High Performance Attics & Walls with Spray Polyurethane Foam

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RESNET 2016

Spray Foam Basics

FOR INSULATION AND ROOFING APPLICATIONS OF SPF

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Technical Director, Spray Polyurethane Foam Alliance

Rick is currently Technical Director for the Spray Polyurethane Foam Alliance. Prior to joining SPFA, he was the Senior Marketing Manager for Honeywell's Spray Foam Insulation business from 2006 to 2008. From 1997 to 2006, he was the Global Program Director for CertainTeed/Saint-Gobain Insulation's New Materials and Applications Portfolio. From 1989 to 1997 he was a Visiting Assistant Professor of Mechanical Engineering at Bucknell University. He holds a Ph.D. in Engineering Science and Mechanics from The Pennsylvania State University, MSME from Bucknell and a BSME from the University of Maryland. Rick is a Registered Professional Engineer in Pennsylvania and is a certified BPI Building Analyst.

Presentation Overview

1. History
2. Product Categories
3. Basic Chemistry
4. Delivery Methods
5. Performance
6. Questions

History of SPF in Buildings

Late 60's - Medium Density (agricultural and industrial)

Mid 70's - Roofing

- Medium Density (general const.)

- Sealants

Mid 90's - Low Density (residential)

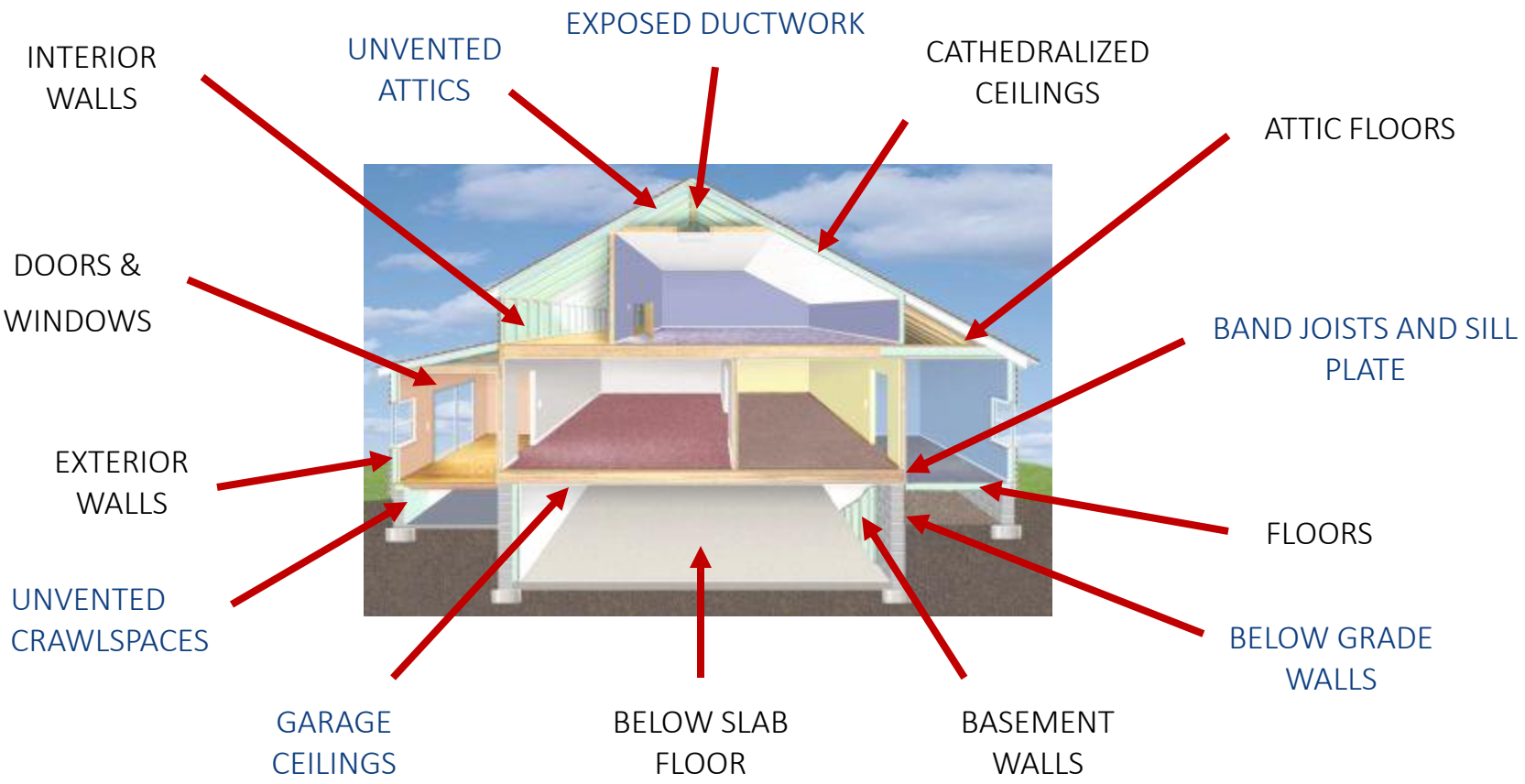
SPF used in construction for more than 50 years

Product Category

	Spray Foam Category			
	Sealant	LD	MD	Roof
Density (lb/ft^3)	0.6 – 1.8	0.5 - 1.4	1.5 -2.3	2.5 - 3.5
Thermal Resistivity (R/in)	NR	3.6 - 4.5	6.2 - 6.8	6.2 - 6.8
Air Impermeable Material	*	> 3.5”	> 1.0”	> 1.0”
Integral Air Barrier System		✓	✓	✓
Integral Vapor Retarder			✓	✓
Water Resistant			✓	✓
Cavity Insulation		✓	✓	
Continuous Insulation		✓	✓	✓
Roofing				✓
Structural Improvement			✓	✓

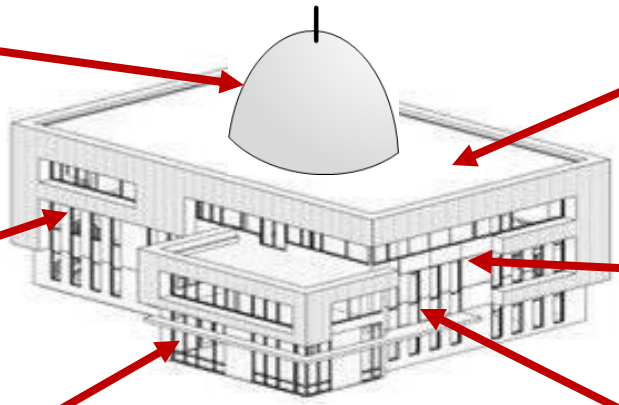
Product selection is application and climate dependent

