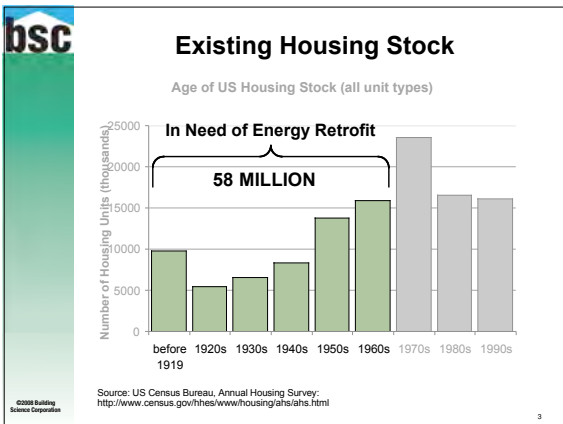
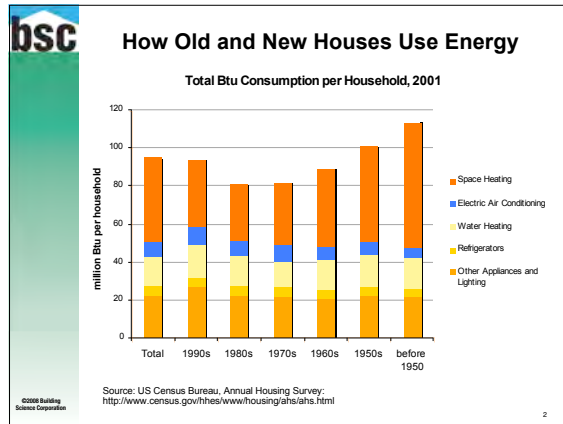


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2: RENOVATION - CONCORD, MA

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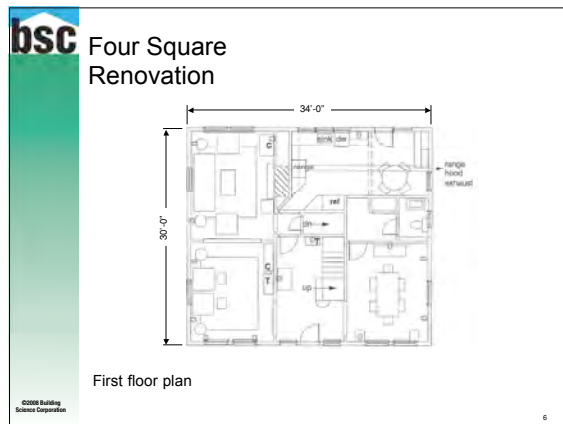
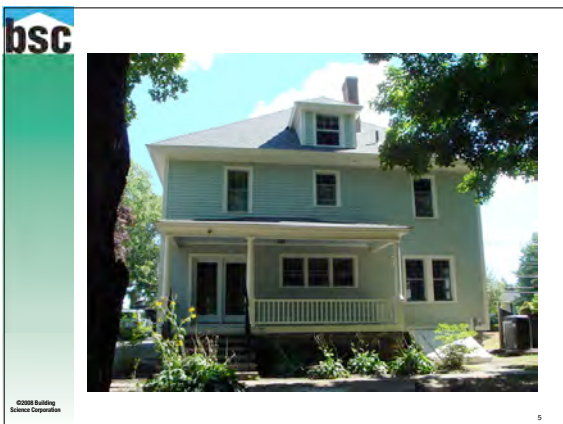


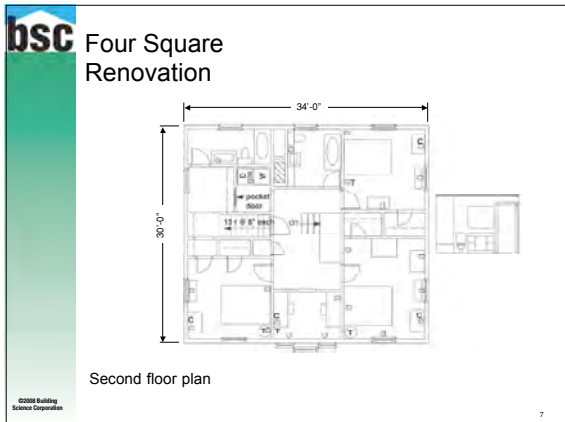
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3200 kWh and 566 Therms HERS 45

Electric @ \$.15 /kWh Gas @ \$1.50/therm
Electric \$471 Gas \$858
Electric/mth - \$39 Gas/mth = \$71

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bsc How a 100 year old house is renewed to last an additional 100 years cost \$100/sq. ft.

