



Achieving Higher Performance with Cost Neutrality through Building America

Residential Energy Efficiency
Stakeholder Meeting
March 1, 2012



Agenda

- Imagine Homes – An Overview
- 2010 Occupied Test House
 - Objectives
 - From Modeling through Monitoring
- 2012 Occupied Test House
 - Objectives
 - What's Next
- Closing Remarks

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Imagine Homes



Overview:

- San Antonio, TX
- 68 Homes in 2011
- \$140k – \$425k
- 1,300 – 4,500 ft²

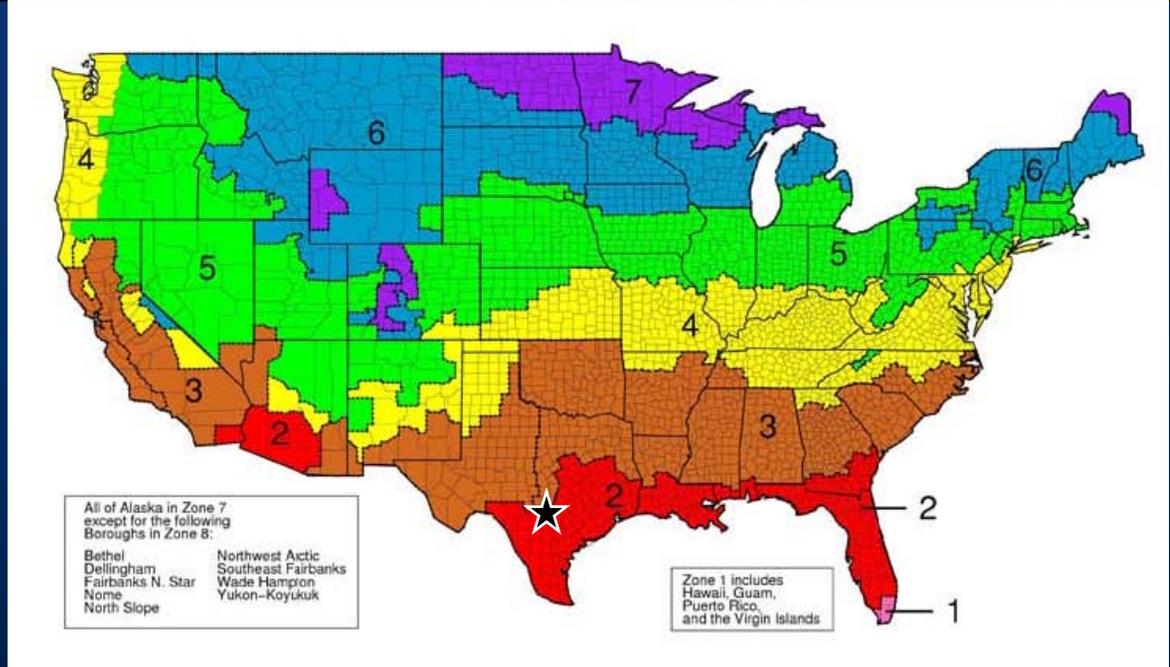
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Environment:

- Hot-Humid
- 2,996 CDD
- 1,546 HDD
- 31" Rainfall

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Imagine Homes



Imagine
Homes

high performance green homes are built to be economical and ecological

Save Energy • Conserve Water • Improve Indoor Air Quality



History:

- Established 2006
- Partnership with Beazer Homes
- Builders Challenge
- Building America

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“Every one of our homeowners not only enjoys lower energy costs and increased comfort, but has peace of mind knowing that our industry certifications and building system help reduce energy use, water consumption, greenhouse gases, and solid waste generation while creating a home of value that is ahead of its time.”