SPF in Residential Buildings



Sealants, LD and MD SPF insulation can be applied in hard to insulate areas

SPF in Commercial Buildings



DOMED ROOFS

LOW-SLOPE ROOFS

EXTERIOR OF WALLS

METAL BUILDINGS

INTERIOR OF WALLS

FRAME WALLS

Other Applications

TEMPORARY STRUCTURES

TANKS AND VESSELS

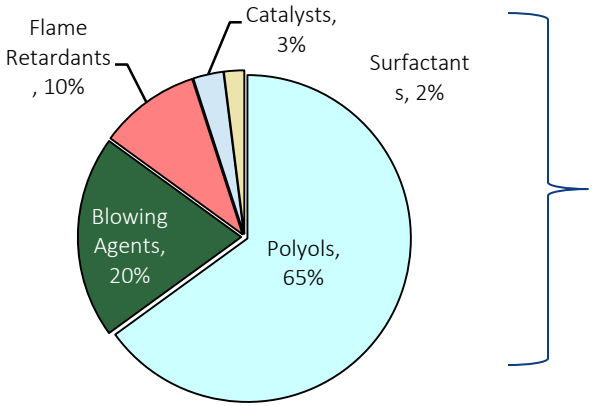
Numerous applications for commercial, industrial and agricultural buildings

Basic Chemistry

- A-Side: Isocyanate

  Polymeric methylene diphenyl diisocyanate (pMDI)

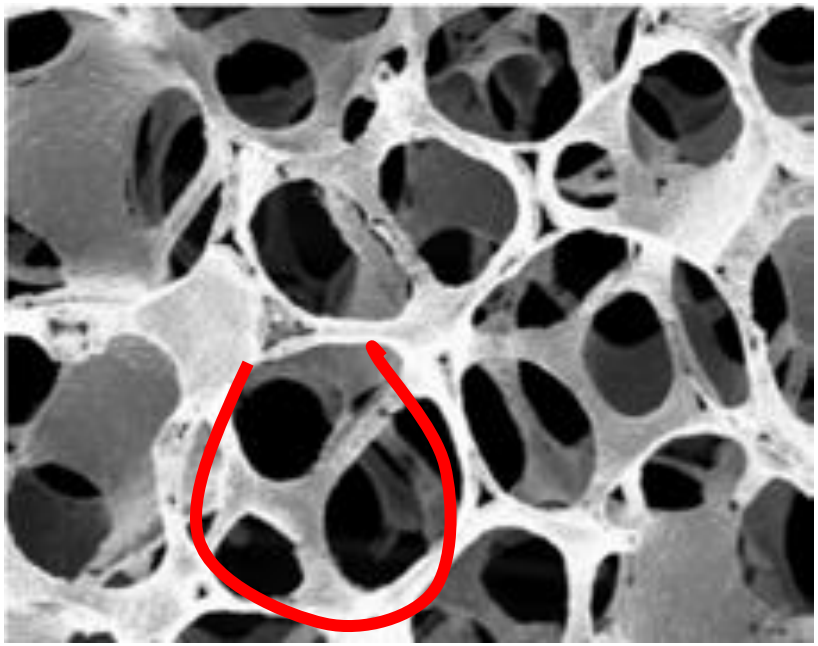
- B-Side or Polyol



Proprietary blend of additives affect cell formation and foam performance

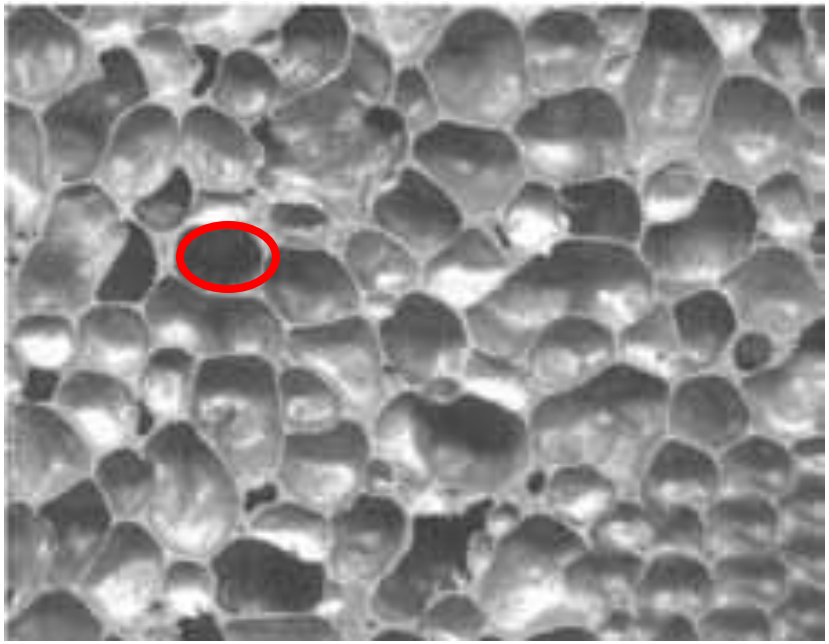
A&B components mixed 1:1 on jobsite to form in-place

Basic Chemistry



OPEN CELL (ocSPF)

- ~100x expansion
- 0.5 to 0.8 lb/ft^3 (soft)
- R-3.6 to R-4.5 per inch (air)
- Moisture permeable



CLOSED CELL (ccSPF)

- ~30x expansion
- 1.7-3.5 lb/ft^3 (rigid)
- R-5.8 to R-6.8 per inch (low-k gas)
- Moisture semi-impermeable

B-side chemistry controls cell structure (foam type)

Delivery Methods:
One-Component Low-Pressure Foam (cans)

- 6-15 BF/min froth
- A and B pre-mixed; cured by contact with ambient moisture
- Low/high expansion
- Air-sealing of small cracks, gaps and holes
- Non-insulating

