PLATINUM POWERED INSULATION

PLATINUM

Graphite Polystyrene (GPS) Rigid Insulation

High Performance Thermal Innovation

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Provider #K031
Course #107

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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

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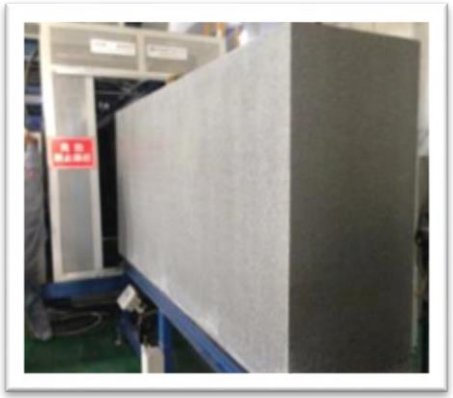
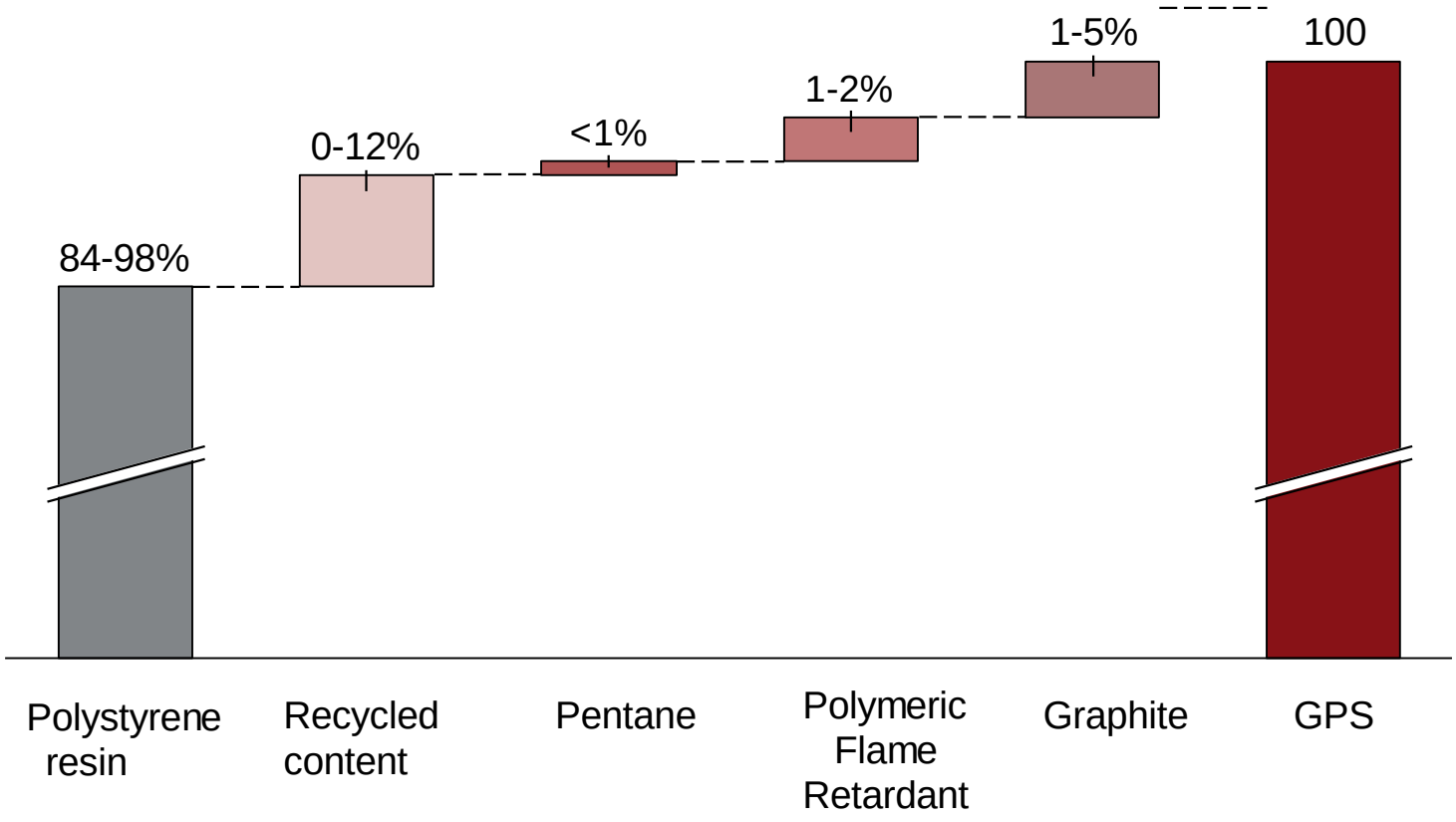
Manufacturing Process



What Is In the GPS Foam

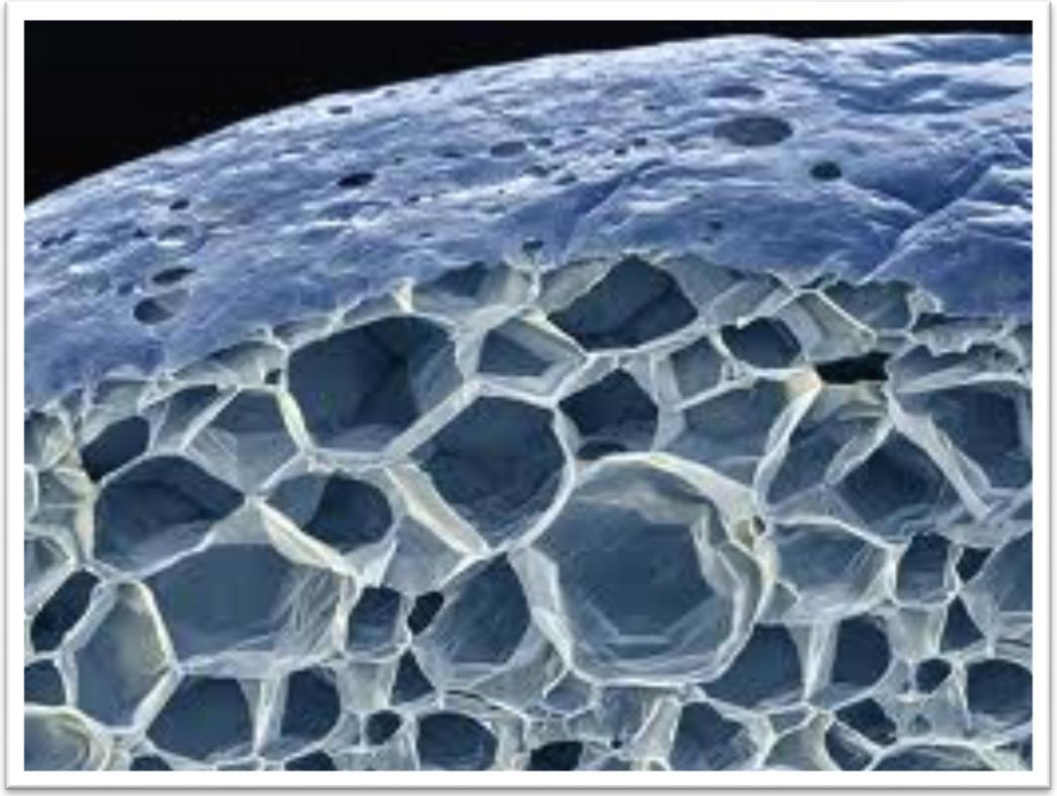


GPS

- 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.

