as a positive environmental impact.

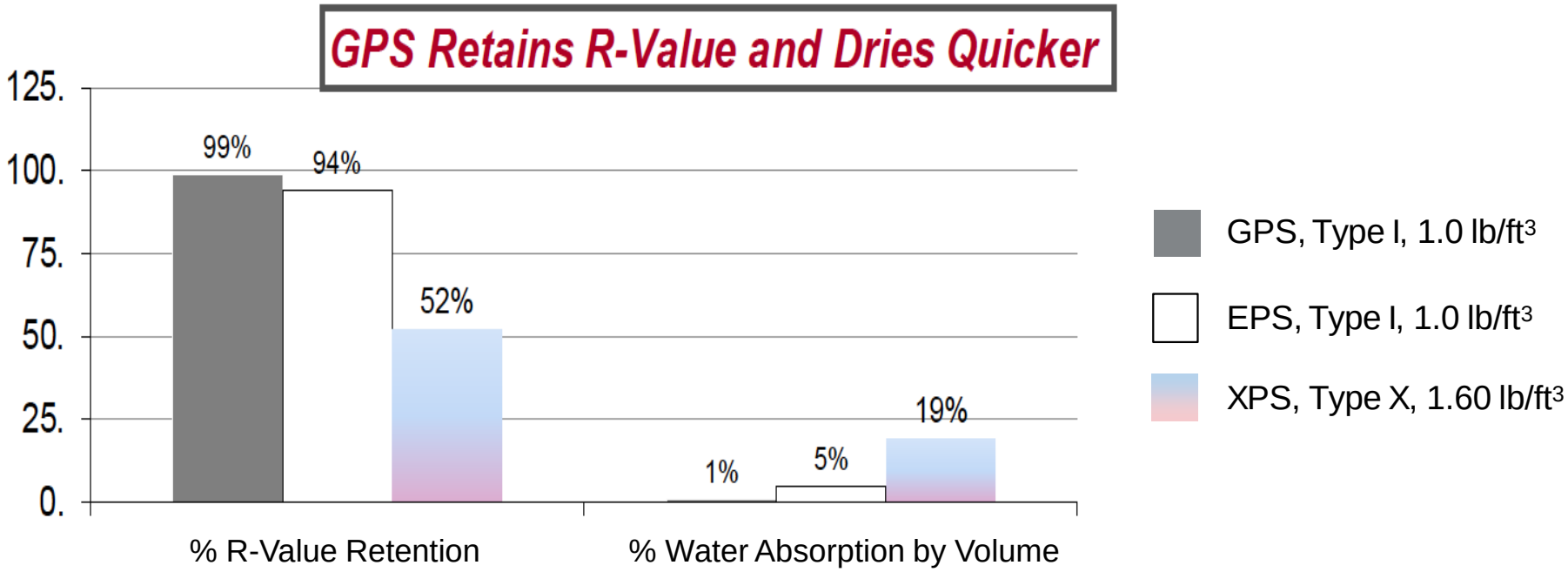
# Learning Objective #3

- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation for achieving maximum occupant comfort.
- Understand the **benefits** of GPS compared to other rigid insulation materials.
- Discuss how the **moisture management** properties of GPS contribute toward the drying strategy of the wall.
- Explain **suitable applications** for GPS insulation and discuss inherent benefits.