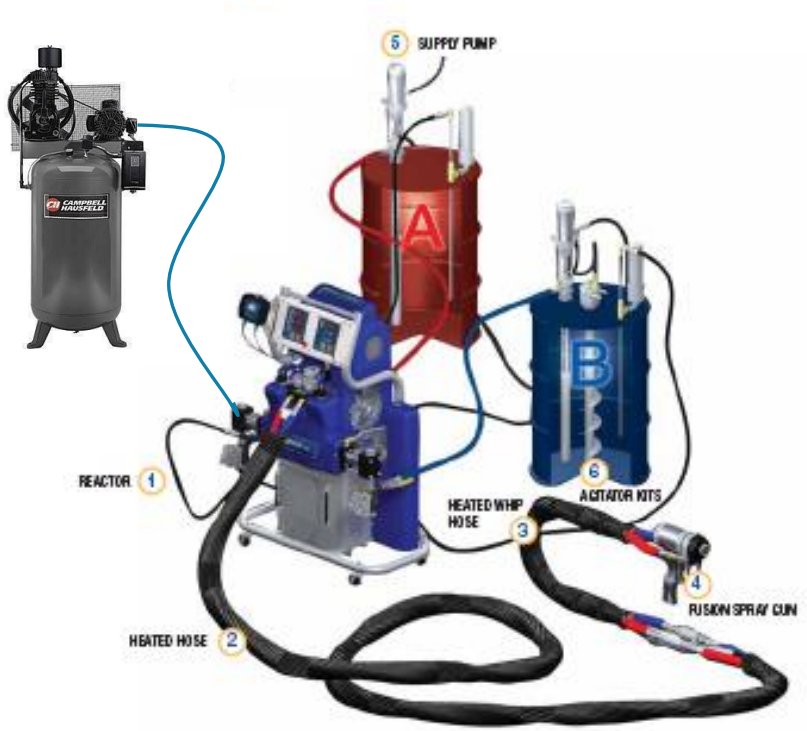
Retail DIY or weatherization professional product for air sealing only

Delivery Methods:
Two-Component Low-Pressure Foam (kits)

- 30-40 BF/minute froth
- A and B in separate pressurized cylinders
- Mechanical mixing
- Insulation and air sealing - small jobs

Professionally installed product used by weatherization contractors or by SPF contractors for small jobs or repair work

Delivery Methods:
Two-Component High-Pressure Foam



- 100-500 BF/minute spray
- A and B in unpressurized drums or totes
- Chemicals heated and pressurized by proportioner
- Larger insulation jobs and all roofing applications
- Special training and capital investment

Professionally installed as insulation and roofing (large jobs)
SPF installed by trained and certified installers

Performance:
Texas Three-Home Study

FEATURE	CP1 - Control	CP2 - High Performance	CP3 - PV
Attic	Vented	Sealed	Sealed
Attic Insulation	R-30 blown fiberglass in ceiling plane, Roof deck radiant barrier, 1979 SF	R-28 open cell spray foam under roof deck, 2216 SF	R-28 open cell spray foam under roof deck, 2216 SF
Wall Insulation	R-13 fiberglass batts	R-15 blown-in fiberglass + R3 insulated sheathing	R-12 open cell spray foam + R4 insulated sheathing
Envelope Leakage	5.84 ACH50	3.64 ACH50	1.95 ACH50
Insulation/AB	All loose-fill or batt fiberglass	LF-FG walls, ocSPF UVA	All ocSPF
Duct Leakage	70 CFM25, Qn=0.035	47 CFM25, Qn=0.024	65 CFM25, Qn=0.033

D. Chasar, J. Sherwin, V. vonSchramm, S. Chandra, "*Measured Performance of Side-by-Side South Texas Homes*," DOE Buildings XI Conference, December 2010

Questions?

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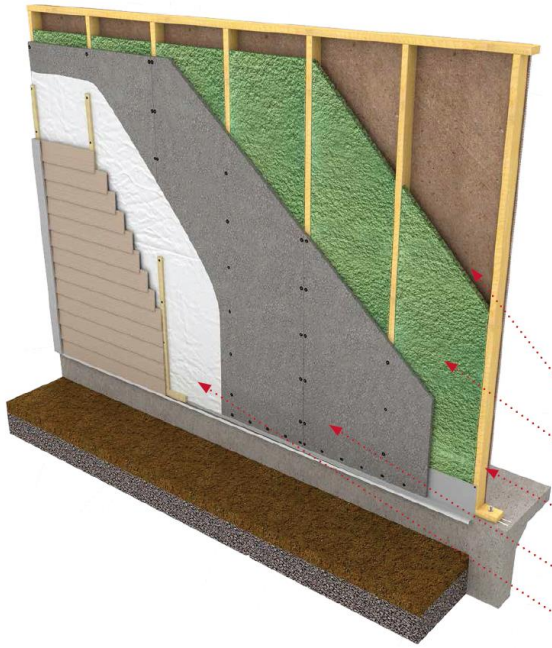
HP+™ Wall System
BEYOND.High Performance®

BASF
We create chemistry

HP+™ Building Enclosure Systems
HP+™ Wall Systems

The HP+ Wall System is part of BASF's BEYOND.High Performance® systems-centric approach to sustainable construction

- Provide durable structural resistance
- Use less wood than traditional construction
- Deliver exceptional energy and cost efficiency



HP+™ Wall Systems – Features and Benefits

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Building a Better Barrier:

- Utilizes continuous insulation to reduce thermal bridging

HP+™ Wall Systems – Features and Benefits

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Building a Better Barrier:

- Advanced framing can reduce lumber content by up to 15%
- Greater durability, 30+% stronger shear without wood sheathing which results in another 15% reduction in lumber

HP+™ Wall Systems – Features and Benefits

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We create chemistry

Take Control:

- Closed cell spray foam provides shear strength for wall
- High performance in a single application
- Reduces condensation potential, improves moisture management

HP+™ Wall System – Walltite HP

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Closed Cell Spray Foam:

- Strength comes from high compressive and tensile values
- Spray foam “glues” building components together
- Engineering requires 1 ½” minimum of spray foam
  - 2” cavity available for additional insulation

HP+™ Wall Systems – Features and Benefits

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Building a Better Barrier:

- Higher thermal performance in a standard dimension wall cavity
- Up to R-34 in 2”x4” construction
- Low HERS rating

Roofing Applications

Design considerations

- Vented or Unvented
- Open Cell or Closed Cell
- All foam or Combination System

Ensure code compliance

Attic Applications

Duct insulation

- Insulates and air seals in single application
- Code compliant 2009-2015 IRC Section M1601.3

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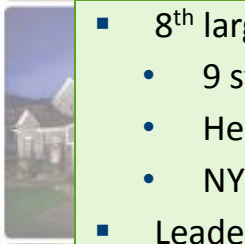
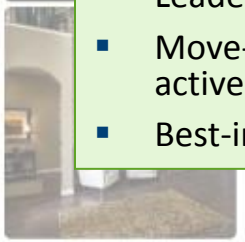
Thank you for your time