Building Enclosure	BEFORE	CONDITIONED SQ. FT. = 2,000
Air Leakage	10 sq. in. of leakage area per 100 sq. ft. of surface area	
Wall Insulation	Little to none	
Attic Insulation	R-19	
Windows	Single pane glass with storm window	

Building Enclosure	AFTER	CONDITIONED SQ. FT. = 3,600
Conditioned Attic	R-39 High Density Spray Foam on sheathing R-21 roof deck insulation – Total Roof R-60	
Walls	R-13 cellulose blown into existing 2x4 walls	
Wall Sheathing	4" Polyiso R-28 sheathing – Total Wall R-41	
Basement Floor	Under-slab 2" XPS, R-10	
Basement Walls	4" R-28 HD SPF on perimeter walls	
Windows	Andersen Woodwright Replacement Windows Weighted Average U=0.33, SHGC=0.33	
Infiltration	2.0 sq in leakage area per 100 sf of envelope	

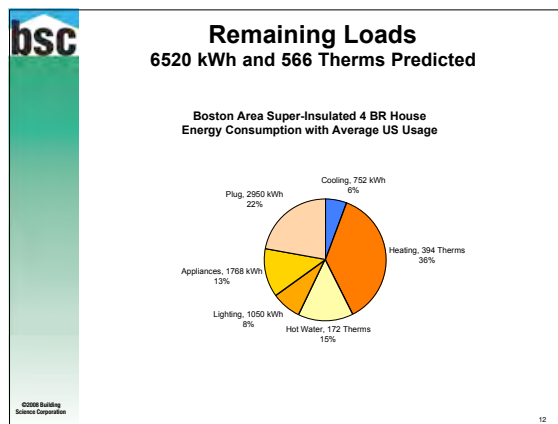
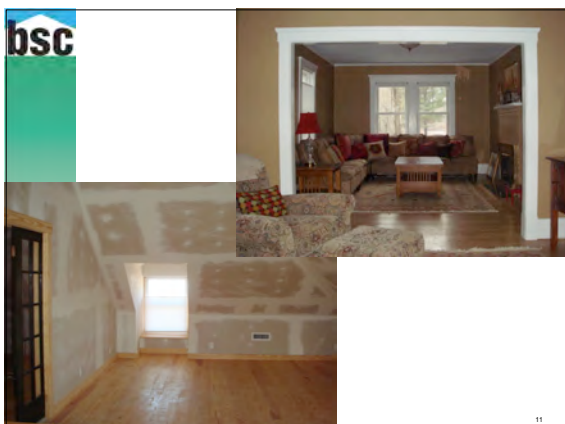
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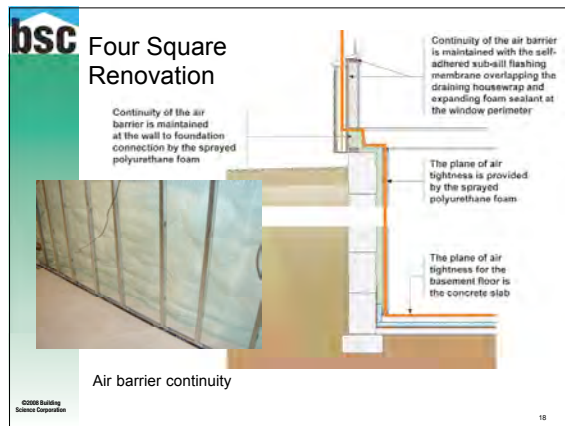
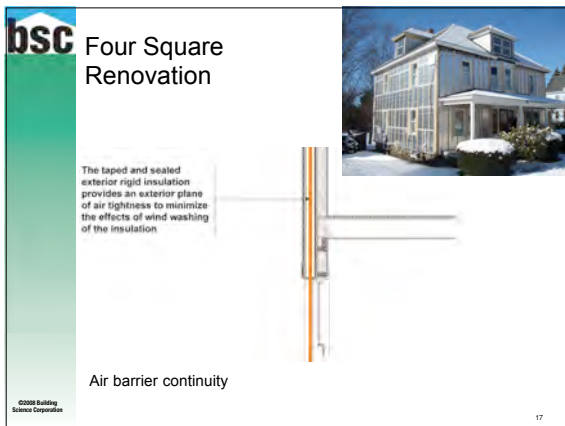
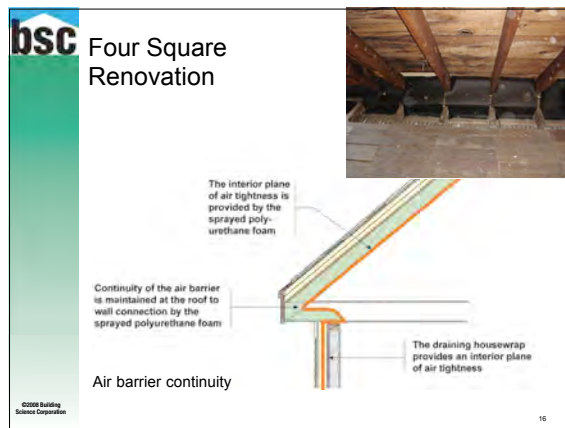
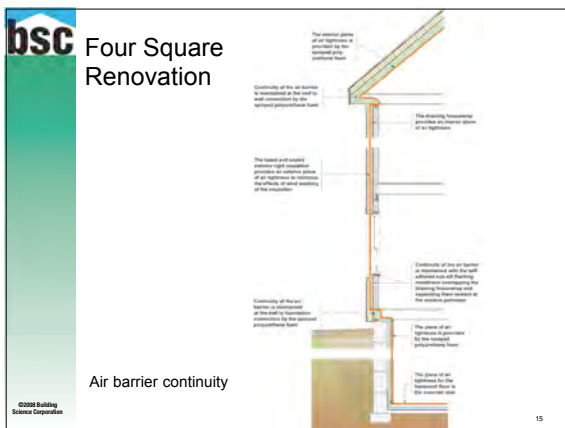
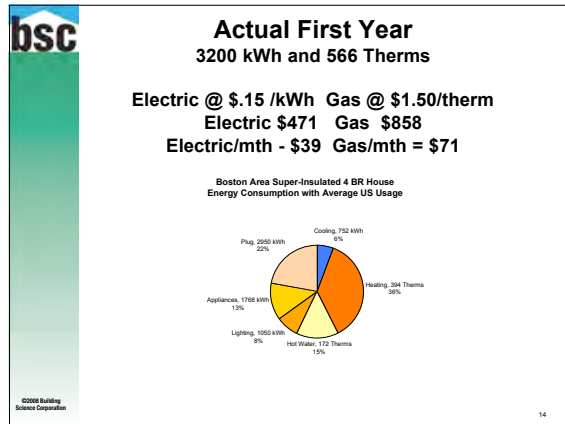
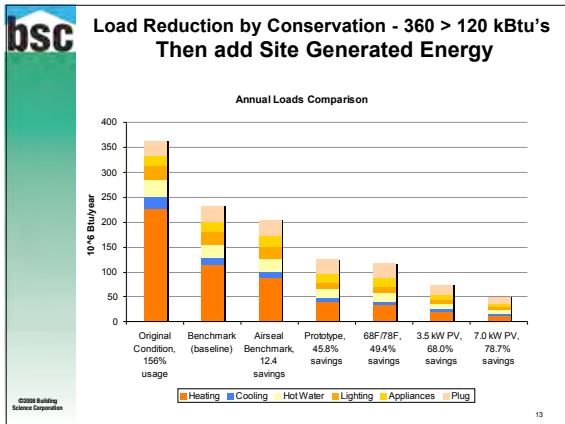
bsc How a 100 year old house is renewed to last an additional 100 years