# GPS: Superior Below Grade Moisture Management



# Why GPS is Best in Class Insulation



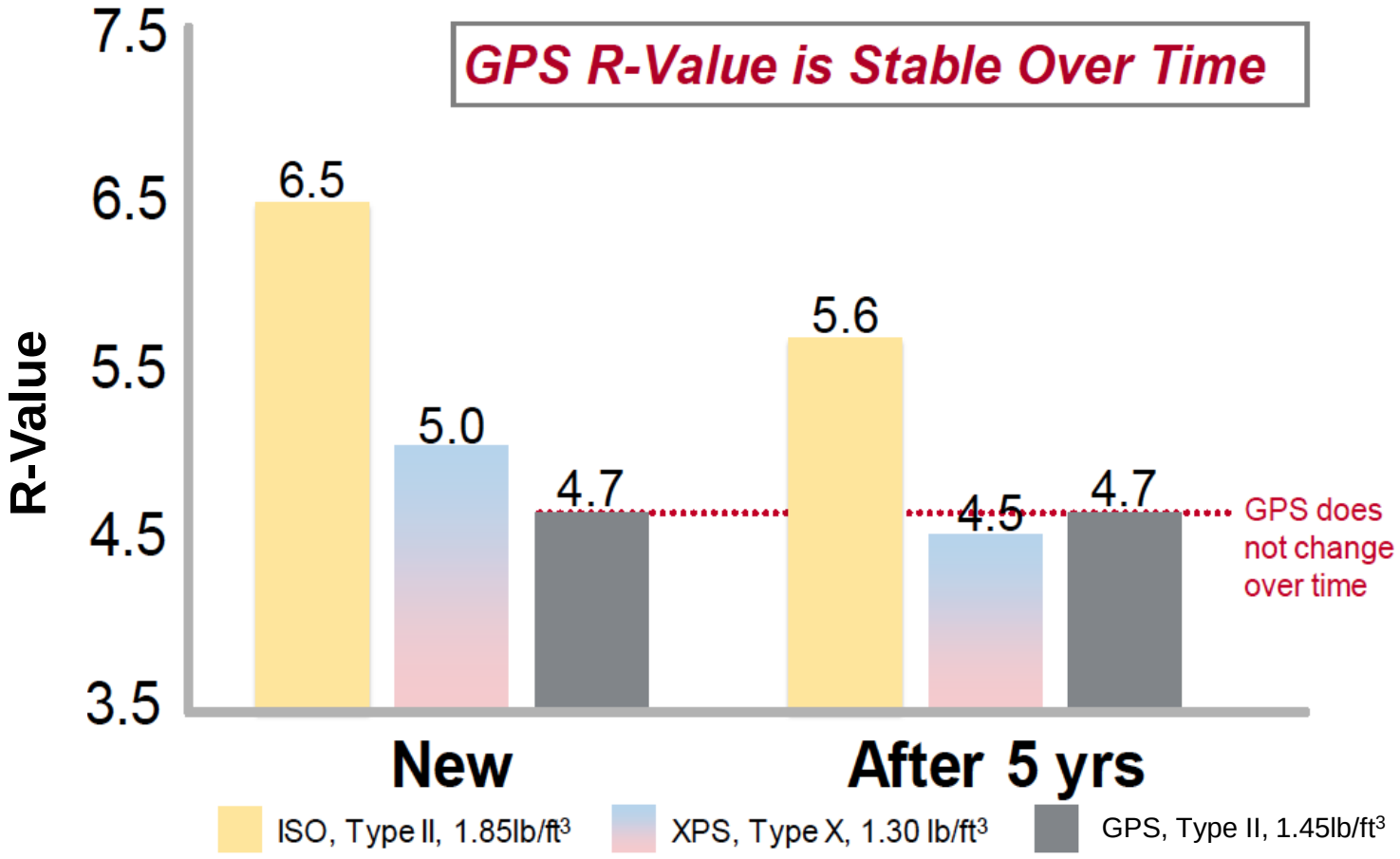

Below grade insulation experiences wetting/drying cycles

R-Value loss for XPS insulation is directly related to the % of water absorption by volume



Source :BASF and 2013 Independent Test of Expanded Polystyrene referenced in March 2014 Series 105 Technical Bulletin – EPS Industry Alliance

# Why GPS is Best-in-Class Insulation

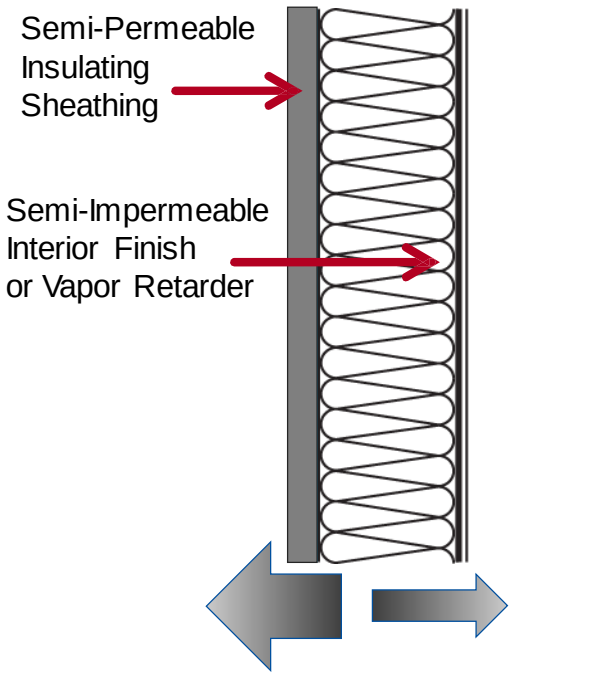



Sources: XPS Warranty; ASTM C1289 Standard for Faced Rigid Cellular Polyisocyanurate;
EPS Industry Association Technical Bulletin Series 105

