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Building for Energy Efficiency 4:

Alternative design approaches for energy efficient homes

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Session Objectives

- Learn about different metrics and programs available to better quantify the savings message
- Discuss different specification packages that achieve different levels of energy efficiency
- Next steps

Program Introductions

- There are several different energy savings programs and incentives out there but this session will focus on three:
  - Building America Program
  - HERS Index
  - Federal Tax Credit for Home Builders

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Building America

- Building America is sponsored by the U.S. Department of Energy and conducts research to find energy efficient solutions for new and existing housing
- Throughout the design and construction process, research participants in Building America projects evaluate the interaction between the building site, envelope, mechanical systems, and energy-use factors
- The research conducted by Building America teams increases the quality and performance of today's homes and provides valuable information for homes of the future

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Building America

- The long-term goal of the Building America program is to develop cost-effective systems for homes that can produce as much energy as they use – a zero energy home
- Whole house energy savings goals were established and mapped out – 30%, 40%, 50%...
- The reference used to determine the whole house energy savings of a project is the Building America Benchmark

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Building America Benchmark

- Building America Benchmark defined:
  - Benchmark is generally consistent with mid-1990s standard practice
  - In addition to the tradition programs that focus on space conditioning and hot water, the Benchmark has additional definitions that allow the evaluation of all residential end-uses
  - All building envelope component references to U-values for the Benchmark have been updated to 2003 International Energy Conservation Code (2003 IECC)
  - Benchmark represents typical construction at a fixed point in time so it can be used as the basis for Building America's multi-year energy savings goals

HERS Index

- The HERS Index is a scoring system established by the Residential Energy Services Network (RESNET)
- The HERS Reference Home is based on the 2006 International Energy Conservation Code
- The lower a home's HERS Index, the more energy efficient it is in comparison to the HERS Reference Home
- A house built with the same specifications as the Reference House would have a HERS Index of 100, while a net zero energy home has a HERS Index of 0
- Each 1-point decrease in the HERS Index corresponds to a 1% reduction in energy consumption

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Federal Tax Credit

- Tax Credit for Home Builders:
  - Home builders are eligible for a $2,000 tax credit for a new energy efficient home
  - The house must achieve 50 percent energy savings for heating and cooling over the 2004 International Energy Conservation Code (IECC) and supplements. At least 1/5 (10%) of the energy savings must come from building envelope improvements
  - This credit also applies to contractors of manufactured homes conforming to Federal Manufactured Home Construction and Safety Standards

Federal Tax Credit

- Additional Tax Credit for Manufactured Home Builders:
  - Producers of a new manufactured are eligible for a $1,000 tax credit
  - The house must achieve 30 percent energy savings for heating and cooling over the 2004 International Energy Conservation Code (IECC) and supplements. At least 1/3 (10%) of the energy savings must come from building envelope improvements
  - Manufactured homes meeting the requirements established by EPA under the ENERGY STAR program also qualify

30% Specification Package

Greensburg - Preliminary Specification Analysis	
Two-Story w/ Unfinished Basement	
2182 ft² conditioned floor area, 287 ft² window area	
System Specifications	
Component	**30% Specification Package**
Foundation System	R-10 Basement walls, conditioned basement
Above Grade Exterior Walls	2x6 framed walls with R-19 batt insulation
Overhanging Floors	R-30
Roof	R-40 vented attic
Exterior Doors	R-5
Windows	Low-E/Low SHGC (U=0.30;SHGC=0.37)
Building Air Tightness	ACH50 = 4
Mechanical Ventilation	Supply air to return duct with runtime and damper control, adjustable to meet ASHRAE 62.2 ventilation requirements
Heating	90% AFUE Natural Gas Furnace
Cooling	SEER 14 A/C Unit
Ductwork	Supply ducts located within conditioned space, return ducts and air handler located in conditioned basement, 5% leakage to exterior, R-8 duct insulation
Water Heater	Nat. gas, EF=0.61
Appliances	Electric range & dryer
Fluorescent Lighting	50% Fluorescent lighting
% Better than Building America Benchmark	**34.0%**
HERS Index 2006	**65**
Tax Credit Compliant	**Compliant (53% htg/clg - 40% envl)**