For additional information come see us at
Booth #113

Innovation Overview

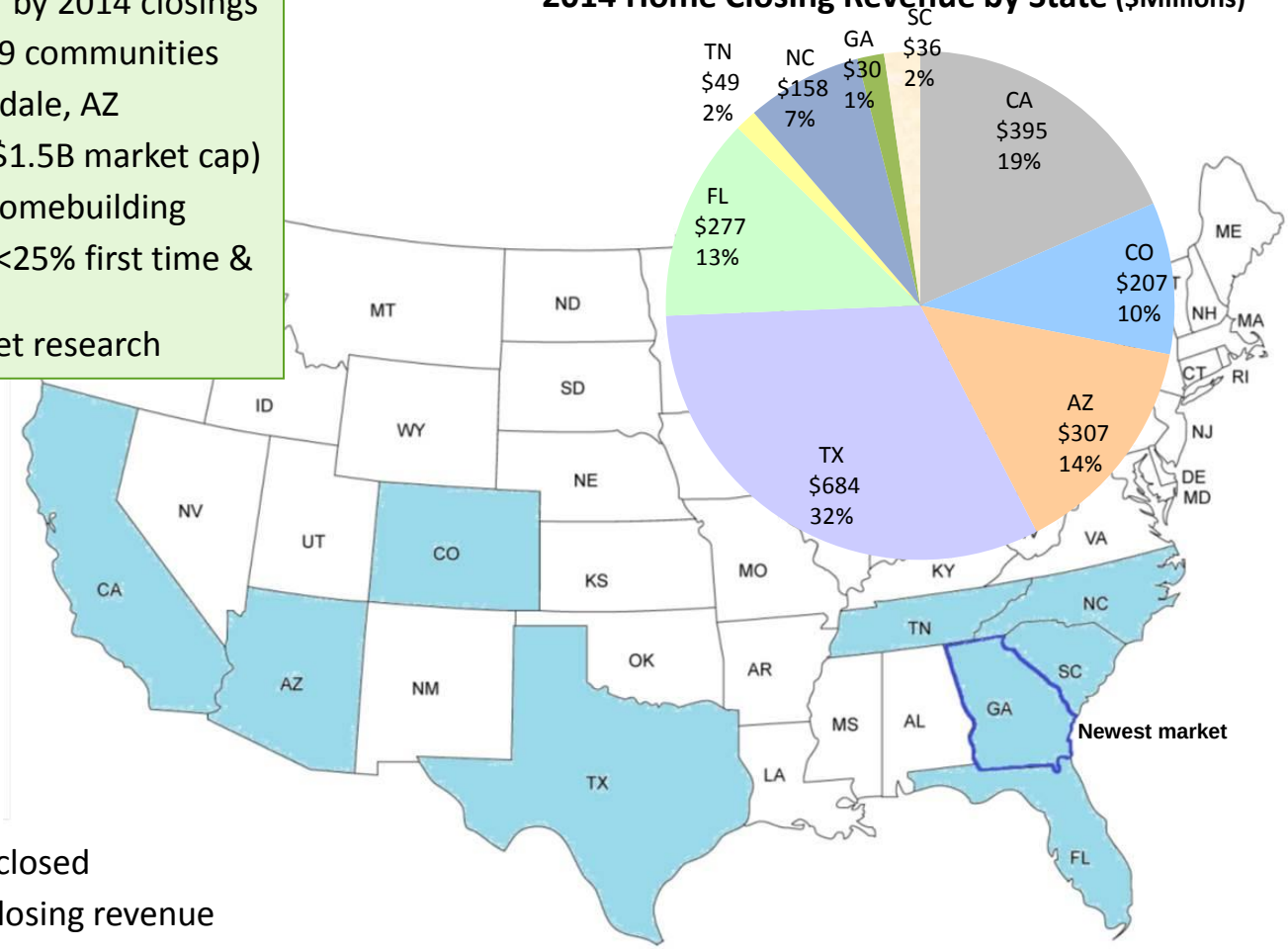
Setting the standard for energy-efficient homes™


Profile of Meritage Homes

- 8th largest U.S. homebuilder by 2014 closings
  - 9 states, 21 markets, 229 communities
  - Headquartered in Scottsdale, AZ
  - NYSE: MTH since 1996 ($1.5B market cap)
- Leader in energy-efficient homebuilding
- Move-up buyers primarily (<25% first time & active adult)
- Best-in-class strategic market research

2014 Home Closing Revenue by State ($Millions)



2014 Stats:

- 5,862 homes closed
- $2.1B home closing revenue
- $365,000 ASP
- $1.9B real estate assets
- 30,295 lots owned or controlled

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The Mother of Invention

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Customer Priorities

- **Location**
- **Floor Plan**
- **Price**
- **?**

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Why do we build Better?

(Hilton's Two 'CR Rules')

VALUE

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Sustainable Sustainability

- Creating Value to Consumers
- Creating Value to Utilities
- Creating value to the US
- Extracting Value
  - Builders
  - Buyers
  - Banks
  - Utilities
  - Economy

How do typical customers buy a home?

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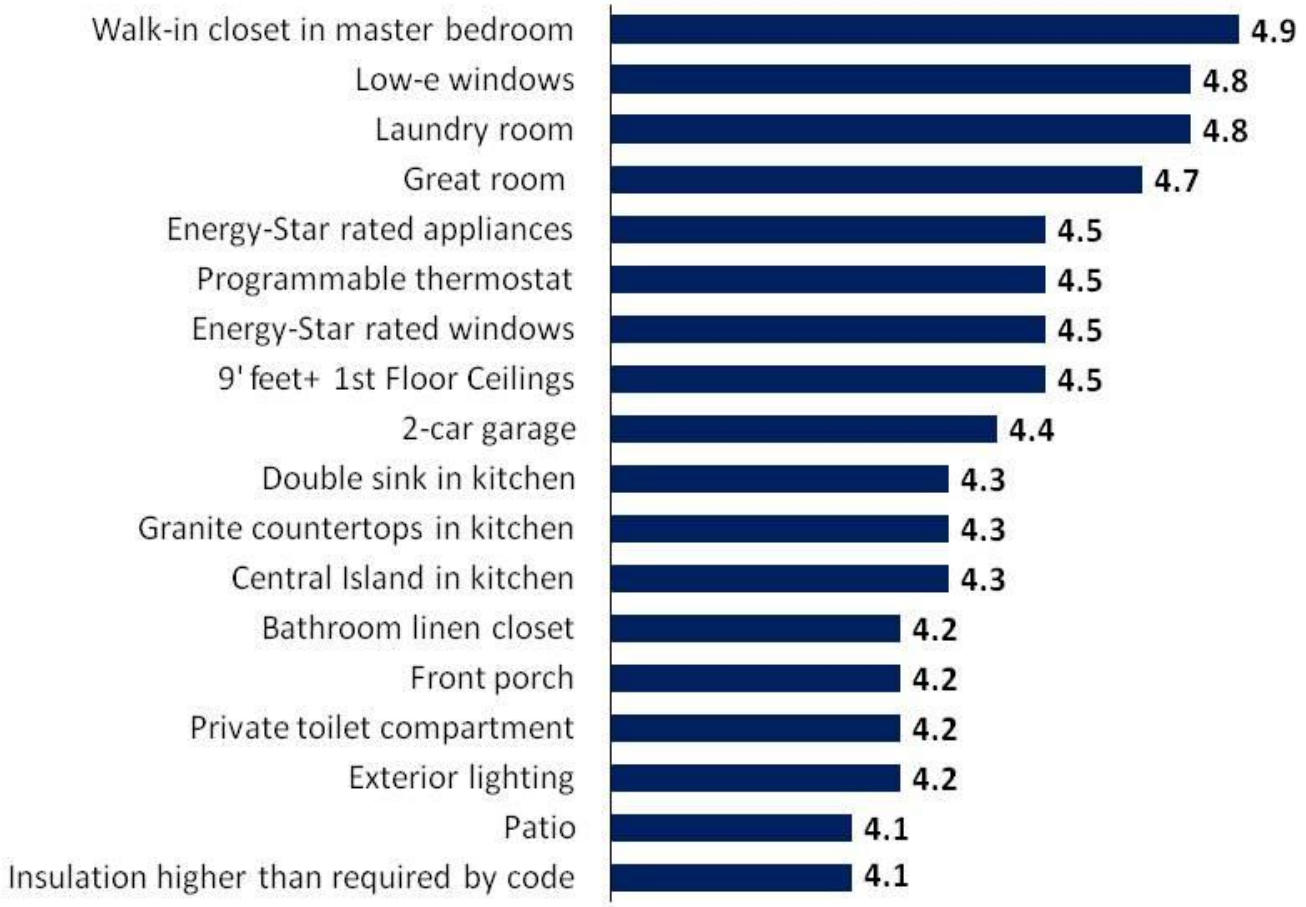
Progressing along the scale