# Permeance Drives Wall Design

## Moisture Vapor in Above Grade Walls:

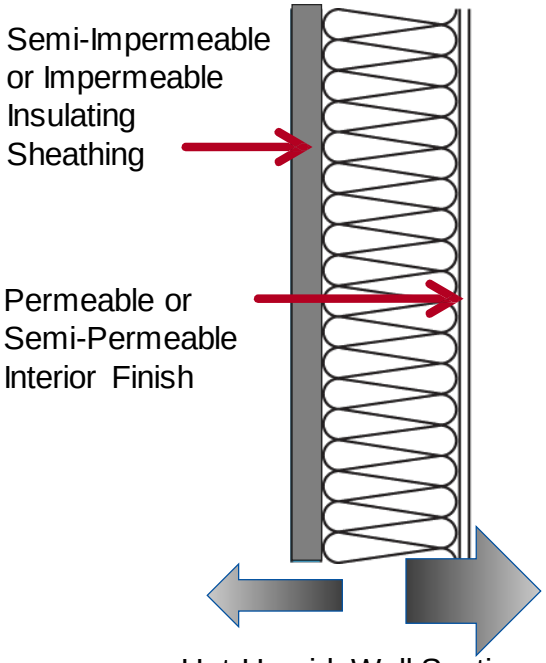
### 1. Dry to outside




Cold Climate Wall Section
(Drying Primarily to the Exterior)

*i.e. Northern U.S.*

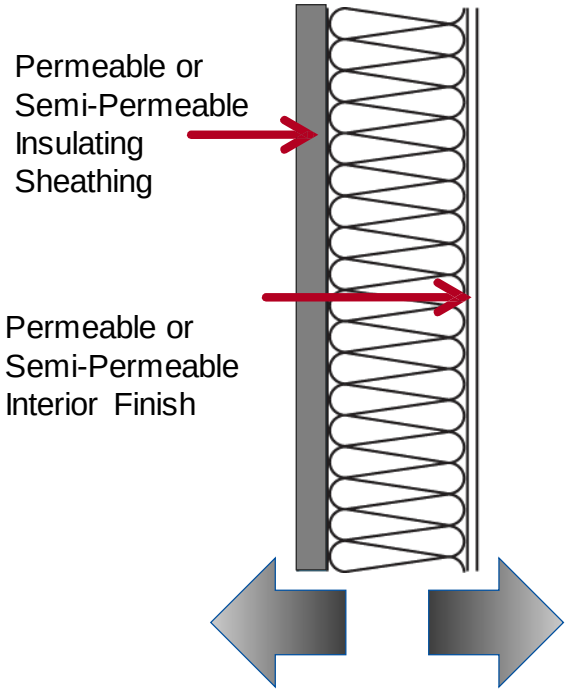
### 2. Dry to inside




Hot-Humid Wall Section
(Drying Primarily to the Interior)