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30% Cost Savings

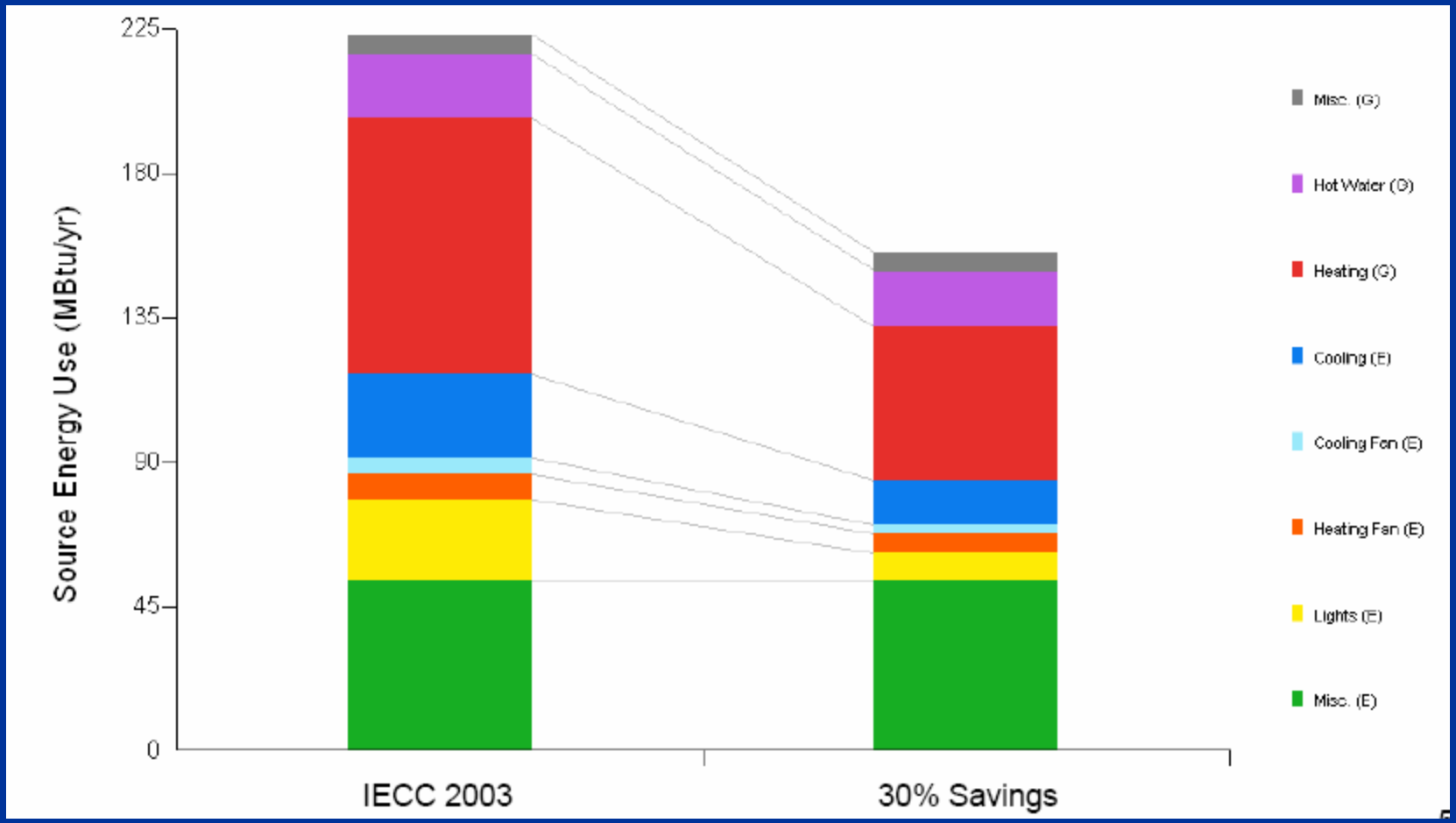
Estimated Annual Cost Savings: 30% Savings Target