—www.imaginehomessa.com

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2010 Occupied Test House



Plan Type:

- 2-Story, Slab
- 5 Bedrooms
- 3,670 ft²
- Electric + Natural Gas

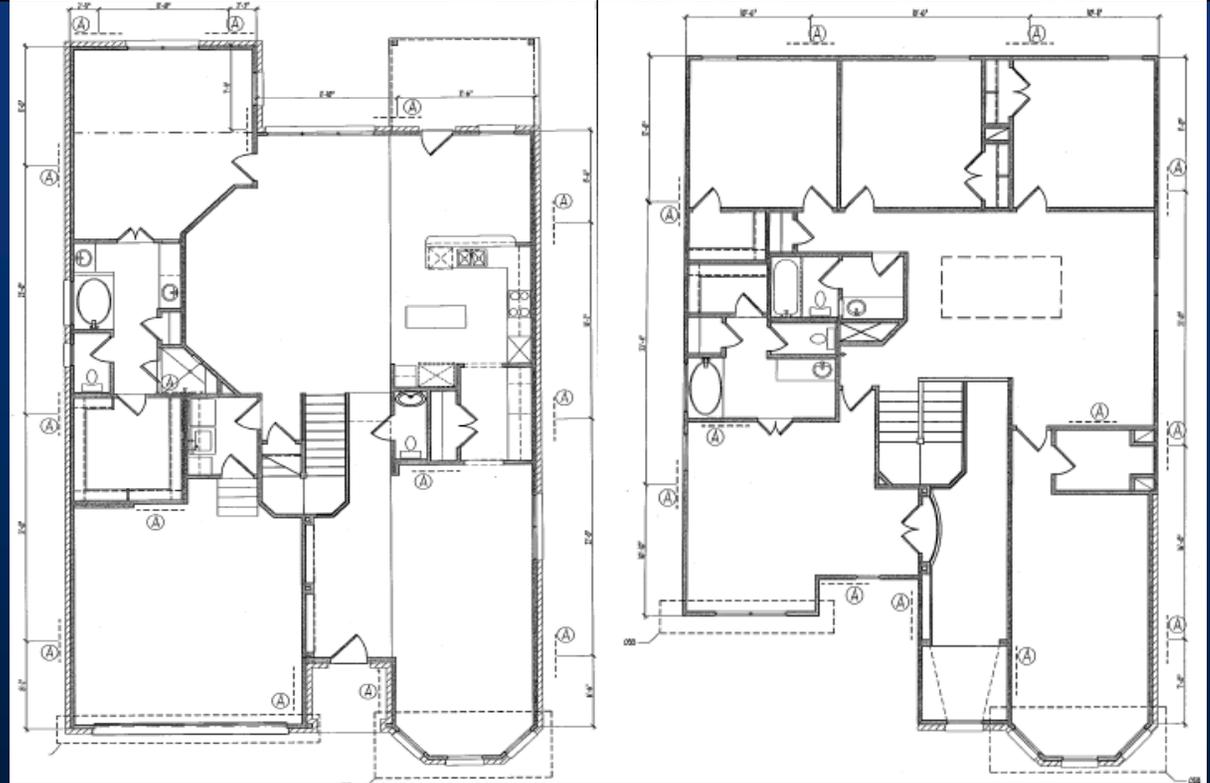
Component	2010 Base Spec Package
Concrete Slab	Slab on grade, uninsulated
Exterior Walls	R-13 (16" O.C.), spray foam insulation
Roof	R-19 spray foam on roof deck
Exterior Doors	U-value: 0.329
Windows	U-value: 0.36; SHGC: 0.29; vinyl frame
Building Air Tightness	2.58 ACH50
Mechanical Ventilation	Runtime ventilation to return plenum (filtered w/damper)
Heating	92.5 AFUE
Cooling	15 SEER
Ductwork	Trunk & branch, R-6, Semi-conditioned (sealed) attic
Water Heater	Gas tankless, 0.82 EF, located in garage
DHW Distribution	Viega Mani-bloc, pex, no pipe insulation
Appliances	Gas range; All ENERGY STAR
Fluorescent Lighting	80% fluorescent
Photovoltaic System	N/A

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2010 Occupied Test House



Why this Plan?

- Size (2 story)
- Popularity
- Flexibility; multi-generational
- Efficiently move contractor to advanced framing approaches

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2010 Occupied Test House



Upgrades to:
 Framing,
 Insulation,
 Windows, HVAC,
 Hot Water,
 Lighting,
 Photovoltaics

