



# Predictions, Performance and Real World Results

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# Houston Energy Efficiency Study

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Using real-world data, evaluate the performance differences between baseline, ENERGY STAR® and Guaranteed Performance homes

Compare actual versus predicted performance, as well as identify construction techniques and products that deliver energy savings

# Electric Data: Usage Summaries

**COMPOSITION OF DATA SET**

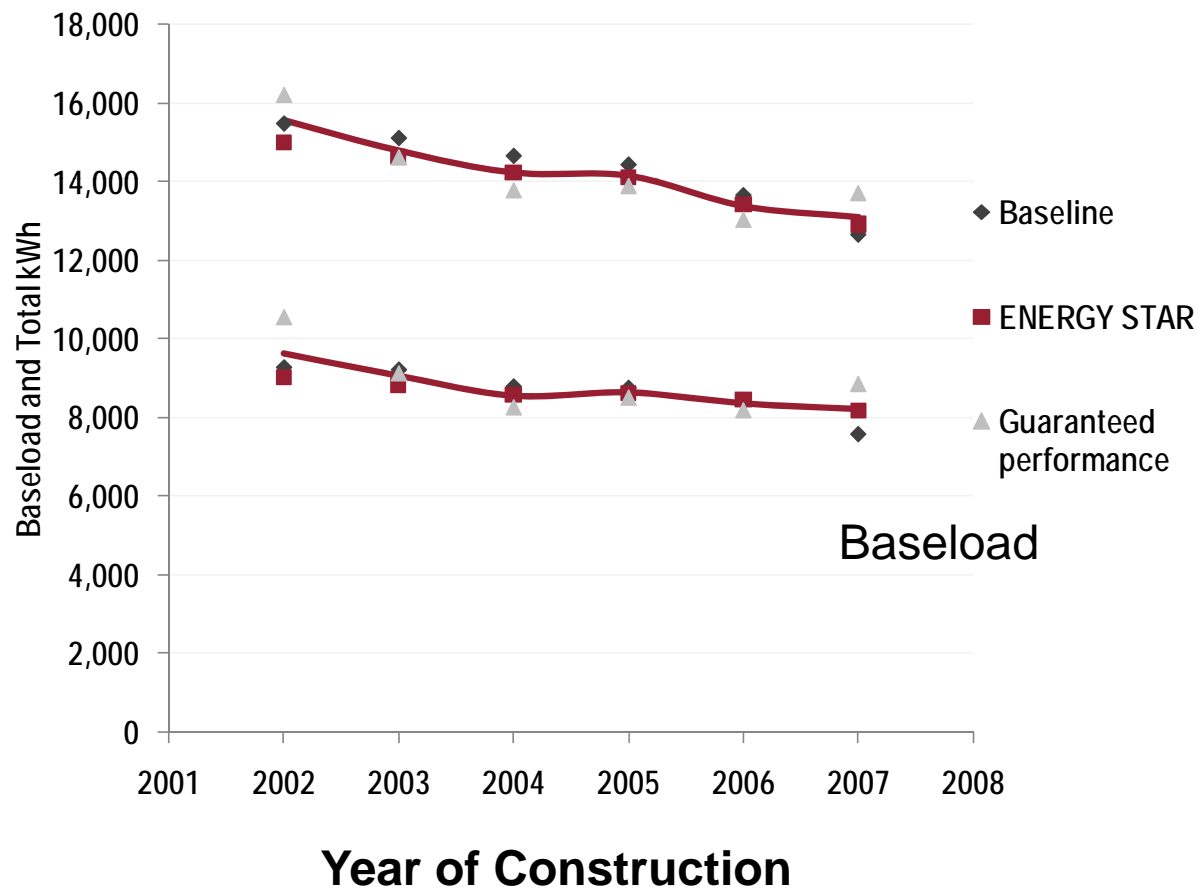
**ENERGY STAR**

**Homes database, utility usage data, property assessor data, REM/Rate files, field testing files, weather data, manufacturer and distributor data**

<i>Number of homes in study groups</i>	Overall analysis	Electric usage analysis	Gas usage analysis
Baseline	70,828	40,981	10,815
ENERGY STAR	81,755	42,154	15,301
Guaranteed performance	6,115	2,795	659
Total	158,698	85,930	26,775