*i.e. Southern/Gulf U.S.*

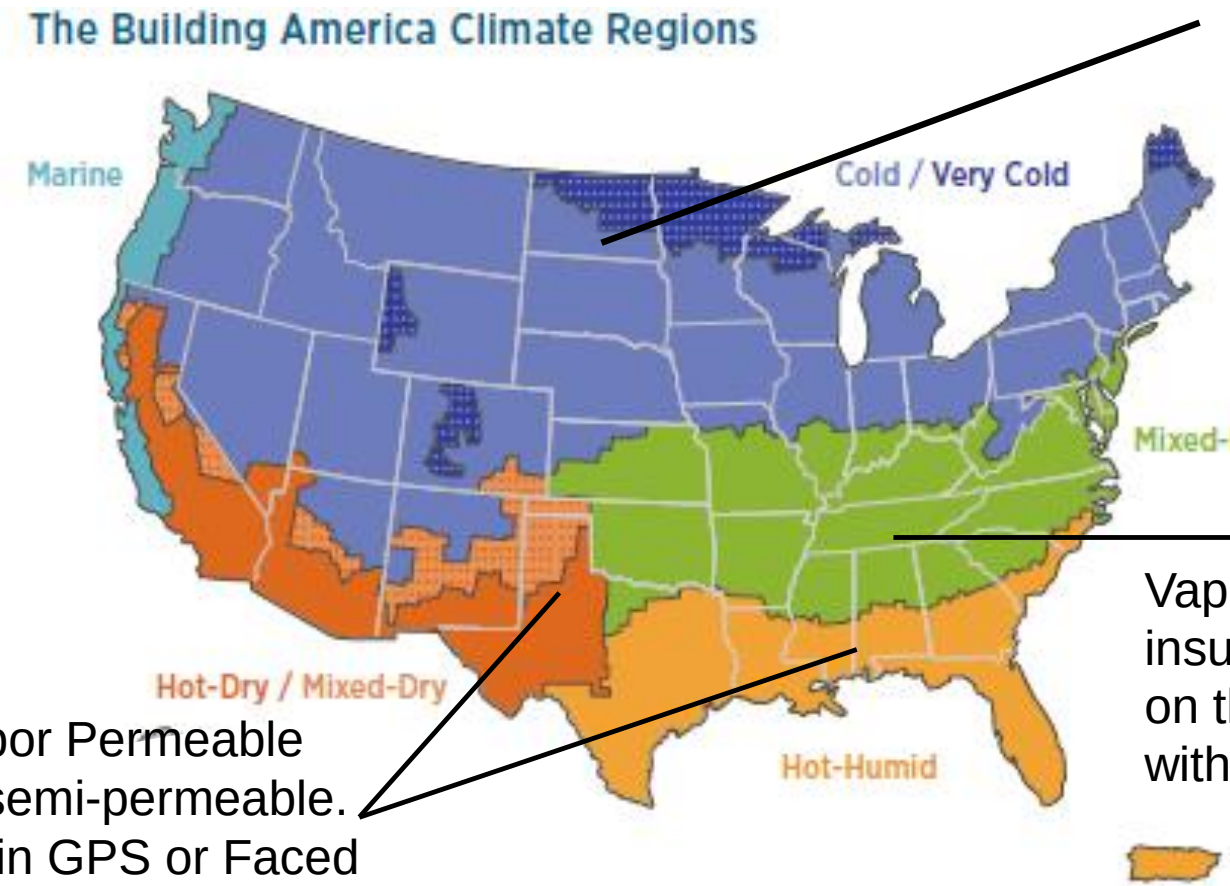
### 3. Dry in both directions




Mixed-Humid Wall Section
(Drying to both the Exterior and the Interior – "Flow through approach")

*i.e. Central/Plains U.S.*

# Climate Specific: GPS Insulation




Vapor permeable or semi-permeable insulating sheathing.

Plain GPS or Faced with >1 perm films.

Vapor impermeable insulating sheathing on the exterior. GPS with <1 perm films.