Component	2010 Test House Spec Package
Concrete Slab	Slab on grade, uninsulated
Exterior Walls	R-20 (2x6", 24" O.C.) sprayed-in cellulose + R-3 XPS sheathing
Roof	R-19 spray foam on roof deck
Exterior Doors	U-value: 0.20
Windows	U-value: 0.35; SHGC: 0.22
Building Air Tightness	1.3 ACH50
Mechanical Ventilation	AirCycler, 50% runtime, 80 CFM, filter and damper
Heating	94 AFUE
Cooling	17 SEER
Ductwork	Trunk & branch, R-6, Semi-conditioned (sealed) attic
Water Heater	115-gallon electric tank, 0.85 EF with 64 sf collector solar thermal system
DHW Distribution	Viega Mani-bloc, pex, no pipe insulation
Appliances	Gas range; All ENERGY STAR
Fluorescent Lighting	100% fluorescent
Photovoltaic System	2.0-kW PV array; grid-tied

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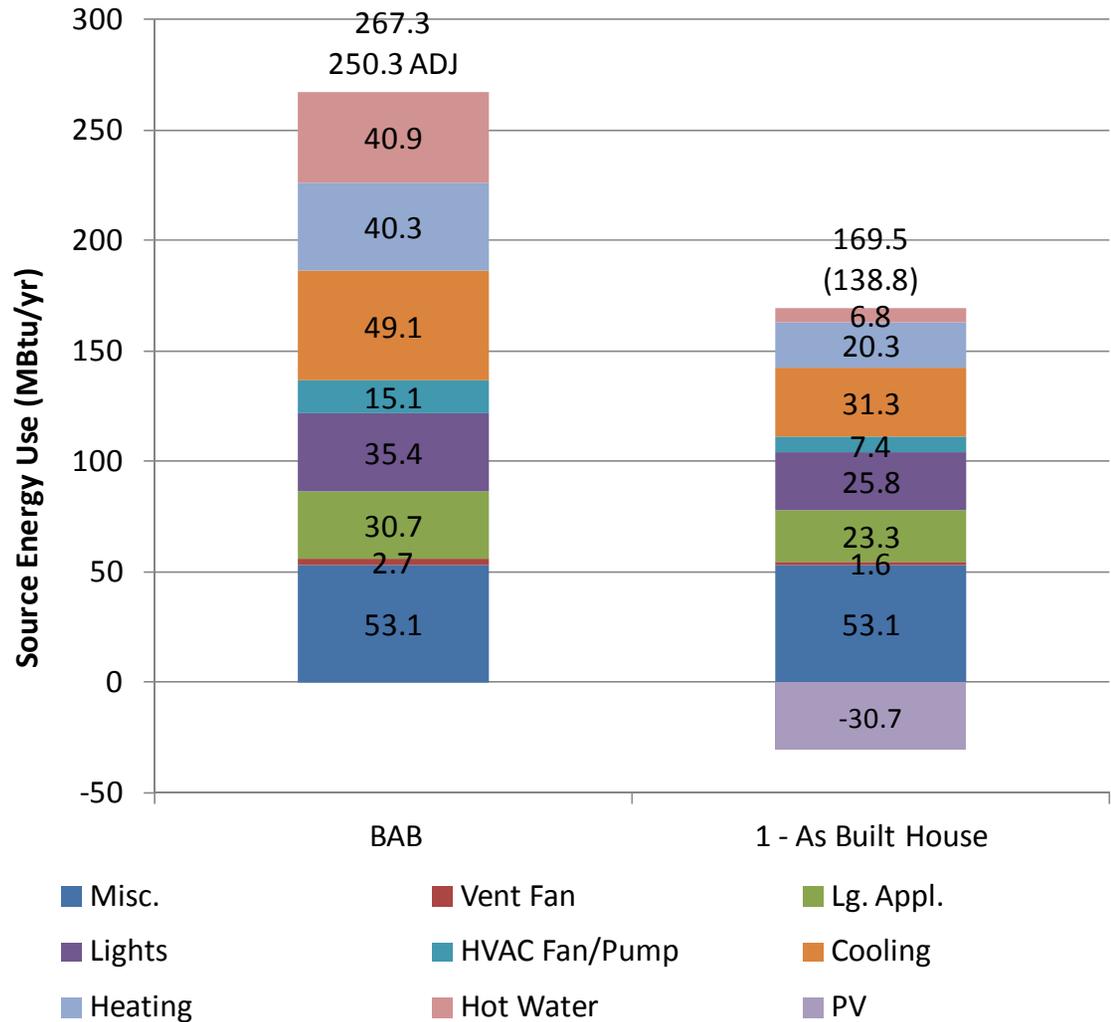
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2010 Occupied Test House