MOST LIKELY Features in Typical Single-family Home in 2014

(1=Not at all likely, 5=very likely; avg. rating)

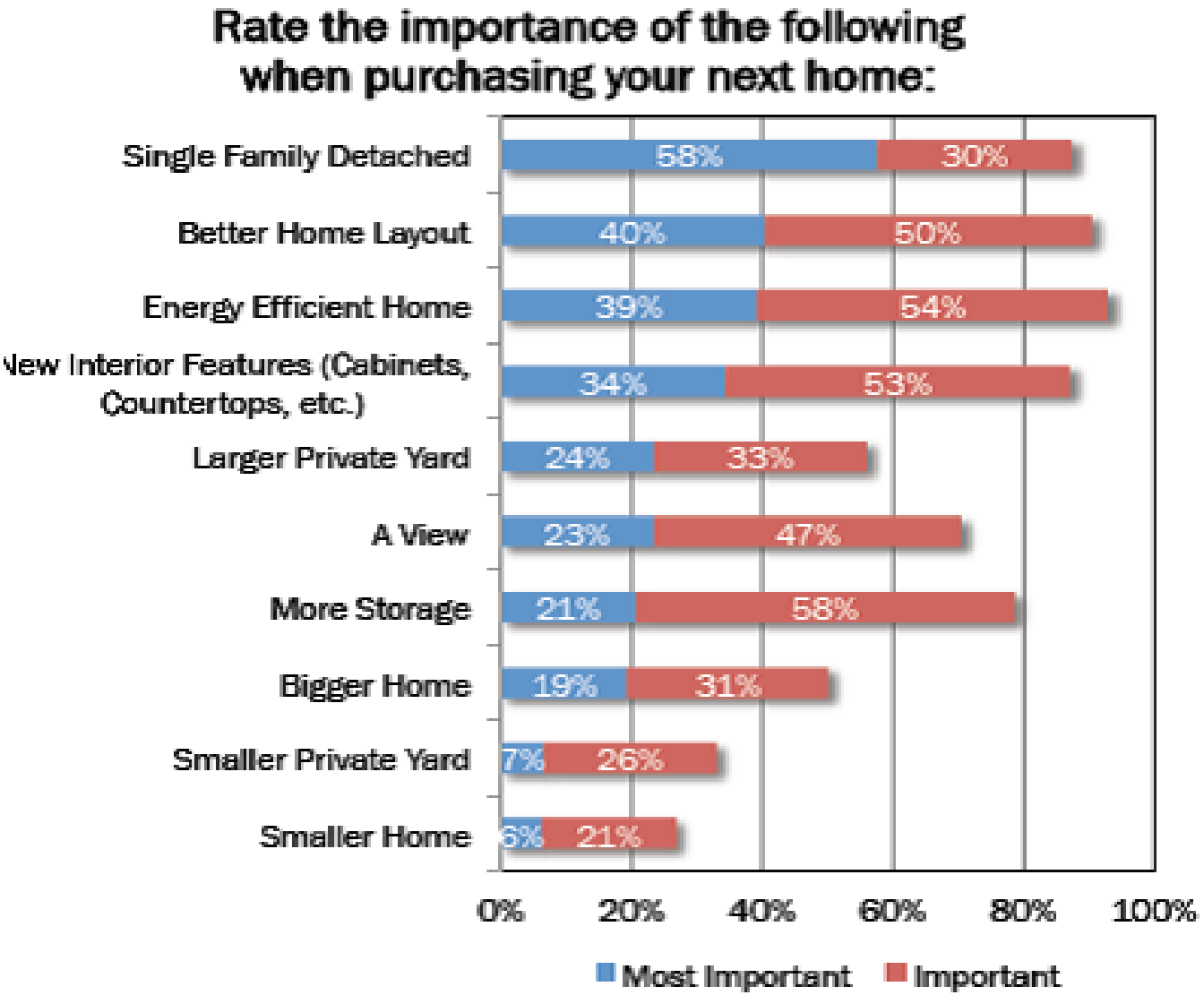


Source: NAHB EcHP Group. HMI Survey, December 2013.