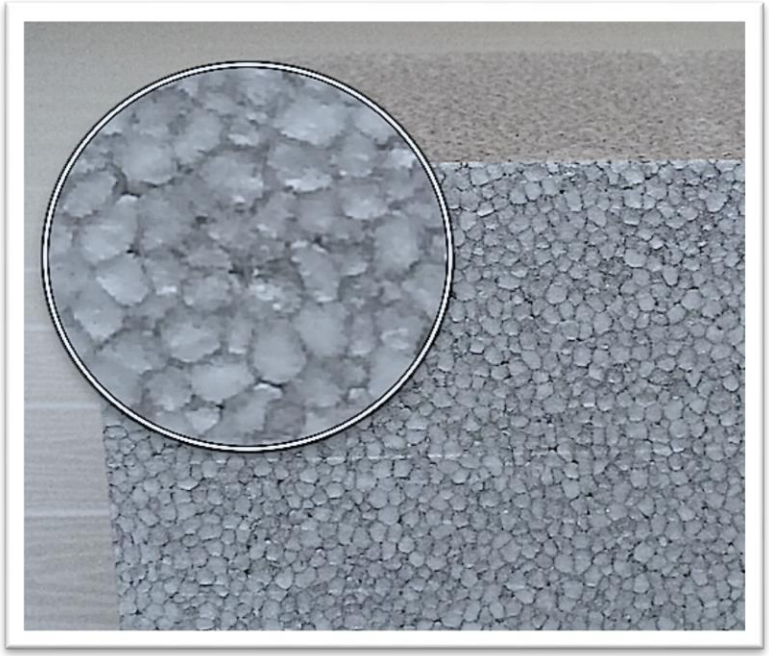
GPS

Close up of graphite contained within the polymer matrix



Graphite: How It Improves GPS

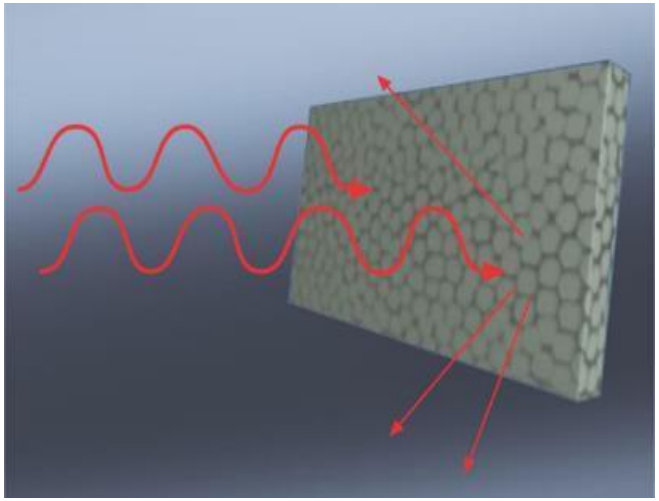
- Graphite is the most stable form of carbon – safe and chemically inert
- Thermal Performance
  - Reflects radiant heat energy
  - Reduces thermal conductivity
  - Increases R-Value

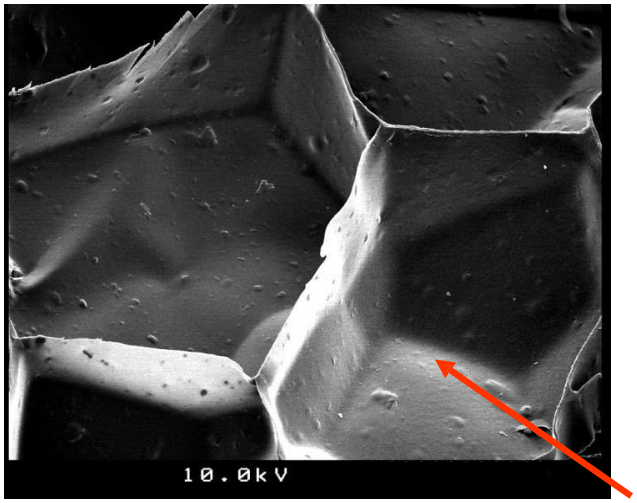


Foam Chemistry Basics

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.



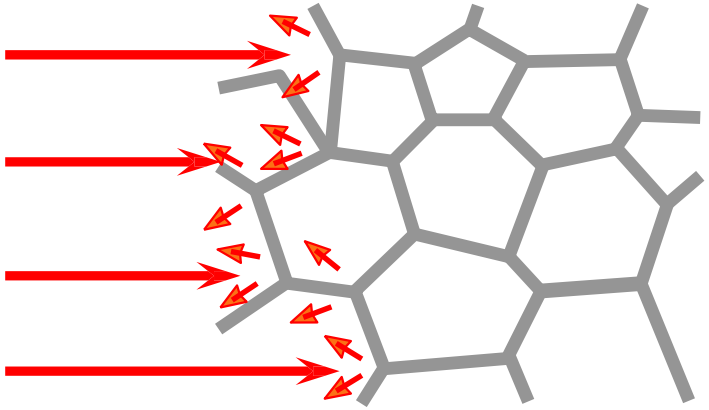


IR-Absorber

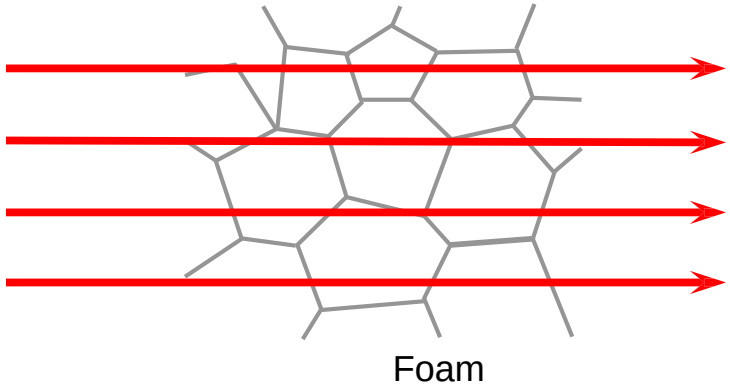
R-Value = GPS Matrix + Cell gas + Radiation

Influence of Foam Density

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



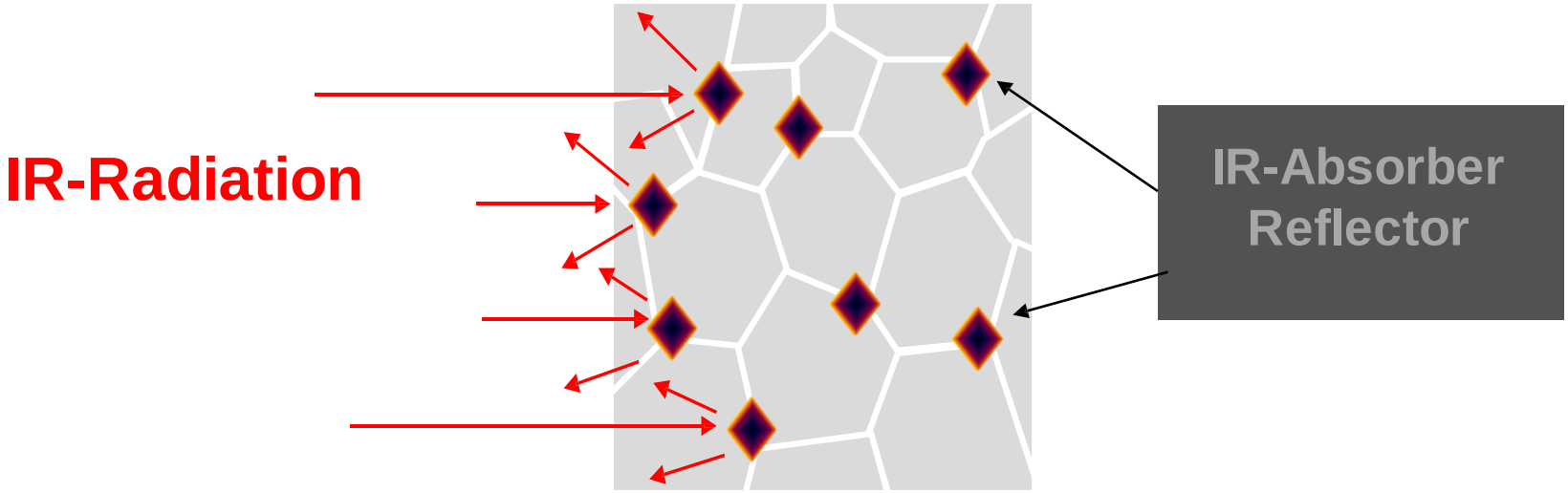
Low density
⇨ thin membranes
(< 0.95 lbs/ft³)