- B10 Benchmark:**
- Base House: 13.9% Savings
 - Test House: 32.3% Savings (44.6% with PV)



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2010 Occupied Test House

Description	Annual Source Energy				Estimated Source Energy Savings						Annual Utility Bill Reduction		
	Benchmark	Regional Standard Practice	Builder's Standard Practice	Prototype House	Percent of End-Use			Percent of Total					
	(Mbtu/yr)	(Mbtu/yr)	(Mbtu/yr)	(Mbtu/yr)	vs. Benchmark	vs. Regional Standard Practice	vs. Builder's Standard Practice	vs. Benchmark	vs. Regional Standard Practice	vs. Builder's Standard Practice	Prototype WRT Benchmark	Prototype WRT Regional Standard	Prototype WRT Builder Standard
End-Use													
Space Heating	45	63	24	16	56%	69%	17%	9%	13%	2%	\$215	\$246	\$42
Space Cooling	59	119	55	50	25%	63%	21%	6%	23%	6%	\$192	\$782	\$227
DHW	41	20	10	3	93%	83%	68%	14%	5%	4%	\$297	\$262	\$107
Lighting	35	40	17	13	63%	67%	20%	8%	8%	2%	\$84	\$59	\$25
Appliances & MELs	84	84	82	80	5%	4%	2%	1%	1%	1%	\$65	\$64	\$0
OA Ventilation	3	0	9	7	(75%)	NA	22%	(1%)	NA	1%	\$9	(\$14)	\$0
Subtotal	267	327	196	168	37%	49%	15%	37%	49%	15%	\$862	\$1,399	\$401
PV Panel Generation	0	0	0	-31	NA	NA	NA	12%	13%	21%	\$267	\$267	\$267
Total	267	327	196	137	37%	49%	15%	49%	61%	36%	\$1,129	\$1,666	\$668
Added Annual Mortgage cost w/o Site Generation											\$1,254	\$730	
Net Cash Flow to Consumer w/o Site Generation											\$145	(\$62)	
Added Annual Mortgage Cost with Site Generation											\$2,310	\$1,786	
Net Cash Flow to Consumer with Site Generation											(\$644)	(\$1,118)	

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2010 Occupied Test House



Challenges:

- HOA Sign-off on solar panels
- Tape over XPS foam joints



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2010 Occupied Test House



Successes:

- Switch to ½" XPS (away from Thermo-ply®)
- Few trade issues (good contractors + pre-con meeting)
- Now offering Energy Option package



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2010 Occupied Test House



Monitoring:

Sep'10 – Aug '11

- Campbell Scientific Equipment
- 5-Person Family Occupants



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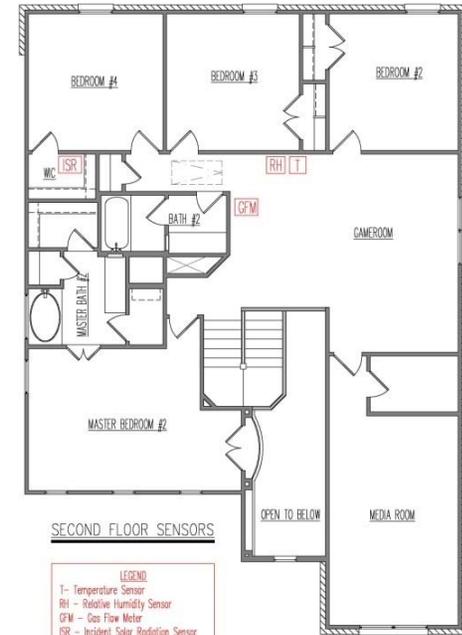
2010 Occupied Test House



Monitored for:
 Energy Consumption,
 Energy Production,
 System Efficiency,
 Indoor/ Outdoor Temp and RH



LEGEND
 T - Temperature Sensor
 RH - Relative Humidity Sensor
 WFM - Water Flow Meter
 WT - Water Temperature Sensor
 EM - Electric Measurement
 DL - Data Logger



LEGEND
 T - Temperature Sensor
 RH - Relative Humidity Sensor
 CFM - Gas Flow Meter
 ISR - Incident Solar Radiation Sensor