	Greensburg
Estimated Incremental First Cost Relative to Standard Practice[1]	$4,000
Annual Amortized Cost 7%, 30Year mortgage[2]	$211
Estimated Annual Utility Bill Savings	$723
Net Annual Savings	**$512**

(2000 ft2, 2-story, 16% window to floor area ratio, unconditioned basement)

[1] Evaluated relative to minimum IECC 2003.
[2] Assumes 28% marginal tax bracket and includes present value of future replacements of equipment over 30 year life of mortgage.

Estimated Annual Energy Savings by End Use – 30% Target



40% Specification Packages

Greensburg - Preliminary Specification Analysis	
Two-Story w/ Unfinished Basement	
2182 ft² conditioned floor area, 287 ft² window area	
System Specifications	
Component	**40% Specification Package**
Foundation System	R-10 Basement walls, conditioned basement
Above Grade Exterior Walls	2x6 framed walls with R-21 batt insulation
Overhanging Floors	R-30
Roof	R-50 vented attic
Exterior Doors	R-5
Windows	Low-E/Low SHGC (U=0.28;SHGC=0.37)
Building Air Tightness	ACH50 = 3
Mechanical Ventilation	Supply air to return duct with runtime and damper control, adjustable to meet ASHRAE 62.2 ventilation requirements
Heating	90% AFUE Natural Gas Furnace
Cooling	SEER 18 A/C Unit
Ductwork	Supply ducts located within conditioned space, return ducts and air handler located in conditioned basement, 2.5% leakage to exterior, R-8 duct insulation
Water Heater	Nat. gas, EF=0.61
Appliances	Electric range & dryer
Fluorescent Lighting	80% Fluorescent lighting
% Better than Building America Benchmark	40.2%
HERS Index 2006	61
Tax Credit Compliant	Compliant (60% htg/clg - 45% envl)