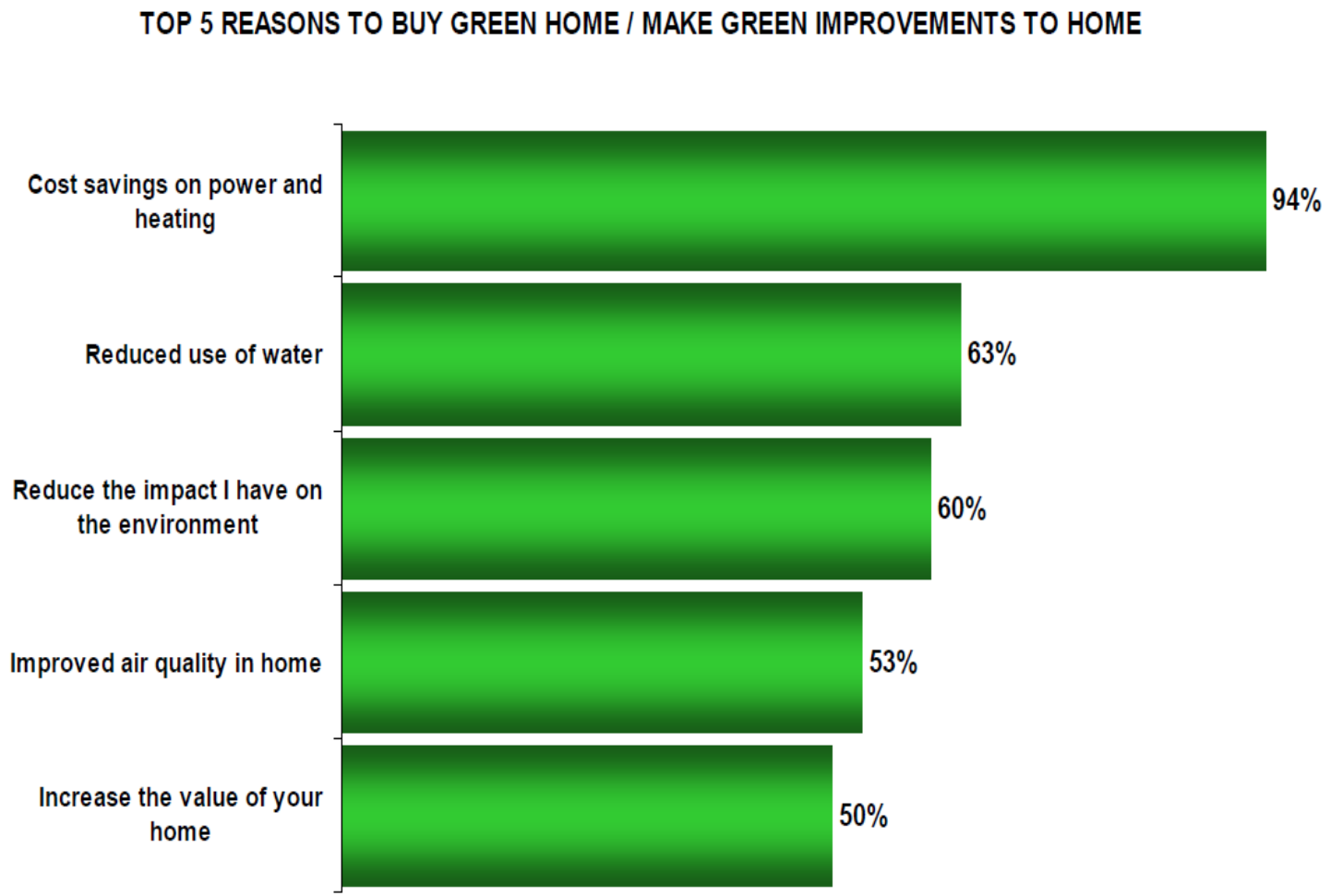





Consumer Choice drives change



Consumer Focus



J.D. POWER AND ASSOCIATES

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81%

say higher energy efficiency would cause them to choose one new home over another.

84%

think energy-efficient homes are healthier homes.

Valuing E(nergy)

MeritageHomes

ENERGY PERFORMANCE RATING

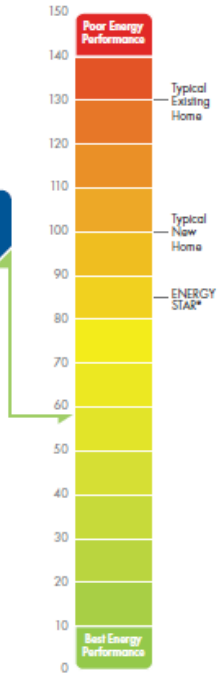
The Salida 4032

HOW THIS SCORE IS DETERMINED.

Home Energy Rating System, or simply HERS, is a scoring system set by the Residential Energy Services Network (RESNET) to measure a home's energy efficiency and determine if it meets ENERGY STAR guidelines. The lower the HERS Index, the more energy efficient a home is.*

This home exceeds ENERGY STAR® Guidelines. **59**

Plan	Salida 4032
Living Area	2,246 sq.ft.
HERS Score (Home Energy Rating)	59
Estimated Reduction In Energy Use	55%
Estimated Average Monthly	$115/mo.



5 Years: >$7,000

10 Years: >$15,000

20 Years: >$37,000

30 Years: >$65,000

the Year

ENERGY SAVING FEATURES

More Solar: We use a better solar platform that produces over four-times more energy, and advanced features that heat your water, heat and cool your air, manage fresh air, and allow remote energy management from anywhere in the world through a computer or smart phone.

More Health: We include EPA Indoor Air plus features such as low VOC paints and finishes, better home air filtration and circulation, a fresh air management system, and advanced thermostats. The result is reduced pollution, allergens, and dirt which make your home more comfortable, cleaner and better for the whole family.

More Comfort: We use industry leading spray foam insulation which seals the building twenty-five times better than standard insulation, reducing leaks, drafts, and wasted energy. It will also make the home quieter, more comfortable, and cleaner.

More Sustainability: We include EPA WaterSense faucets, showers, toilets, irrigation controllers, and ENERGY STAR Appliances, reducing your water consumption by 50%, with no sacrifice in lifestyle or performance.

More Savings: With an unprecedented level of energy efficiency throughout our homes, our total HERS score in this community is as low as **XX**, reducing home energy consumption by up to **XX%** in these homes.

Energy performance for The Salida 4032.

This Meritage home performs at a HERS score of **59**. This equates to a **55%** energy use reduction compared to a typical new home.

Save $115/mo. in home energy bills.*

55% ENERGY SAVINGS*

Scan this code with your smart phone to see how Meritage is changing the way homes are built.

Reference Home. Thus a home with a HERS Index of 65 is 35% more energy efficient than the HERS Reference Home. Specifications based on the 2006 International Energy Conservation Code. For more information visit www.energystar.gov and www.energysavers.gov. ... ns, dimensions, features, specifications, materials and availability of homes or communities are subject to change without notice or obligation.