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2010 Occupied Test House

Modeled Results					Measured Results (Sep'10-Aug'11)
	BA (B10) Benchmark	Regional Standard Practice	Builder's Standard Practice	2010 Test House	2010 Test House
End-Use	MMBtu	MMBtu	MMBtu	MMBtu	MMBtu
Space Heating	45	63	24	16	14
Space Cooling	59	119	55	50	63
DHW	41	20	10	3	9
Lighting	35	40	17	13	13
Appliances & MELs	84	84	82	80	37
OA Ventilation	3	0	9	7	6
Subtotal	267	327	196	169	141
PV Panel Generation	0	0	0	-41	-18
Total	267	327	196	128	123

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2010 Occupied Test House

Comparing Measured vs. Modeled Results:

- Similar Total energy consumption
- Lower measured MELS
- Higher measured Cooling and DHW
 - # of Occupants

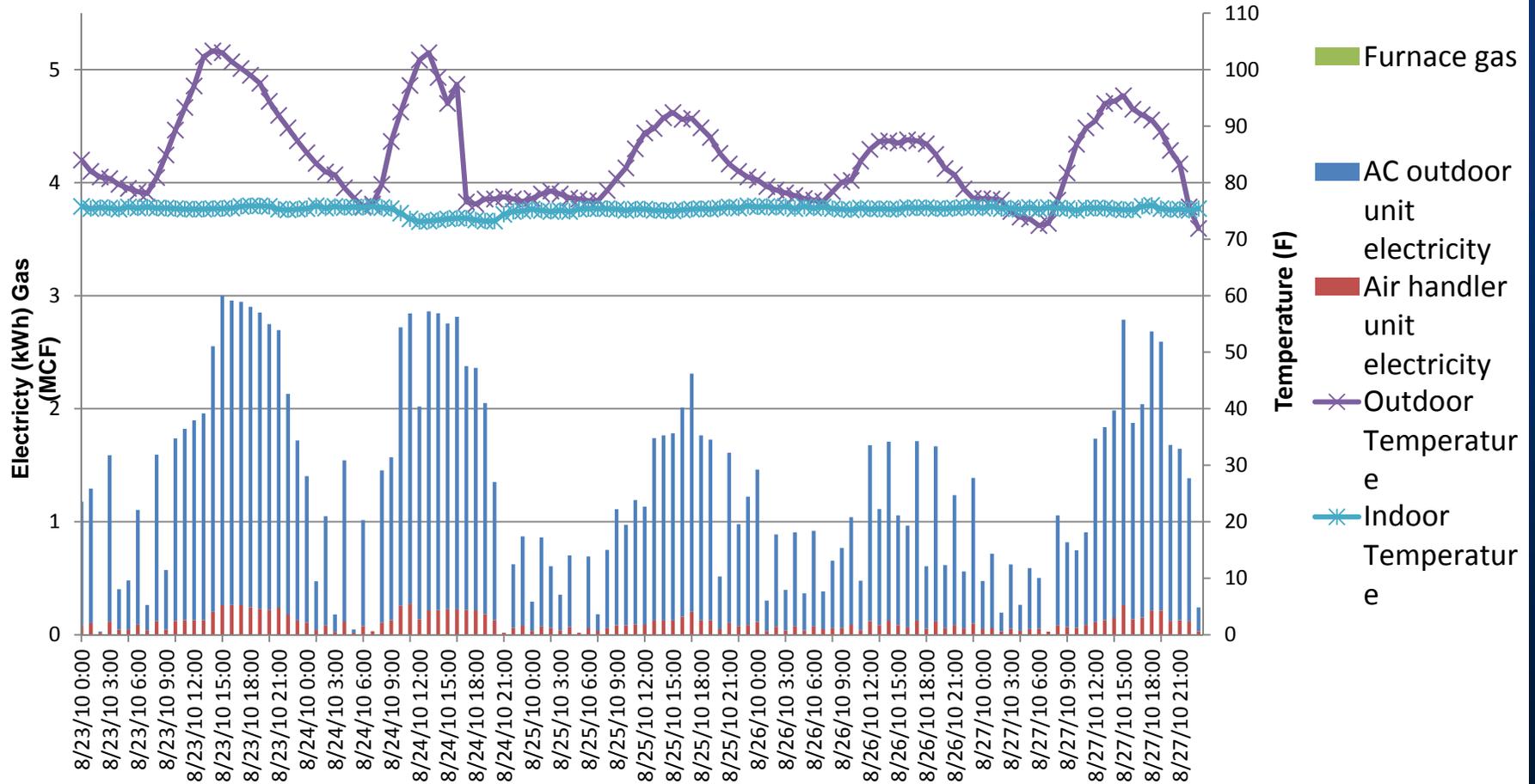
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2010 Occupied Test House