Reduction of Thermal Transfer by IR-Radiation

Target:

Reduction of the Radiation in case of low foam densities.

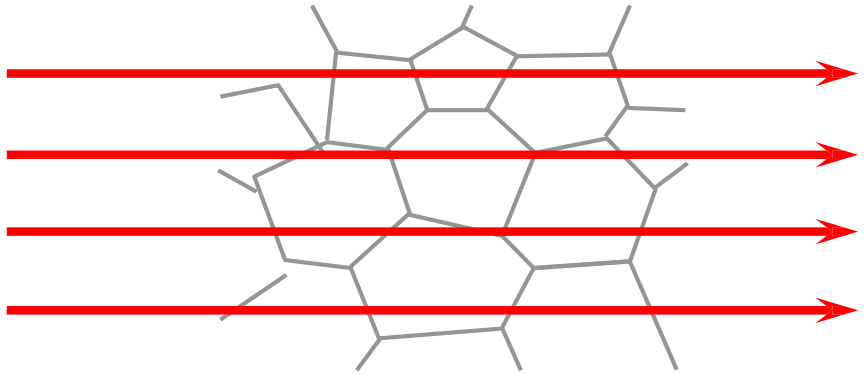


Solution:

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

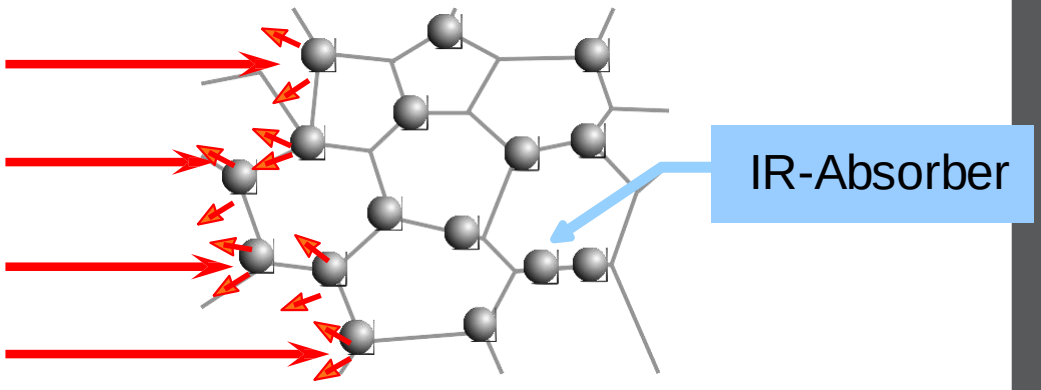
Reduction of Heat Conduction by IR-Radiation

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



Foam

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

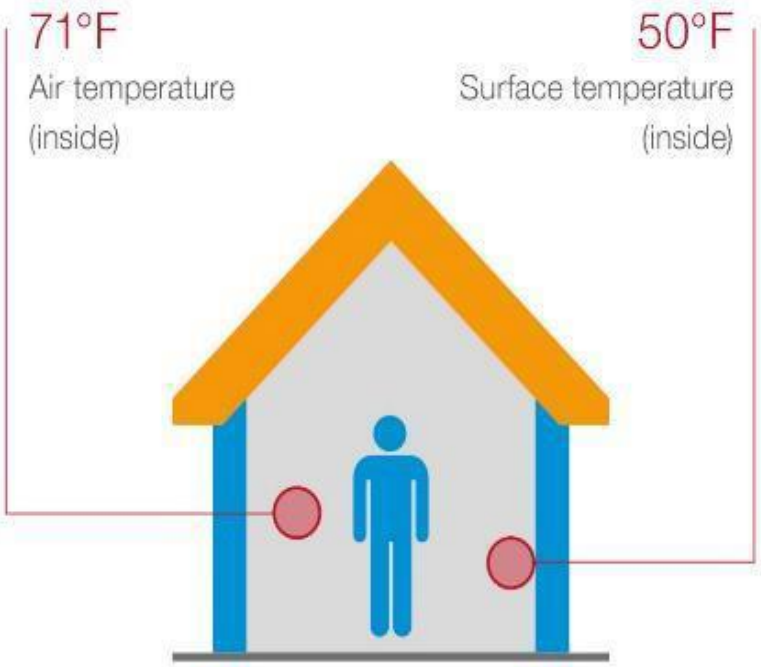


Foam

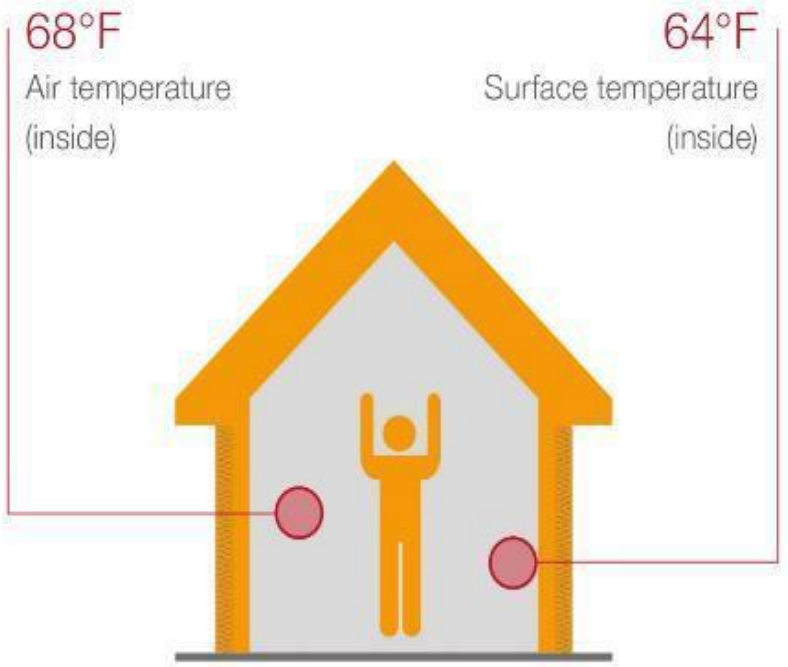
Thermal Insulation Matters!