Vapor Permeable or semi-permeable. Plain GPS or Faced with >1 perm films

Source: BASF

# Learning Objective #3 Summary

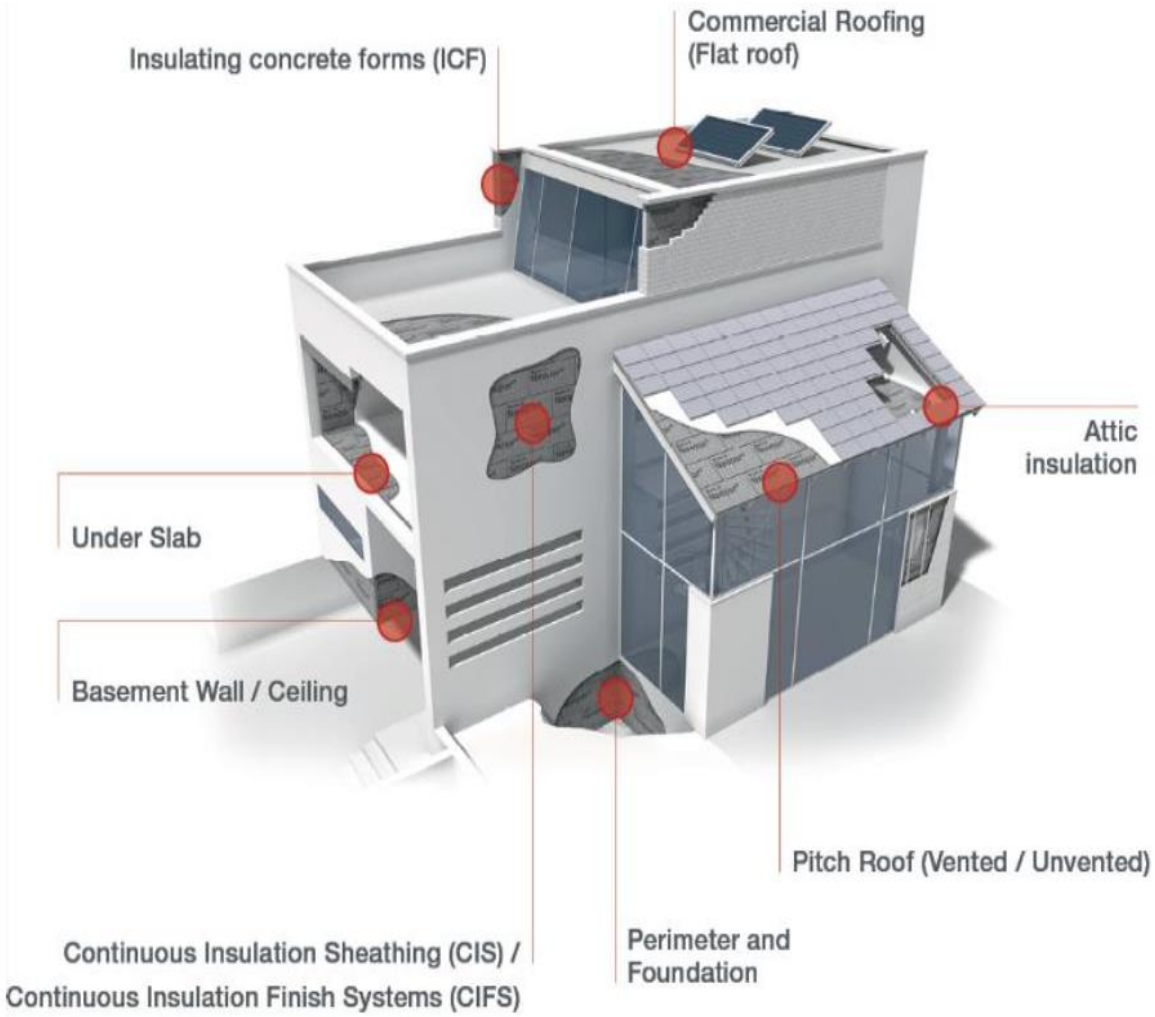
- Discuss how the **moisture management** properties of GPS contribute toward the drying strategy of the wall.
  - GPS is breathable allowing it to dry quickly.
  - Due to breathability, GPS retains R-Value overtime better than XPS.
  - Depending on climate zones, permeability is addressed with facer options available from the manufacturer.

**GPS is suited for all climate zones**

# Learning Objective #4

- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation for achieving maximum occupant comfort.
- Understand the **benefits** of GPS compared to other rigid insulation materials.
- Discuss how the **moisture management** properties of GPS contribute toward the drying strategy of the wall.
- Explain **suitable applications** for GPS insulation and discuss inherent benefits.

# Applications



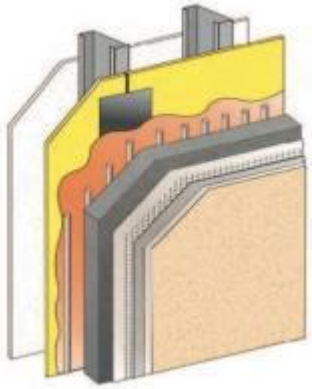
# GPS Application Versatility

| Most Common Rigid Foam By Application | GPS | XPS | ISO |
|---|---|---|---|
| Exterior Continuous Insulation | X | X | X |
| Roof Insulation | X | X | X |
| Under Slab Insulation | X | X | X |
| Below Grade Walls Insulation | X | X | X |
| Insulated Garage/Entry Doors | X | X | X |
| Structural Insulated Panels | X | X | |
| EIFS | X | X | |
| Insulating Concrete Forms | X | | |
| Integrated Insulated Vinyl Siding | X | | |
| Radiant flooring OEM products | X | | |
| Geofoam used to stabilize soil | X | | |
| One Coat Stucco (T&G) | X | | |