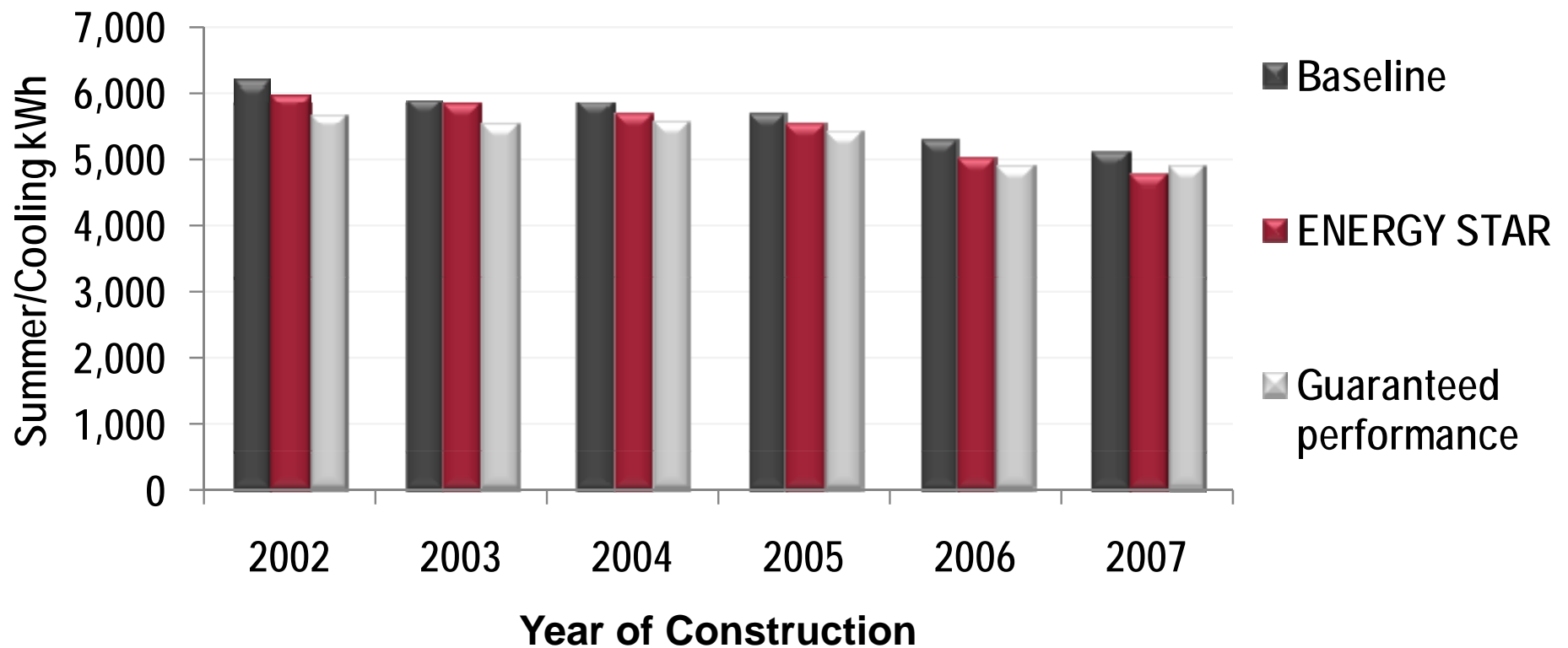
# Trends in 2008, loads by year

Total kWh



# Data Analysis and Results

## 2008 usage by year of construction



# Data Analysis and Results

**2008 difference in energy use from baseline homes  
(adjusted for size but not vintage)**

	Percent Usage Difference vs. Baseline	
	ENERGY STAR	Guaranteed Performance
Summer/cooling kWh (2008)	5% less	6% less
Total kWh (2008)	4% less	2% less