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

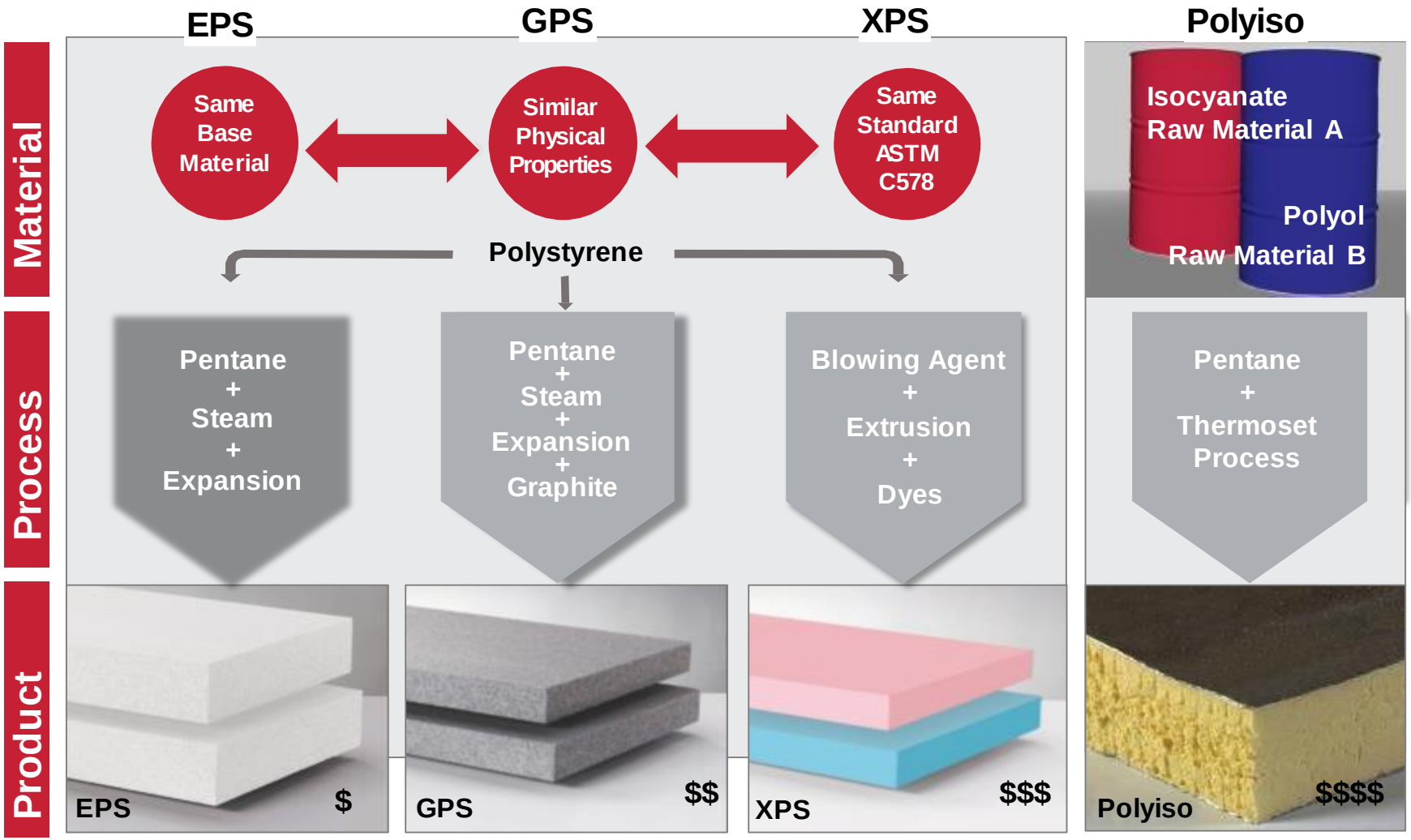
- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation and how that contributes to occupant comfort.
  - Primary raw material is Polystyrene.
  - High purity graphite embedded in polymer matrix.
  - Graphite acts as IR absorber and reflector.

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

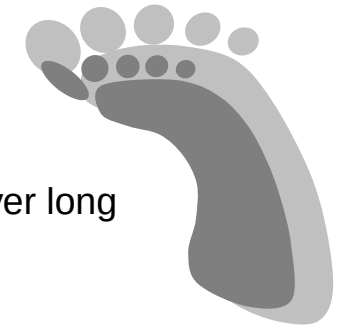
- 100% Recyclable – can be re-formed into another product
- Can contain post-industrial and post-consumer recycled content

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



Learning Objective #2 Summary

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

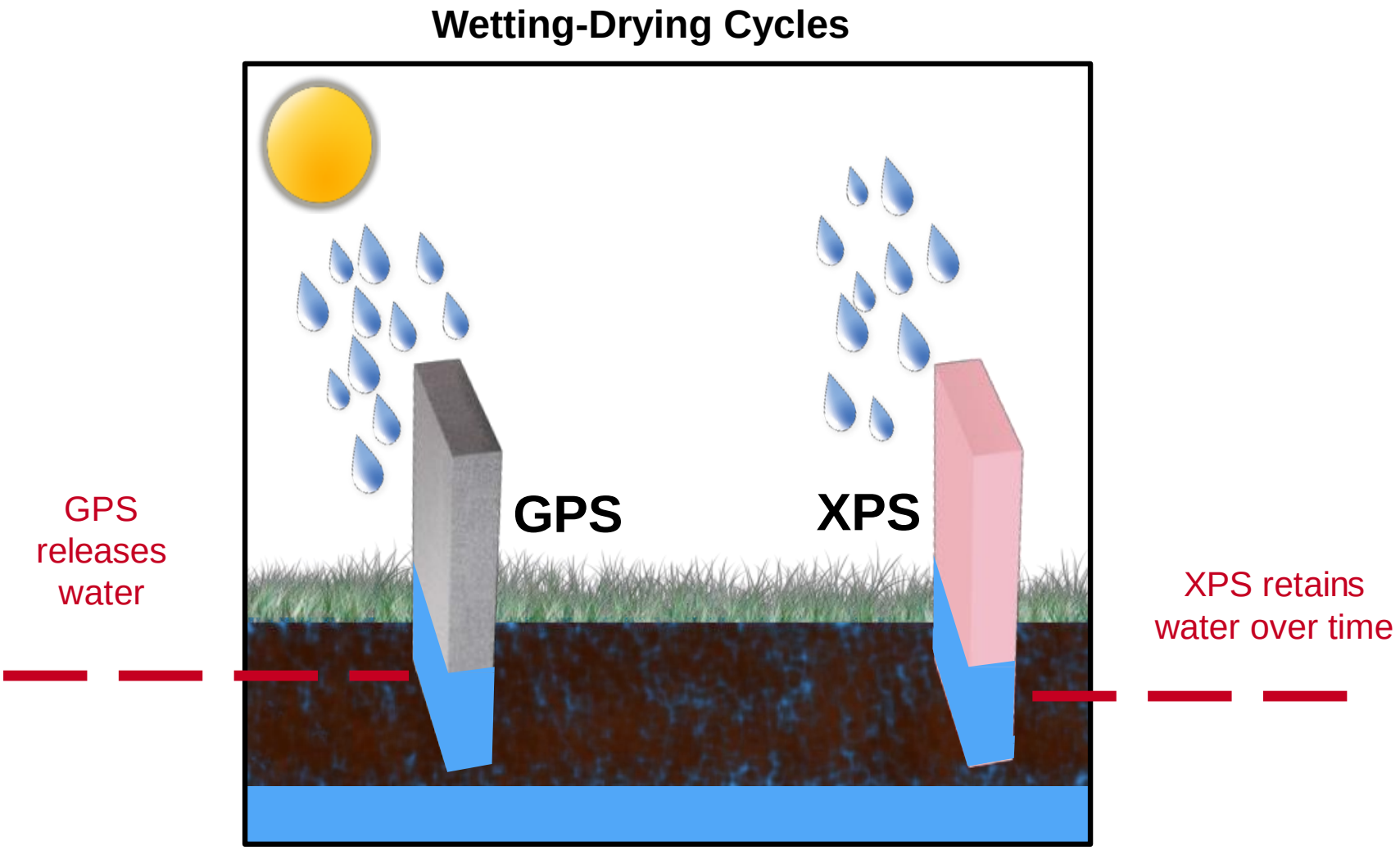
  As a result:

  - 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.