# Above Grade Walls & Roofs

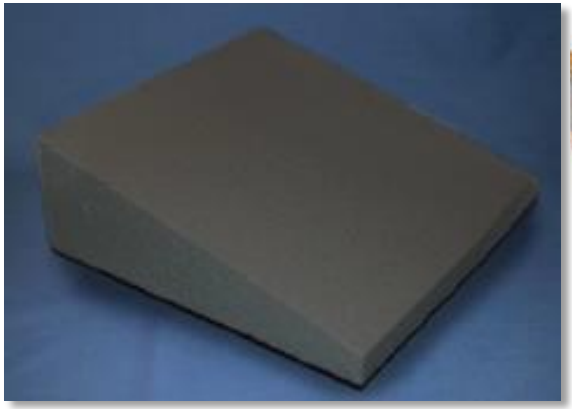
Plain or Faced Insulation

Siding Underlayment



EIFS Systems

Freezer Panels



Roof Insulation

SIPS

# Below Grade Walls & Foundations

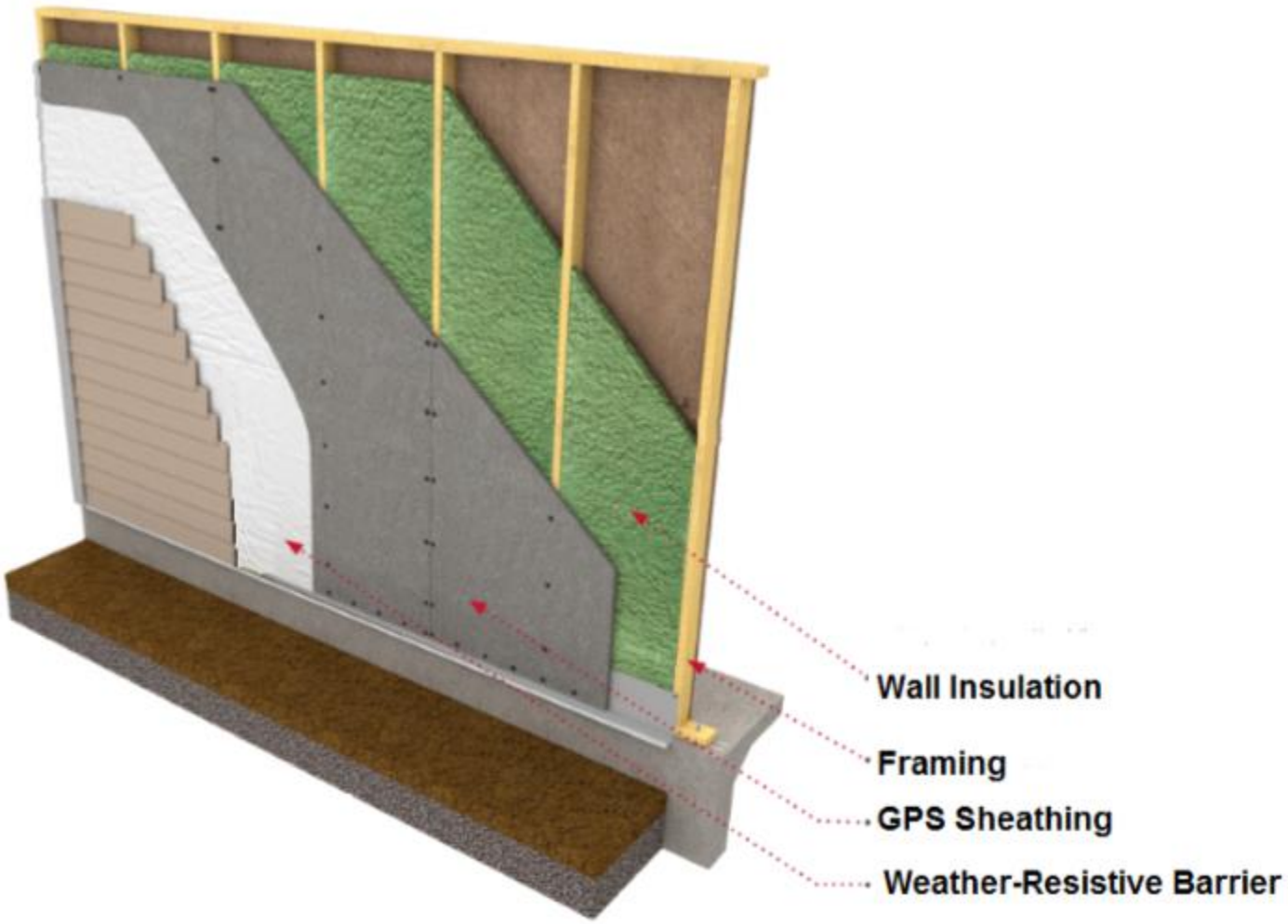