40% Cost Savings

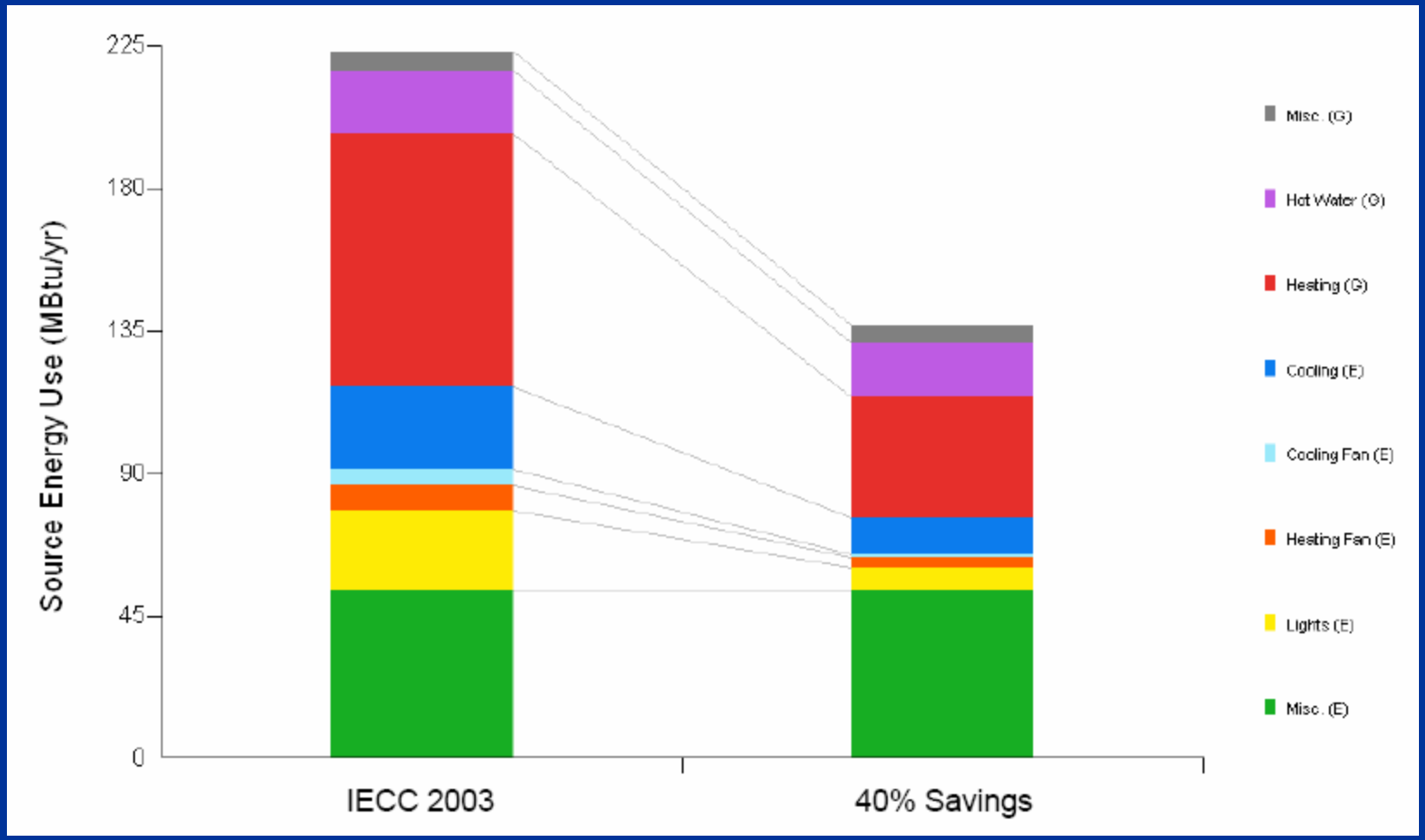
Estimated Annual Costs: 40% Efficiency Target

	Greensburg
Estimated Incremental First Cost Relative to Standard Practice[1,2]	$7,000
Annual Amortized Cost 7%, 30 Year mortgage[3]	$411
Annual Utility Bill Savings	$919
Net Annual Savings	**$508**

(2000 ft2, 2-story, 16% window to floor area ratio), unconditioned basement

1 Evaluated relative to minimum IECC 2003.
2 Qualifies for federal new home tax credit.
3 Assumes 28% marginal tax bracket and includes present value of future replacements of equipment over 30 year life of mortgage.

Estimated Annual Energy Savings by End Use – 40% Target



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50% Specification Packages

Greensburg - Preliminary Specification Analysis	
Two-Story w/ Unfinished Basement	
2182 ft² conditioned floor area, 287 ft² window area	
System Specifications	
Component	**50% Specification Package**
Foundation System	R-10 Basement walls, conditioned basement
Above Grade Exterior Walls	2x6 framed walls with R-22 batt insulation and foam sheathing
Overhanging Floors	R-30
Roof	R-50 vented attic
Exterior Doors	R-5
Windows	Low-E/Low SHGC (U=0.28;SHGC=0.37)
Building Air Tightness	ACH50 = 2
Mechanical Ventilation	Supply air to return duct with runtime and damper control, adjustable to meet ASHRAE 62.2 ventilation requirements
Heating	94% AFUE Natural Gas Furnace
Cooling	SEER 18 A/C Unit
Ductwork	Supply and return ducts and air handler located within conditioned space, 0% leakage to exterior
Water Heater	Nat. gas, Tankless EF=0.82
Appliances	Electric range & dryer, Energy Star appliances
Fluorescent Lighting	80% Fluorescent lighting
% Better than Building America Benchmark	49.3%
HERS Index 2006	51
Tax Credit Compliant	Compliant (68% htg/clg - 50% envl)