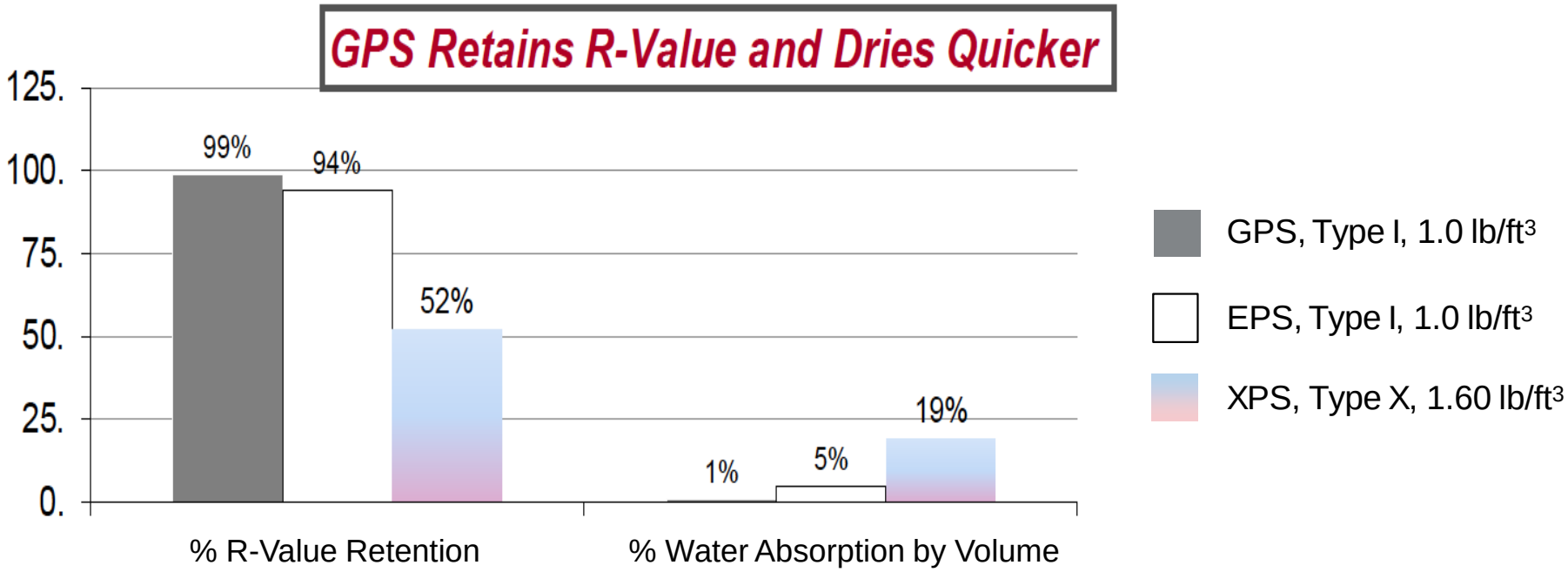
Learning Objective #3

- 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

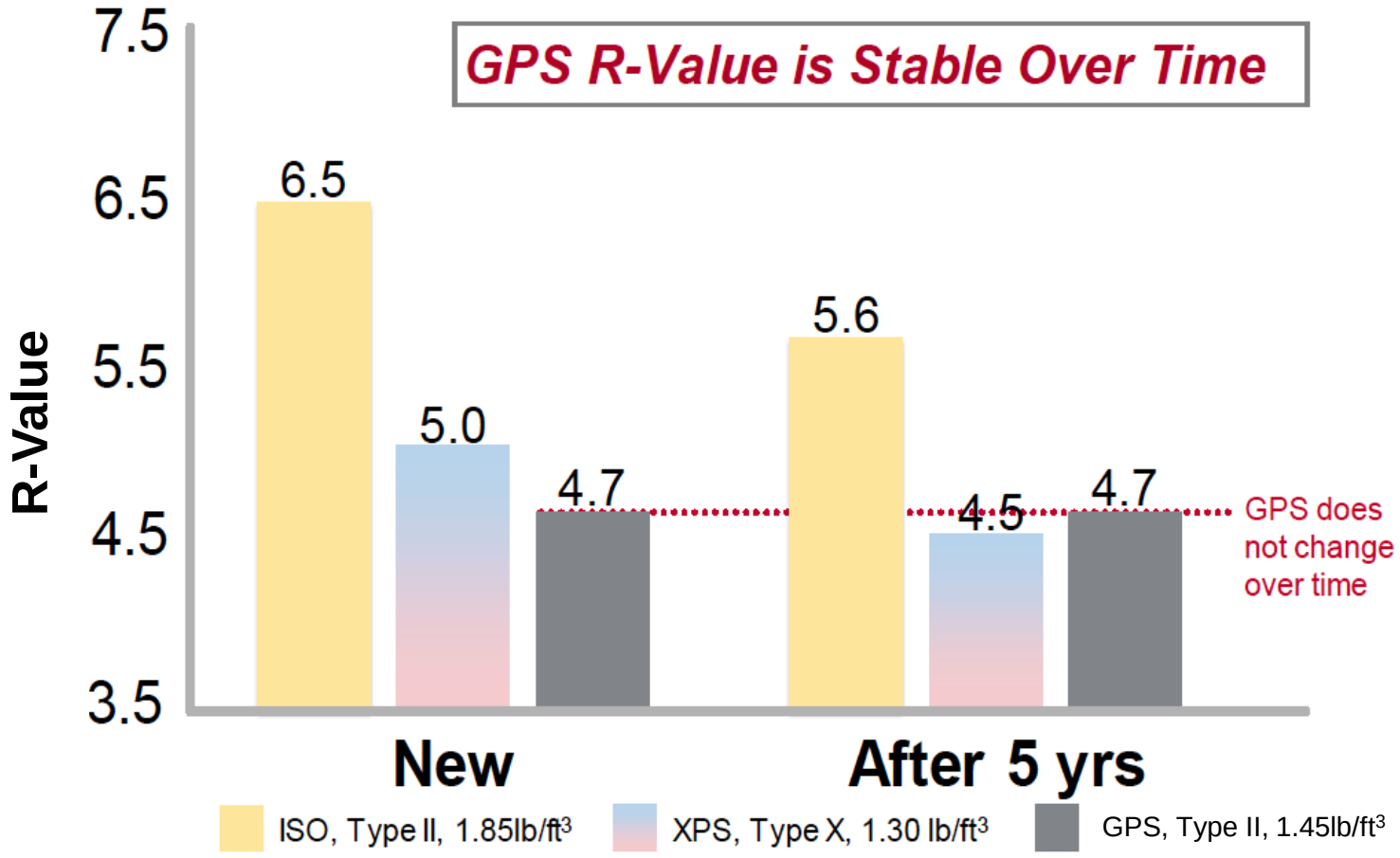


Below grade insulation experiences wetting/drying cycles

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

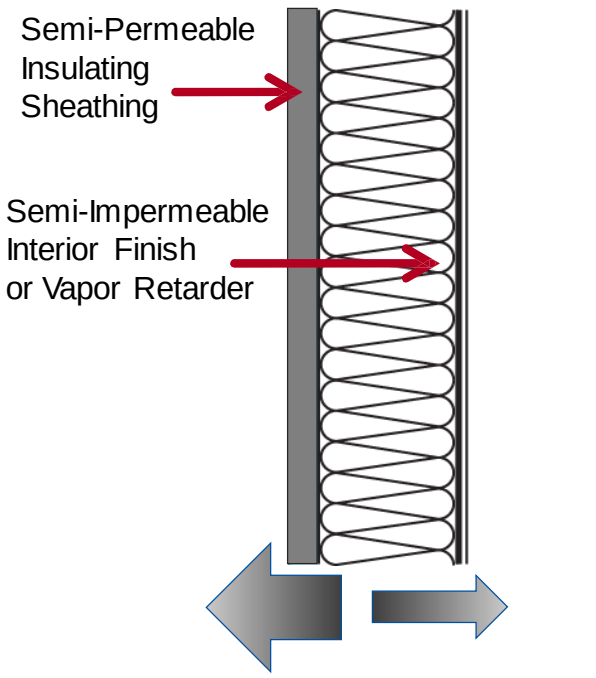


Sources: XPS Warranty; ASTM C1289 Standard for Faced Rigid Cellular Polyisocyanurate;