Mechanical Systems	BEFORE
Heating	60% AFUE for the old boiler -gas -delivered by radiators
Cooling	9 EER for the window units
DHW	0.4 EF for hot water efficiency- AVERAGE summer efficiency is much worse winter efficiency would be about at 60% (since the boiler is heating the house already)

Mechanical Systems	AFTER
Heat	Sealed combustion 92% AFUE gas boiler boiler in conditioned basement
Cooling	13 SEER split system in conditioned space
DHW	0.80 EF side-arm storage tank
Ducts	R-4.2 flex runouts in dropped ceiling or in floor joists
Leakage	none to outside (5% or less)
Ventilation	Fan Cyclor Supply-only system integrated with AHU 33% Duty Cycle, 10 minutes on, 20 minutes off 60-80 CFM continuous average flow
Return Pathways	Transfer grilles/jump ducts at bedrooms

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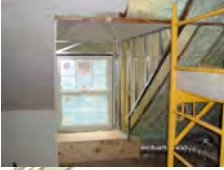
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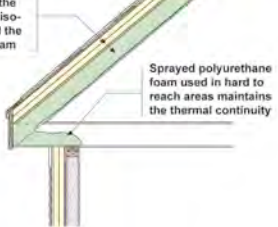
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Thermal resistance of the roof assembly is made up of the two layers of 2-inch polyisocyanurate insulation and the sprayed polyurethane foam