Radiant Floor Panels

Exterior Basement Wall

Under Slab

Interior Basement Wall

# Wall Sheathing Example



# Insulation Requirements By Climate Zone

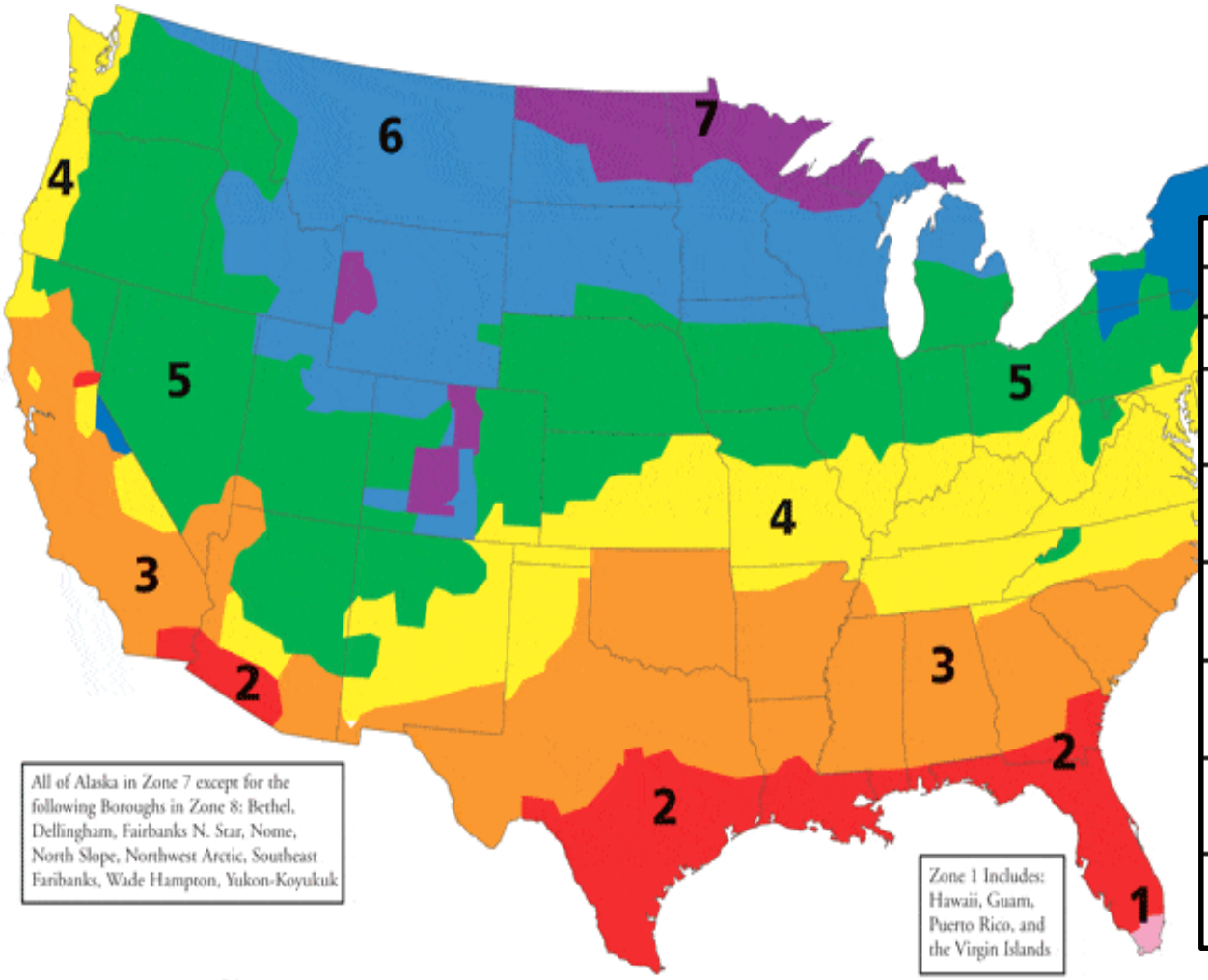
## Insulation and Fenestration Requirements by Climate Zone