EPS Industry Association Technical Bulletin Series 105

Permeance Drives Wall Design

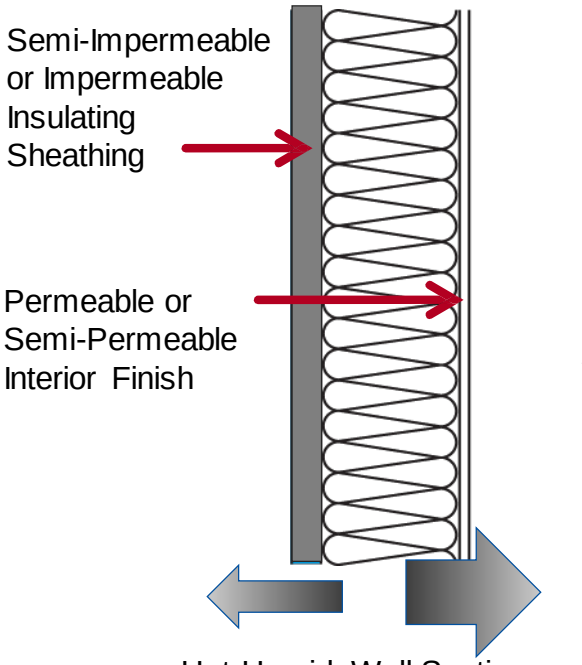
Moisture Vapor in Above Grade Walls:

1. Dry to outside



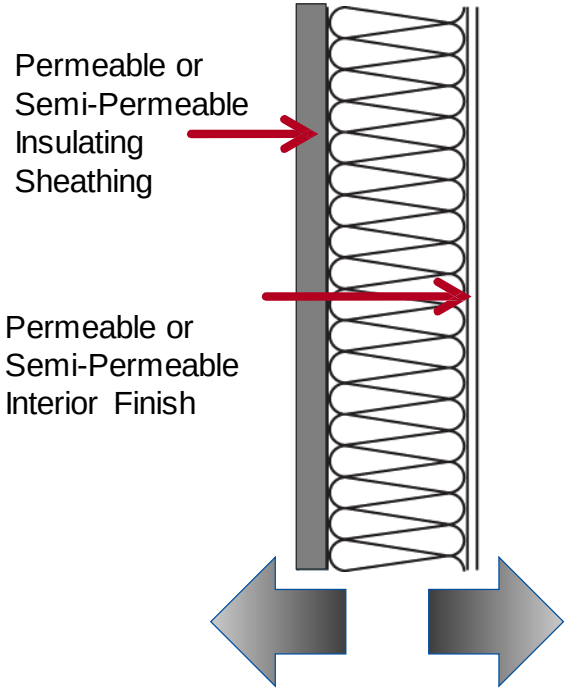
Cold Climate Wall Section
(Drying Primarily to the Exterior)

2. Dry to inside



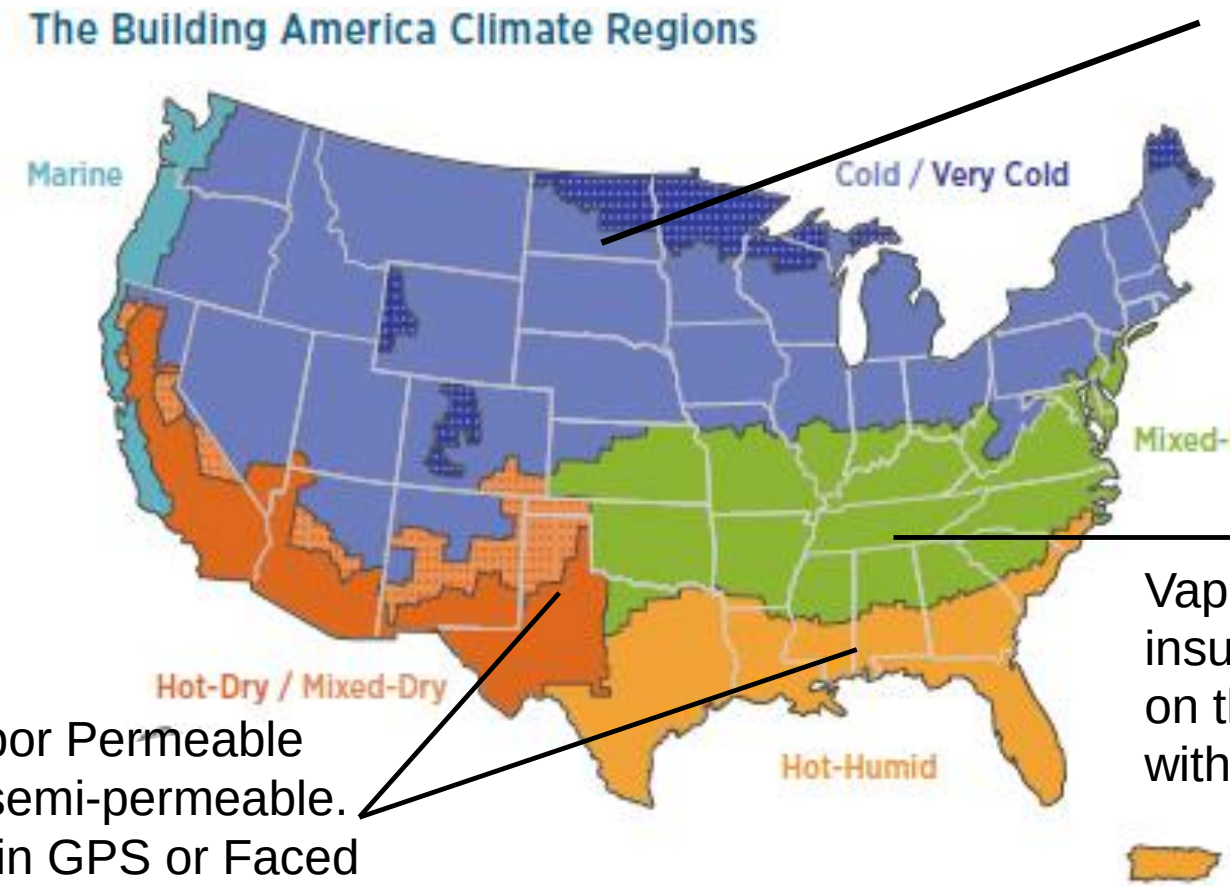
Hot-Humid Wall Section
(Drying Primarily to the Interior)

