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## Towards Zero Energy Homes (Six Case Studies)

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BSA Residential Design Conference  
April 3, 2008 Boston, MA



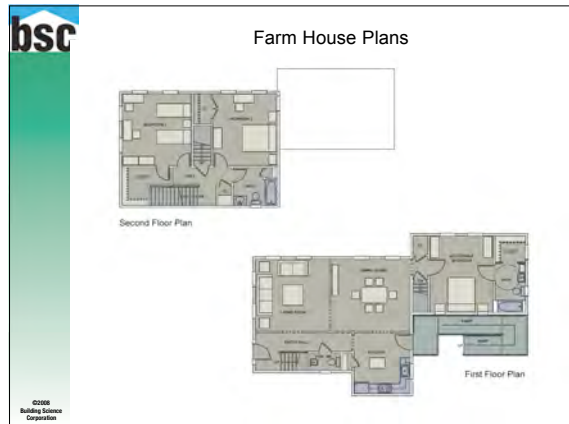
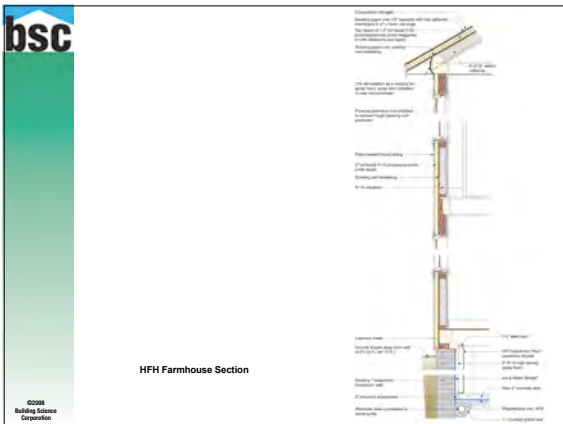
**Building AMERICA**  
U.S. Department of Energy  
Research Toward Zero Energy Homes

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## 3: RENOVATION - BEDFORD, MA

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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

**Return Pathways**

**Lighting**

**Appliances**

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**bsc** Energy Analysis

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

Parameter	Item ID	Description of change	Year BA Benchmark*	Incremental Cost/Benefit	Annual energy cost savings	Item Savings	NETS INDEX	Cooling Change kWh/yr	Heating Change kWh/yr
0		2008 BA Benchmark	100	0	\$4,500	0	121.0	11.2	22.4
1		2008 BA Characteristics	49.1%	0	\$4,750	\$1,000	51.0	19.2	31.7

**Benchmark Component Energy Use**

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

**2008 BA Characteristics Component Energy Use**

MEL: 59 Million Btu  
Cooling: 8 Million Btu  
Heating: 88 Million Btu  
DHW: 13 Million Btu  
Lighting: 13 Million Btu

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