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2010 Occupied Test House

HVAC System Monitored Results:

- System properly sized to accommodate peak cooling load conditions
- CU and AHU energy use tracks outdoor temperature

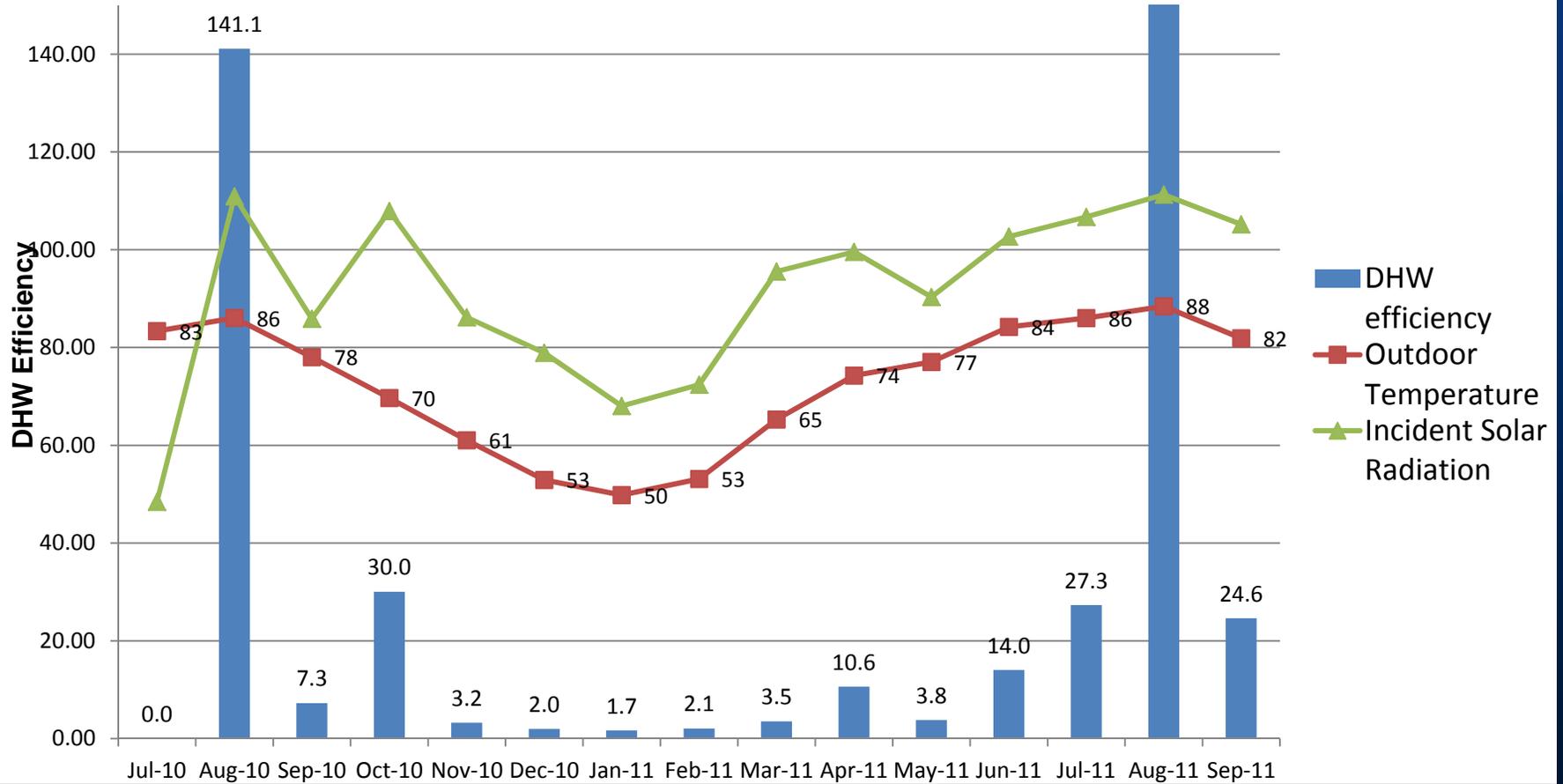
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2010 Occupied Test House