Sprayed polyurethane foam used in hard to reach areas maintains the thermal continuity

Thermal continuity

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The thermal resistance of the wall assembly is made up of the blown cellulose cavity insulation and the two layers of 2-inch rigid polyisocyanurate insulating sheathing




New windows with low-E squared glazing maintain the thermal continuity of the wall

Thermal continuity

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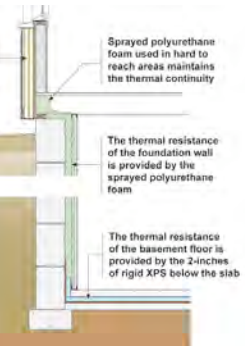
The continuous exterior insulating sheathing eliminates thermal bridging



Sprayed polyurethane foam used in hard to reach areas maintains the thermal continuity

The thermal resistance of the foundation wall is provided by the sprayed polyurethane foam

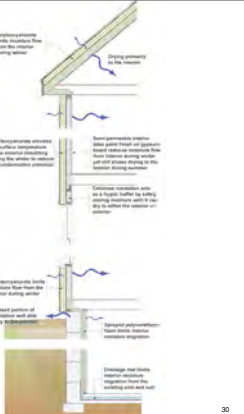
The thermal resistance of the basement floor is provided by the 2-inches of rigid XPS below the slab



Thermal continuity

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Vapor barrier continuity

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Polyisocyanurate limits moisture flow from the interior during winter

Drying primarily to the interior

Vapor barrier continuity

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Polyisocyanurate elevates the surface temperature of the exterior sheathing during the winter to reduce the condensation potential

Semi-permeable interior latex paint finish on gypsum board reduces moisture flow from interior during winter yet still allows drying to the interior during summer

Cellulose insulation acts as a hygric buffer by safely storing moisture until it can dry to either the interior or exterior

Vapor barrier continuity

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Polyisocyanurate limits moisture flow from the interior during winter

Exposed portion of foundation wall able to dry to the exterior

Sprayed polyurethane foam limits interior moisture migration

Drainage mat limits interior moisture migration from the existing slab and soil

Vapor barrier continuity

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bsc New Windows

Photos courtesy of Dan Morrison, *Fine Homebuilding Magazine*

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bsc New Windows

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Mechanical schematic

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bsc Old Boiler to New Boiler plus air handlers, outside air intake, filtration, and exhaust at baths and kitchen

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3: RENOVATION - BEDFORD, MA

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Habitat for Humanity
The American Dream

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HFH Farmhouse Section

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Farm House Plans

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bsc Bedford Farmhouse Renovation

Building Enclosure

Roof: Composition shingles with 15# underlayment
 1/2" plywood with fully adhered membrane in 5' from edge
 2 layers of 1.5" foil faced polyisocyanurate (R-20)

Walls: 2x4 framing cellulose filled (R-14)

Foundation: 2" high density spray foam (R-13) with steel studs

Windows: Replacement/New windows wood framed LoE

Infiltration: 2.5 sq in leakage area per 100 sf envelope

Mechanical systems

Heat: 93% AFUE Furnace

Cooling: no cooling

DHW: Instantaneous Hot Water EF=0.82

Ducts: R-4.2 flex runouts in unvented attic or in floor joists
 none to outside (5% or less)

Leakage: Aprilaire VCS 8126 Supply-only system integrated with AHU

Ventilation: 33% Duty Cycle: 10 minutes on; 20 minutes off, 50 CFM average flow
 Transfer grilles/jump ducts at bedrooms
 CFL lighting package all screw base
 Energy Star fridge, DW, clothes washer

Building America Characteristics

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bsc Energy Analysis

Total Source Energy Savings
 (BSC/ENR/ENR/ENR/ENR/ENR/ENR)

Item ID	Description of change	Year BA Benchmark*	Incremental Cost/Benef	Annual energy cost	Item Savings	NETS INDEX	Cooling Change kWh/yr	Heating Change kWh/yr
0	2008 BA Benchmark	0%	0%	\$4,500	0%	121.0	11.2	22.4
1	2008 BA Characteristics	-48.1%	0%	\$4,750	\$1,250	51.0	19.2	31.7

Benchmark Component Energy Use

MEL: 53 Million Btu
 Heating: 154 Million Btu
 Cooling: 19 Million Btu
 DHW: 24 Million Btu
 Lighting: 30 Million Btu

2008 BA Characteristics Component Energy Use

MEL: 59 Million Btu
 Heating: 154 Million Btu
 Cooling: 8 Million Btu
 DHW: 24 Million Btu
 Lighting: 13 Million Btu

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