# Data Analysis and Results

**REM/RATE™**  
**ANALYSIS**  
**Predicted**  
**versus actual**  
**usage**

<i>Cooling load projections and usage</i>	
Average load [kWh/yr]	
REM/Rate	5,506
Billing data	5,677
Difference	171 [3%]
% Homes where REM/Rate within...	
10% of billing data	28%
25% of billing data	64%
50% of billing data	91%
Correlations with billing data	
REM/Rate	0.62
Floor area, shell area	0.67

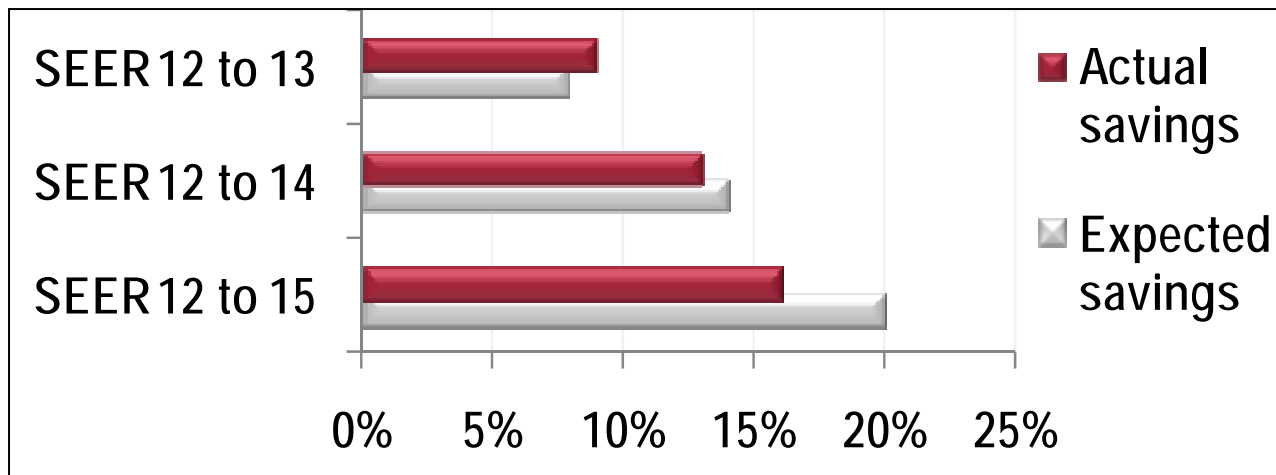
# Regression Modeling of ENERGY STAR Homes

- Regression analysis used to assess how house data relates to summer/cooling usage
  - 16,374 Energy Star Homes with matching REM data
    - 3,254 with duct and shell field test data too



# Regression Modeling Findings (1)

- A/C SEER Savings vs. SEER12
  - SEER 13: 583 kWh, 9% (8% expected)
  - SEER 14: 787 kWh, 13% (14% expected)
  - SEER 15: 984 kWh, 16% (20% expected)



- SEER changes account for 2/3 of ENERGY STAR Homes load reduction from 2005 to 2007



## Regression Modeling Findings (2)

- Building Shell Leakage
  - Summer/cooling ~ 0.4 kWh per CFM50
  - Infiltration Loads: 734 kWh/yr of cooling (14%) in average 1924 CFM50 home
- Duct Leakage
  - Summer/cooling ~ 2-2.5 kWh/CFM25 duct
  - Duct leakage loads: 174 kWh of cooling (3%) in average 87 CFM25 home

## Regression Modeling Findings (3)

- Radiant Barrier Roof Sheathing
  - Reduces loads about .09 kWh/ft<sup>2</sup>, equals about 180 kWh (3%) per home
- Baseload Electric Impact on Summer/Cooling Loads
  - strongly related to summer/cooling loads at 0.13 kWh cooling kWh per annual kWh baseload
    - About 1150 kWh -- 20% of cooling load is removing baseload heat

# Regression Modeling Findings (3)

continued...

- Baseload Electric Loads
  - related to house size (floor or shell) and assessed value of home
  - Baseload kWh/yr  $\sim 2900 + 1.8 * \text{floor area} + 6.5 * \text{Assessed Value } (\$1000\text{s})$

# Conclusions

- ENERGY STAR homes perform very close to the predictions of the models, but baseline homes perform much better than the reference homes defined by the HERS standard.
- Why? Because the reference home never actually gets built and the assumptions about “typical” homes established by the standards are incorrect.