DHW System (Solar Thermal) Monitored Results:

- 4.0 Average Energy Factor (EF)
- Efficiency tracks more with Incident Solar Radiation than Outdoor Temp
- Winter Efficiency Impacts:
 - Fewer sun hours
 - Time of water use relative to solar heating
 - Outdoor Temp

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2010 Occupied Test House

Long-Term Results Report:

- Currently drafted
- Expected availability (following Peer Review) Q2 '12

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2010 Occupied Test House

Lessons Learned:

- Imagine Homes significantly ahead of regional practice
- Shift to 24" O.C. framing larger “leap” than envisioned

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What's Next?

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What's Next?

- How to save 50% energy
- Move away from semi-conditioned attic w/o furring down into living space
- Ensure IAQ

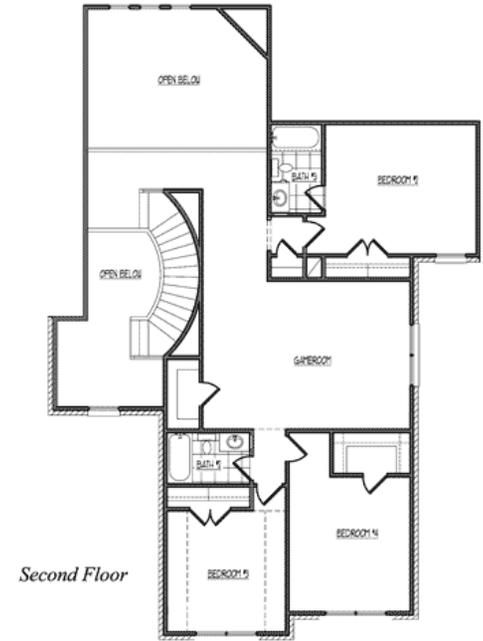
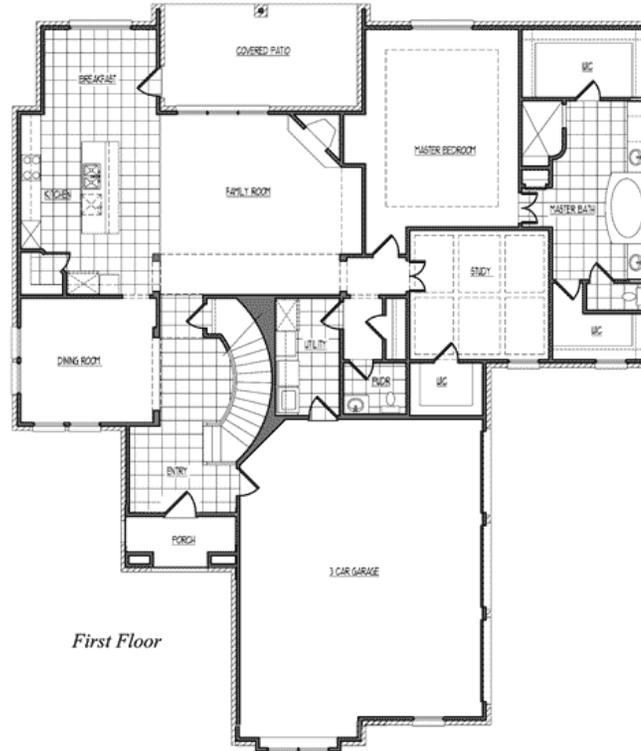
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2012 Occupied Test House



Plan Type:

- 2-Story, Slab
- 4 Bedrooms
- 3,852 ft²
- Electric + Natural Gas



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2012 Occupied Test House



Upgrades to:
 Insulation,
 Windows,
 HVAC,
 Hot Water

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Roof	R-38 blown-in cellulose on flat ceiling
Exterior Doors	U-value: 0.20
Windows	U-value: 0.36; SHGC: 0.25
Building Air Tightness	2.58 ACH50
Mechanical Ventilation	ERV, 100% runtime, 74 CFM continuous
Heating	10.0 HSPF mini-split
Cooling	21 SEER mini-split
Ductwork	No ductwork
Water Heater	80-gallon electric tank, 0.85 EF with 64 sf collector solar thermal system
DHW Distribution	Viega Mani-bloc, pex, R-2 pipe insulation
Appliances	Gas range; All ENERGY STAR
Fluorescent Lighting	100% fluorescent
Photovoltaic System	2.0-kW PV array; grid-tied