50% Cost Savings

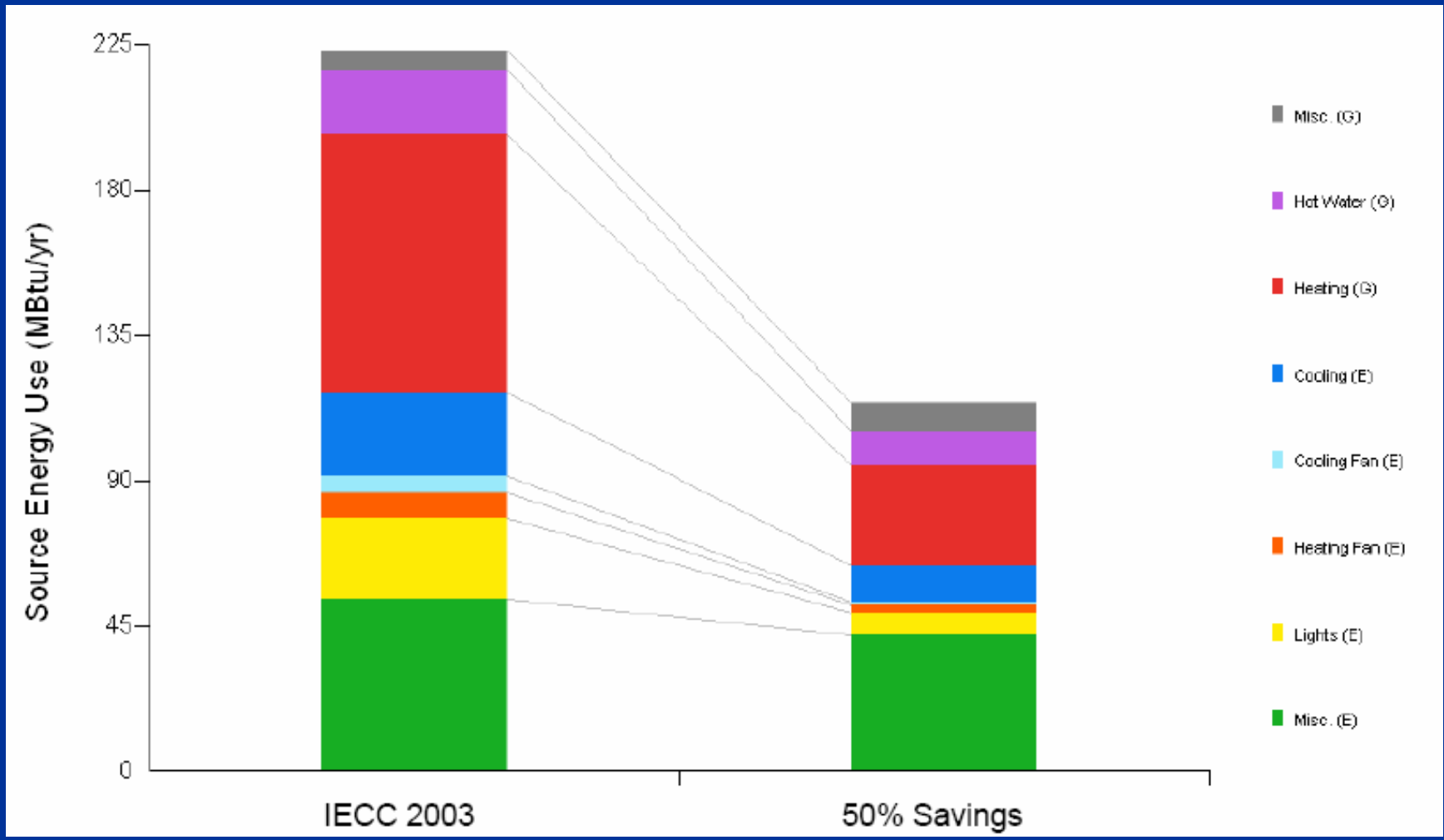
Estimated Annual Costs: 50% Efficiency Target