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

**TABLE R402.1.1**
**INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]**

| CLIMATE ZONE | FENESTRATION *U*-FACTOR[b] | SKYLIGHT[b] *U*-FACTOR | GLAZED FENESTRATION SHGC[b, e] | CEILING *R*-VALUE | WOOD FRAME WALL *R*-VALUE | MASS WALL *R*-VALUE[i] | FLOOR *R*-VALUE | BASEMENT[c] WALL *R*-VALUE | SLAB[d] *R*-VALUE & DEPTH | CRAWL SPACE[c] WALL *R*-VALUE |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | NR | 0.75 | 0.25 | 30 | 13 | 3/4 | 13 | 0 | 0 | 0 |
| 2 | 0.40 | 0.65 | 0.25 | 38 | 13 | 4/6 | 13 | 0 | 0 | 0 |
| 3 | 0.35 | 0.55 | 0.25 | 38 | 20 or 13+5[h] | 8/13 | 19 | 5/13[f] | 0 | 5/13 |
| 4 except Marine | 0.35 | 0.55 | 0.40 | 49 | 20 or 13+5[h] | 8/13 | 19 | 10 /13 | 10, 2 ft | 10/13 |
| 5 and Marine 4 | 0.32 | 0.55 | NR | 49 | 20 or 13+5[h] | 13/17 | 30[g] | 15/19 | 10, 2 ft | 15/19 |
| 6 | 0.32 | 0.55 | NR | 49 | 20+5 or 13+10[h] | 15/20 | 30[g] | 15/19 | 10, 4 ft | 15/19 |
| 7 and 8 | 0.32 | 0.55 | NR | 49 | 20+5 or 13+10[h] | 19/21 | 38[g] | 15/19 | 10, 4 ft | 15/19 |

# 2015 IECC Requirements

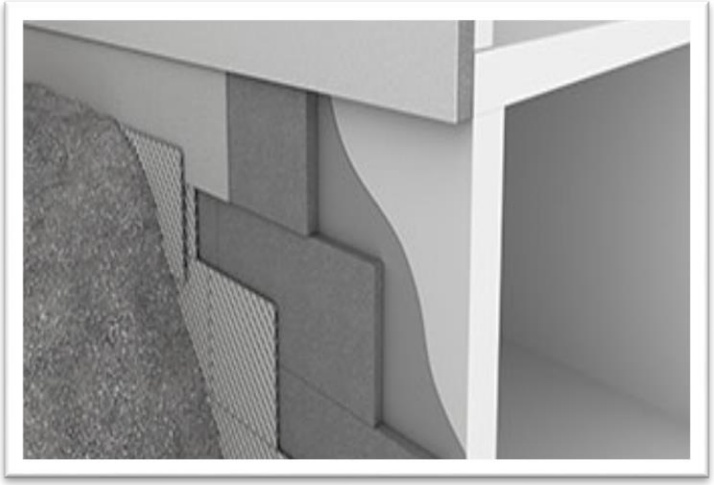



| Zone | Wood-Framed[1] Wall |
|---|---|
| 1 | R-13 |
| 2 | R-13 |
| 3 | R-13+5ci<br>or R-20 |
| 4 except Marine | R-13+5ci<br>or R-20 |
| 5 and 4 Marine | R-13+5ci<br>or R-20 |
| 6 | R-13+10ci<br>R-20+5ci |
| 7 | R-13+10ci<br>R-20+5ci |
| 8 | R-13+10ci<br>R-20+5ci |

**For 2x4 construction, Zones 3-5 require 1” of GPS. Zones 6-8 require 2” of GPS.**

# Below Grade

**Foundation Perimeter**



**Under Slab**

| Zone | Below Grade Wall |
|---|---|
| 1 | 0 |
| 2 | 0 |
| 3 | R-5/13 |
| 4 except Marine | R-10/13 |
| 5 and 4 Marine | R-15/19 |
| 6 | R-15/19 |
| 7 | R-15/19 |

# Learning Objective #4 Summary

- Explain **suitable applications** for GPS insulation and discuss inherent benefits.
  - GPS suitable for virtually every type of building application.
    - Wide range of compressive strengths available to meet more demanding applications.
    - Quick drying capabilities makes it ideal for applications where product could be exposed to moisture.
  - High R-Values per inch and wide range of thicknesses allows GPS to meet the energy code requirements.
  - GPS is produced regionally/locally.

# GPS: Overall Summary

- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation for achieving maximum occupant comfort.
- Understand the **benefits** of GPS compared to other rigid insulation materials.
- Discuss how the **moisture management** properties of GPS can keep a building interior comfortable and dry.
- Explain **suitable applications** for GPS insulation and discuss inherent benefits.

# Why Do Insulation Experts Specify GPS?

| | |
|---|---|
| Versatility in manufacturing, sourcing, and installation | On a $/R basis, GPS is a cost effective rigid insulation |
| Fast drying insulation | R-Value not compromised by cyclic water exposure |
| Certified for Indoor air quality standards, low Global Warming Potential | Supports sustainable building practices |
| Long-term stable R-Value | Energy savings will not decline over time |
| Adaptable | Available as a monolithic board in nearly any thickness up to 48” wide and 24’ long |

**This officially concludes the AIA/CES course**

**Graphite Polystyrene (GPS) Rigid Insulation**

# Thank You