Additional available income for the family

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Residential Green and Energy Efficient Addendum

AI Reports®
Form 820.03*

Client File #:		Appraisal File #:	

Residential Green and Energy Efficient Addendum

Client:		
Subject Property:		
City:	State:	Zip:

Additional resources to aid in the valuation of green properties and the completion of this form can be found at http://www.appraisalinstitute.org/education/green_energy_addendum.aspx

ENERGY EFFICIENT ITEMS

The following items are considered within the appraised value of the subject property:

Insulation	☐ Fiberglass Blown-In ☐ Foam Insulation ☐ Cellulose ☐ Fiberglass Batt Insulation ☐ Other (Describe): ☐ Basement Insulation (Describe): ☐ Floor Insulation (Describe):						R-Value: ☐ Walls ☐ Ceiling ☐ Floor
Water Efficiency	☐ Reclaimed Water System (Explain): ☐ Rain Barrels - #:			☐ Cistern - Size: Gallons ☐ Rain Barrels Provide Irrigation			Location:
Windows	☐ ENERGY STAR®	☐ Low E	☐ High Impact	☐ Storm	☐ Double Pane ☐ Triple Pane	☐ Tinted	☐ Solar Shades
Day Lighting	☐ Skylights – #:	☐ Solar Tubes - #:	☐ ENERGY STAR Light Fixtures		☐ Other (Explain):		
Appliances	ENERGY STAR Appliances: ☐ Range/Top ☐ Dishwasher ☐ Refrigerator ☐ Other:		Water Heater: ☐ Solar ☐ Tankless (On Demand) Size: Gal.		Appliance Energy Source: ☐ Propane ☐ Electric ☐ Natural Gas ☐ Other (Describe):		
HVAC (Describe in Comments Area)	☐ High Efficiency HVAC – SEER:		☐ Heat Pump		☐ Thermostat/Controllers		☐ Passive Solar
	☐ Programmable Thermostat		☐ Wind		☐ Radiant Floor Heat		☐ Geothermal
Energy Rating	☐ ENERGY STAR Home ☐ HPwES (Home Performance with ENERGY STAR) ☐ Other (Describe):				☐ Indoor Air PLUS Package ☐ Energy Recovery Ventilator Unit ☐ Certification Attached		






Average U.S. Homeowner Costs

2007-2008

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SAVE Act:
Sensible Accounting to Value Energy

- **Senate Bill 1737**
- **Bipartisan Support**
- **Monetizes reduced cost of operation**
  - Buyer Awareness
  - Offset Increased Cost to Builder
  - Opportunity to reduce $1.2B in annual waste
  - 83,000 jobs

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Standard Features Included at Competitive Prices

ENERGY STAR® complete thermal enclosure system

1. Minimum Low-E2 windows
2. Advanced framing, thermal breaks and engineered lumber
3. SPF (Spray Polyurethane Foam) insulation in walls
4. Conditioned attics sealed with SPF

ENERGY STAR complete water management system

5. Damp-proof barrier on below-grade concrete (not slab-on-grade only)
6. Drain slope on exterior of home
7. Sloped grading for superior drainage
8. Moisture-resistant roof underlayment
9. Window flashing
10. Moisture-resistant material behind tubs and showers

ENERGY STAR complete heating and cooling system

11. Minimum SEER 14 HVAC
12. Sealed insulated ducts
13. Jump ducts
14. ANSI/ASHRAE 62.2 mechanical fresh-air management system
15. Minimum MERV 8 HVAC filtration

Additional energy-efficient and standard features

16. Independent inspections and testing
17. ENERGY STAR appliances
18. CFL lighting
19. Advanced programmable thermostat
20. Water-efficient faucets and shower heads
21. Dual-activated toilets
22. Weather-sensing irrigation controller
23. Irrigation weather sensor
24. PEX plumbing
25. Low-to-zero VOC materials, paints, stains and adhesives
26. Humidistats (Coastal divisions only)
27. ACCA manual engineered duct and register systems
28. Optional LED lighting
29. Reinforced concrete slab

Optional Nexia home energy monitoring and control

30. Home bridge
31. Home keypad and deadbolt
32. Indoor/outdoor wireless camera
33. Appliance module
34. Remote monitoring control on laptop, tablet or smart phone
35. Home energy management thermostat

Optional Echo® solar system

36. Solar roof panels for energy production
37. Solar water heater
38. Solar control center
39. Remote monitoring control on laptop, tablet or smart phone

Looking for a good reason to buy a Meritage home? Here are several.

MeritageHomes®

Setting the standard for energy-efficient homes™

Energy-efficient features are standard in every home; entire system designed to maximize energy efficiency

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Challenges

- Cost / Benefit
- Consumer Awareness
- Green Washing
- Transactional
- Change

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Meritage Green v.4 2014 - UPDATE

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Meritage Innovation Standards

Edition 3
Issue Date 8/15/14

- Changes
- Clarifications
- Refinement

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Item	Assumption	Notes
Exterior /Interior Temperature	Per climate zone	
Wall Insulation Type	Open Cell Foam	Model to min R per inch of all manufacturers used
Wall Insulation Method	3.5" min	3.5" nominal fill in 2x4.
Attic Insulation Type	Open Cell Foam	Model to min R per inch of all manufacturers used
Attic Insulation Method	R-19 to R-30	Encapsulated over top chord of truss
Quality of Insulation Install	Grade 1	Expandable foam seals all voids
Air Infiltration Rate	0.15 NACH or less	Per market achieved ACH50 results
Duct Inputs (Duct Gains)	N/A	Conditioned Attic
Attic Volume	Count it	Add to livable volume below
Duct Leakage	6% Max (0% to outside)	Consider Air Handler sealing.
Duct Insulation	R-4.2 max	To prevent condensation
Window Performance		
U-Value	0.35 or lower	Exception: Colorado - 0.30 or lower
SHGC	0.23 or lower	Exception: Colorado - 0.34 or lower
Lighting	100% CFL's	Exposed decorative candle bulbs can be excluded
Return Air Filters	MERV 8	Size return plenum and fan hp accordingly (to account for flow restriction)
Fresh Air Filters	MERV 8	Must be easily accessible for homeowner
Heating	90% AFUE furnace Min	Electric Heat Pump is best practice (Review by community & Climate Zone)
Equipment	14 SEER Min	
Air Cycling	Yes	Variable Speed Furnaces encouraged, but not required.
Over Cycling	Yes	Overcycle 240 seconds after cooling or heating call (Tstat control)
Ventilation	Yes	Per ASHRAE 2010 62.2
Fresh Air Intake Location	Below Roof Line	Pull fresh air from sidewall, eave or other overhang
Fresh Air Intake Size	Sized to home	With damper. Set to > 2x ASHRAE 62.2 continuous, smart control to achieve 62.2 daily volume
Dehumidification	Use Air Cycling dehumidification on fresh air.	T-Stat with humidity control, for Hot/Humid climate zones [13]
Lifestyle Assumptions	Standard Assumptions	Per ACCA Manual J
Exposure	Worst Case	Per ACCA Manual J
Jump Ducts or Transfer Grilles	Yes. All rooms with doors	Ensure Proper Size for <3pa pressure differential
Dedicated return in master	Yes	
Interior Finish	1/2" Drywall	
Exterior Finish	Division Specific	Account for Foam sheathing, if applicable.
Fireplaces	No open fireboxes	All combustion air must be externally supplied. **Exception: Isokern with dampered combustion air and motorized e-damper flue.

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How do customers make Better choices?