3. Dry in both directions



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

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

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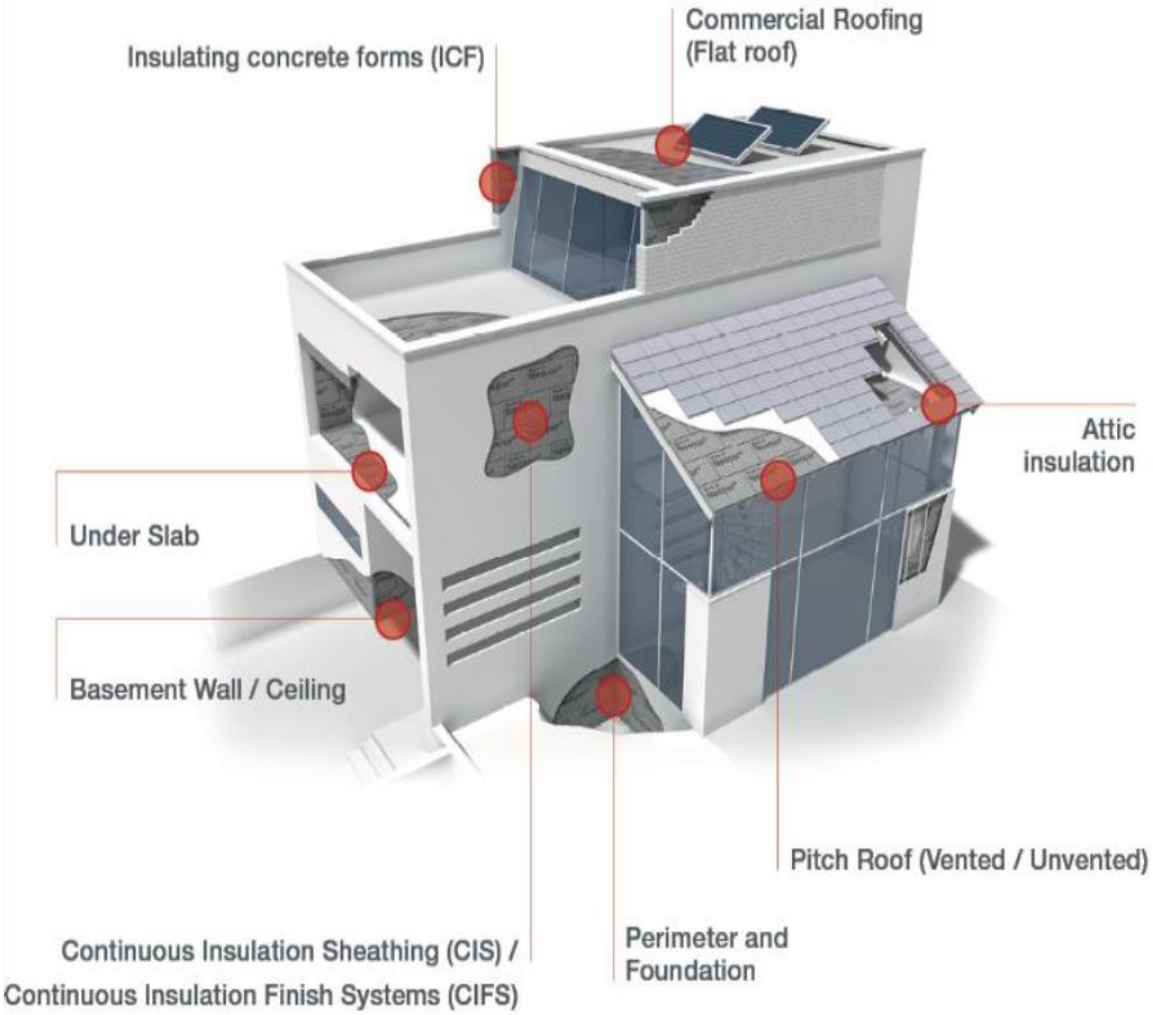
Applications