	Greensburg
Estimated Incremental First Cost Relative to Standard Practice[1,2]	$13,000
Annual Amortized Cost 7%, 30Year mortgage[3]	$706
Annual Utility Bill Savings	$1162
Net Annual Savings	**$456**

(2000 ft2, 2-story, 16% window to floor area ratio), unconditioned basement

1 Evaluated relative to minimum IECC 2003.
2 Qualifies for federal new home tax credit.
3 Assumes 28% marginal tax bracket and includes present value of future replacements of equipment over 30 year life of mortgage.

Estimated Annual Energy Savings by End Use – 50% Target



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Plan 1 Specification Packages

Greensburg - Plan 1 - Preliminary Specification Analysis	
Two-Story w/ Unfinished Basement	
System Specifications	
Component	**Optional Spec Package - Plan 1**
Foundation System	R-5 1" XPS foam insulation on interior of basement walls
Above Grade Exterior Walls	2x6 wood framed 24" o/c (advanced framing) with R-19 damp-spray cellulose cavity insulation and R-5 XPS insulating foam sheathing
Overhanging Floors	N/A
Roof	R-38 cellulose insulation on flat ceilings; R-30 cellulose insulation & R-5 XPS foam sheathing on cathedral ceilings
Exterior Doors	R-7
Windows	High performance, Low-E, double paned, vinyl windows (U=0.32;SHGC=0.32)
Building Air Tightness	ACH50 = 3.4
Mechanical Ventilation	Supply-only system with fan cycling controller and motorized damper, integrated with air handling unit, supply rate @ 55 CFM for 33% run-time
Heating	Natural Gas Furnace, 92.1% AFUE
Cooling	None
Ductwork	Supply and return ducts and air handler located within conditioned space, 0% leakage to exterior
Water Heater	Natural Gas, EF = 0.62
Appliances	Electric dryer & range, Energy Star Appliances
Fluorescent Lighting	100% Fluorescent Lighting
% Better than Building America Benchmark	**33.4%**
HERS Index 2006	**73**
Tax Credit Compliant	**Non-compliant (46% htg/clg - 37% envl)**

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Upcoming this fall . . .

Rebuilding Greensburg:
A Seminar Series on Affordable, Energy Efficient Construction Techniques

The U S Department of Energy's Building America program will be offering a special, five-part training series for builders and homeowners involved in rebuilding Greensburg as a healthy, energy efficient and affordable town.

Each seminar will include a 1/2-day tour of current re-construction projects in Greensburg where participants will learn about and examine best practice construction methods. The field visit will be followed by a 1/2-day in-class training session lead by residential construction experts from Building America project teams.

Part 1: House Design and Foundation Systems
Date: September 8, 2007
Location: TBD
Topics will include:
- An overview of energy efficient and affordable house design
- Foundations and rainwater management

Part 2: Framing
Date: to be announced
Topics will include:
- Advanced framing techniques
- Choosing the right windows and doors

Part 3: Mechanical Systems and Airtightness
Topics will include:
Date: to be announced
- Build tight, Ventilate right
- Mechanical system design and selection

Part 4: Enclosure
Topics will include:
Date: to be announced
- Insulation - theory and installation practices
- Exterior cladding systems

Part 5: Finishes, Testing and Commissioning
Topics will include:
Date: to be announced
- Measuring building performance
- Whole house commissioning and homeowner training

For more information about the seminar series and early registration, please contact betsy@buildingscience.com

The U.S. Department of Energy's Building America Program is reengineering the American home for energy efficiency and affordability. Building America works with the residential building industry to develop and implement innovative building processes and technologies – innovations that save builders and homeowners millions of dollars in construction and energy costs. This industry-led, cost-shared partnership program uses a systems engineering approach to reduce energy use, utility bills, construction time, and construction waste.

For more information, visit our website at: www.buildingamerica.gov