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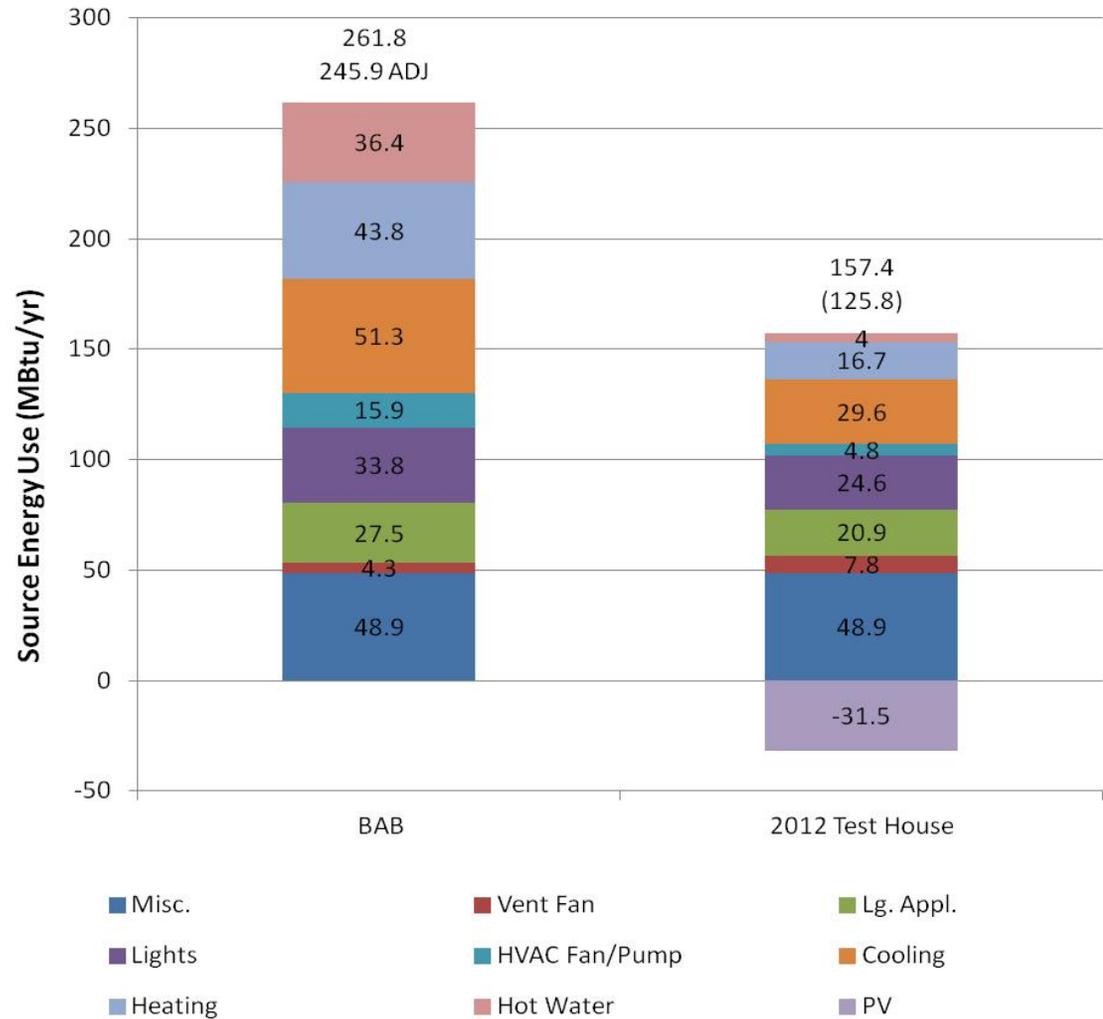
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2012 Occupied Test House



- B10 Benchmark:**
- Base House: 13.8% Savings
 - Test House: 36.0% Savings (48.8% with PV)



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2012 Occupied Test House

Project Timeline:

- Construction May '12 – Aug '12
- Monitoring Sep '12 – Aug '13
- Short-term Results Report Q4 '12
- Long-term Results Report Q4 '13

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Thank You

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