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GET MORE

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BE HEALTHY

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LIVE BETTER

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Lessons Learned

- **Builder Sophistication**
  - Cost / Benefit
  - Assured directs / Unsure returns
  - Business Strategies / Rebates
  - Warranty
- **Buyer Sophistication**
  - Temporal Discount
  - Total Cost of Ownership
  - “Nothing is wrong”
- **Industry Sophistication**
  - Appraisal
  - Underwriting

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Proactive Education

- “Too Tight”
- “Toxic”
- Fire Hazard
- Traps moisture
- “Unproven” / New

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Advanced Ventilation (Hot/Humid)

- Reduced Sensible (windows, lights, insulation, attic)
- Worse w/ HRV / ERVs
- ASHRE 62.2 Latent
- Short cycle AC calls / low dehumidification
- High operating cost of dehumidifiers

- Energy efficient HVAC / Long duty calls =

  multispeed and advanced controls

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People choose Better

- **Cost**
- **Comfort**
- **Clean**
- **Builder Partner**

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Questions?

Thank you!

Meritage Homes

www.MeritageHomes.com

Stephen Davis

Director of Building Science

Quadrant Urethane Technologies

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Quadrant
Urethane Technologies

Quadrant Chemical Corp.

- 40 year old company founded by 3 Veterans
- Based in Texas
- Supply items for the construction, automotive, aerospace, cosmetics, and electronics industries
- ISO 9001-2008 Manufacturing Facility

Quadrant
Urethane Technologies

Technologies

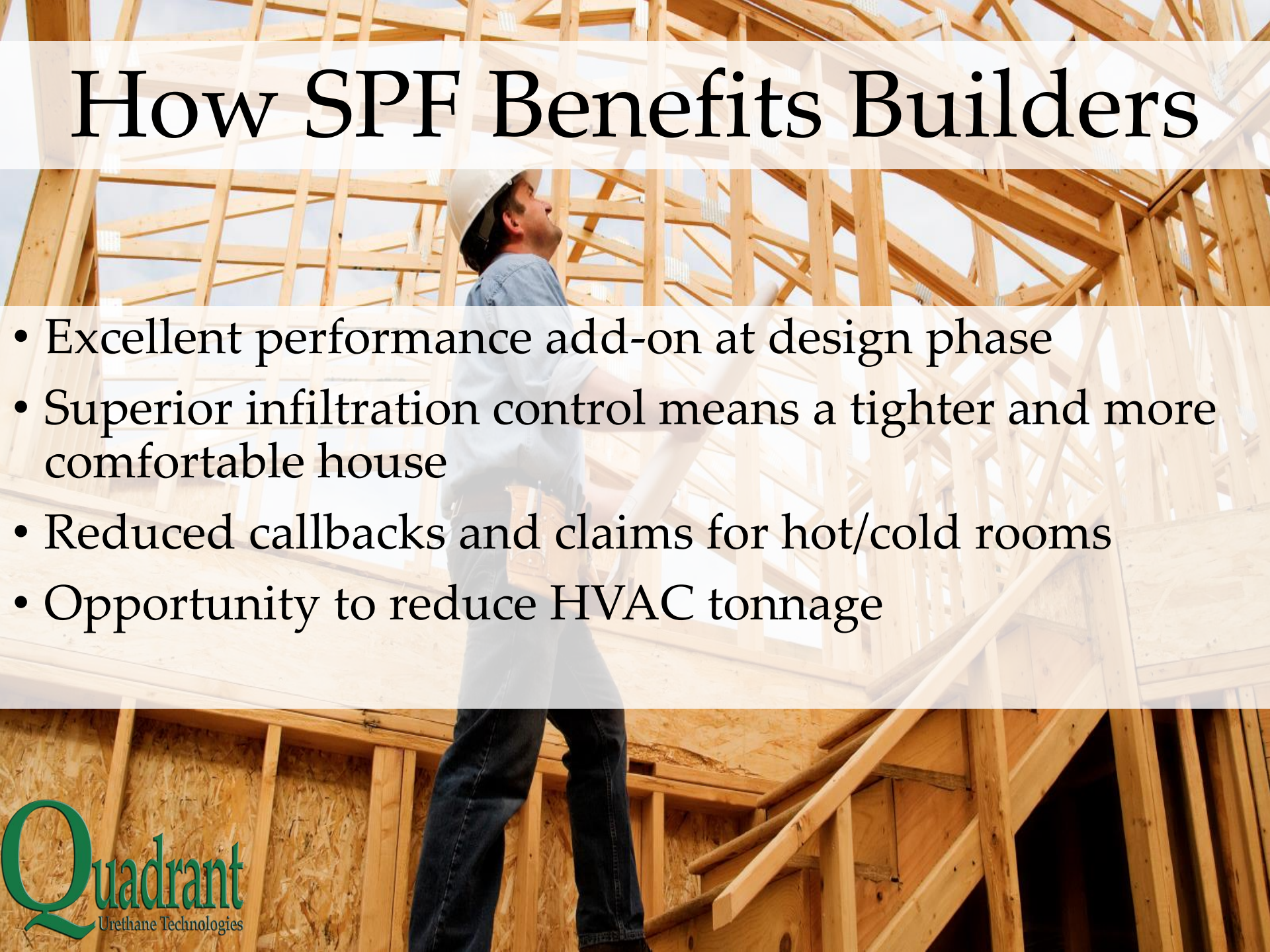
- Manufacturers of QuadFoam spray polyurethane products
- Full suite of open and closed cell spray foam
- Manufacturer ZERO flame spread open cell spray foam
- Launching a next generation closed cell spray foam with 4th generation blowing agent

Quadrant
Urethane Technologies

How SPF Benefits Raters

- Excellent at providing Performance Path evaluations for your clients
- Quicker inspections
- Superior infiltration control means a tighter house
- Opportunity to work with HVAC Contractor to reduce tonnage

How SPF Benefits Builders



- Excellent performance add-on at design phase
- Superior infiltration control means a tighter and more comfortable house
- Reduced callbacks and claims for hot/cold rooms
- Opportunity to reduce HVAC tonnage

Quadrant
Urethane Technologies

How SPF Benefits Utilities

- Superior R-Value and infiltration control means a tighter and more efficient house
- A tighter efficient house equates to lower utility bills
- Installed for the life of the building meaning no drooping, sagging, or settling
- Reduces demand for the life of the building

Quadrant
Urethane Technologies

Additional Resources

- SPFA Technical Documents: www.sprayfoam.org
- Spray Foam Coalition: www.whysprayfoam.org
- Meritage Homes: www.MeritageHomes.com
- BASF: www.polyurethanes.basf.us
- Quadrant Urethane Technologies: www.QuadFoam.com

ON BEHALF OF JUSTIN, RICK, BRIAN, C.R. AND MYSELF . . .

THANK YOU!