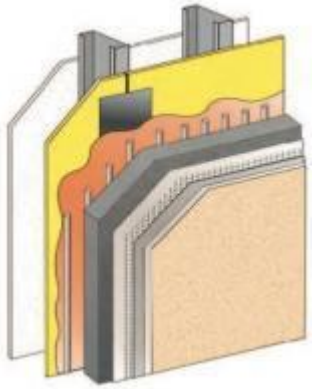
GPS Application Versatility

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

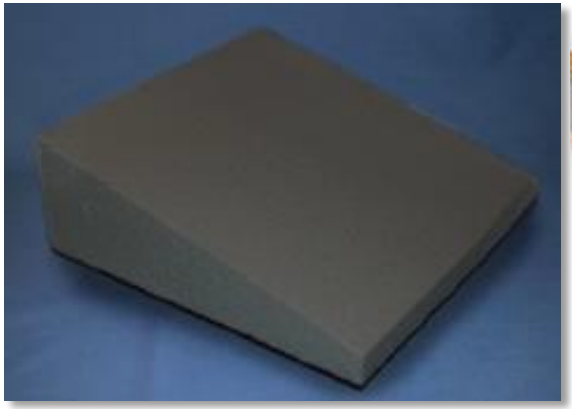
Plain or Faced Insulation

Siding Underlayment



EIFS Systems

Freezer Panels



Roof Insulation

SIPS

Below Grade Walls & Foundations

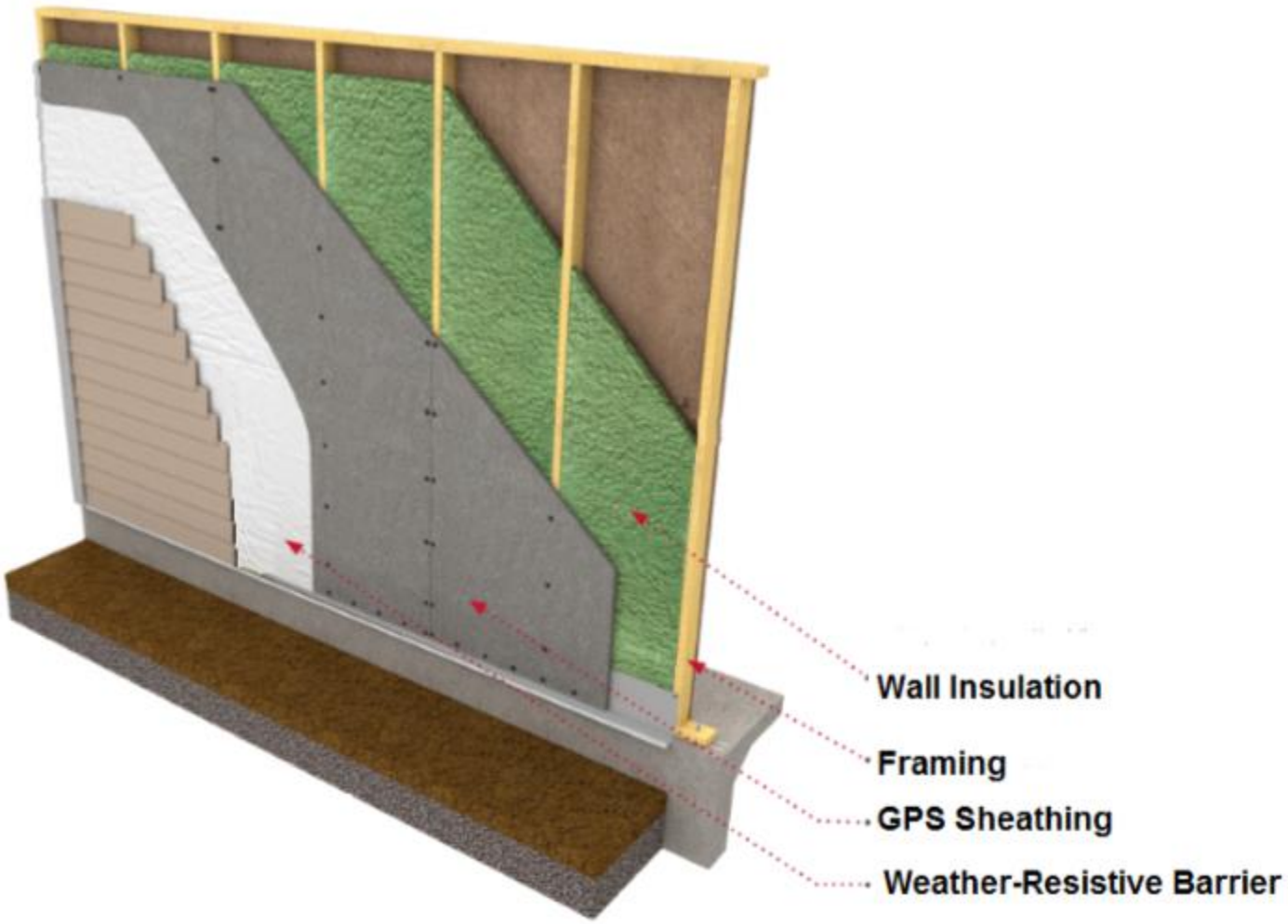
Radiant Floor Panels

Exterior Basement Wall

Under Slab

Interior Basement Wall

Wall Sheathing Example



Insulation Requirements By Climate Zone

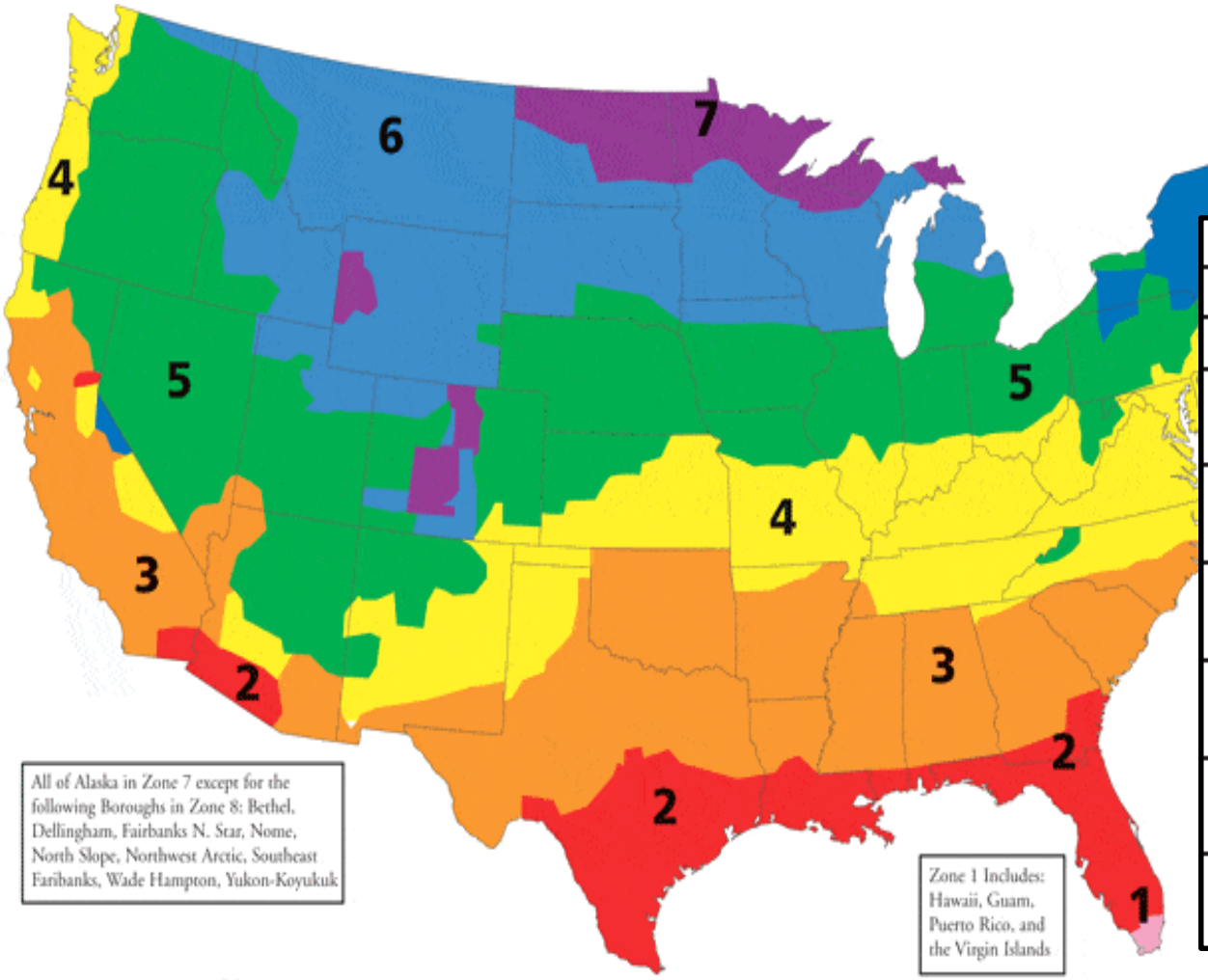
Insulation and Fenestration Requirements by Climate Zone

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

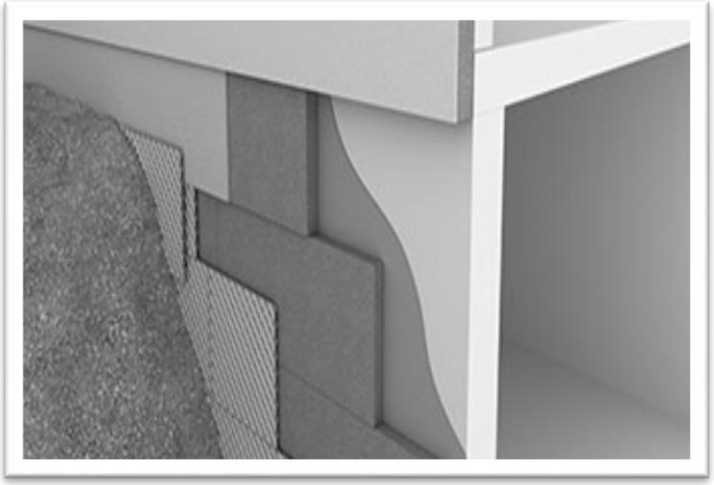


Zone	Wood-Framed[1] Wall
1	R-13
2	R-13
3	R-13+5ci or R-20
4 except Marine	R-13+5ci or R-20
5 and 4 Marine	R-13+5ci or R-20
6	R-13+10ci R-20+5ci
7	R-13+10ci R-20+5ci
8	R-13+10ci R-20+5ci

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 – Questions?