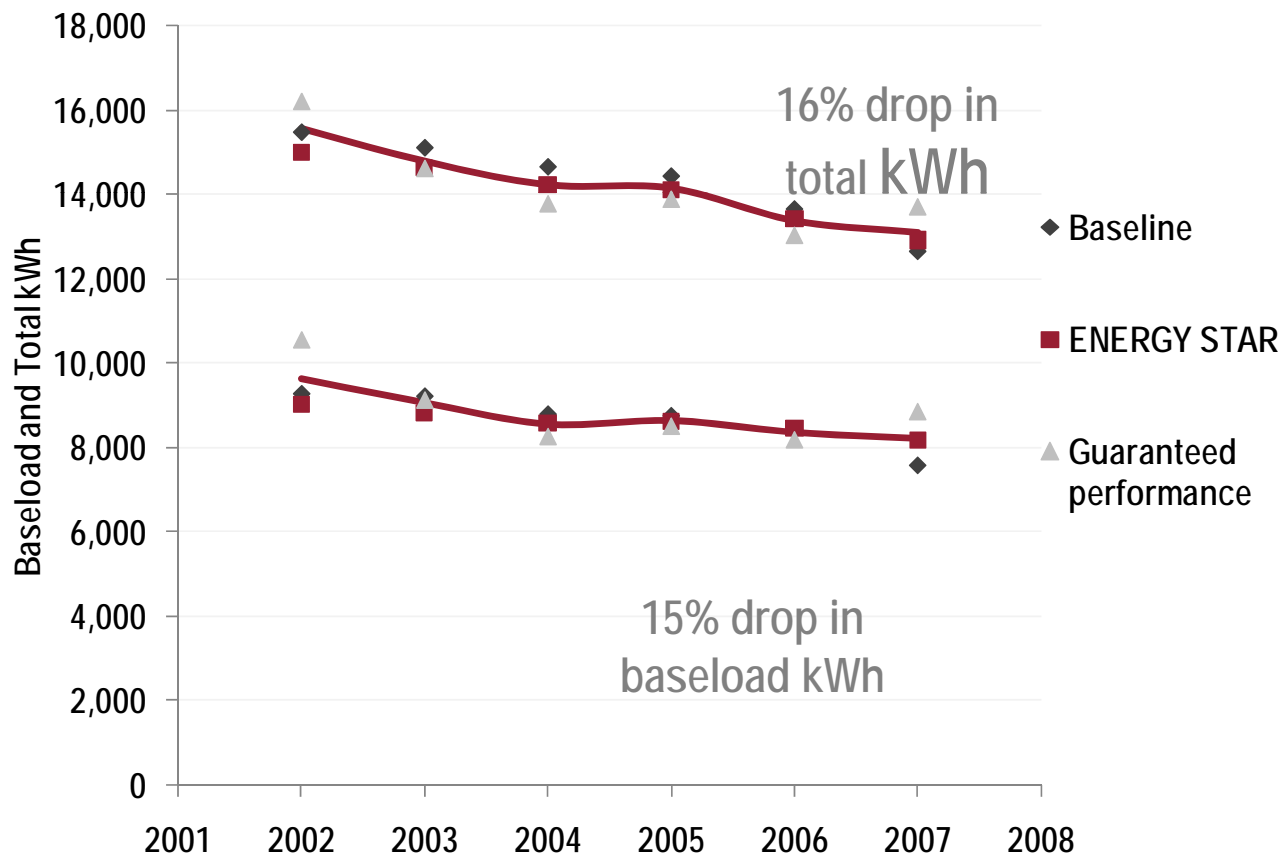
# Conclusions

- As a result, savings between program homes and baseline homes in Houston are small

	Percent Usage Difference vs. Baseline	
	ENERGY STAR	Guaranteed Performance
Summer/cooling kWh (2008)	5% less	6% less
Total kWh (2008)	4% less	2% less

# Conclusions

- All New Homes in Houston Are More Efficient



# Conclusions

- Why?
  - 2001 IECC
  - 2006 federal SEER minimum increased
  - The presence of high-performance home programs in Houston made everyone better – but to what extent?

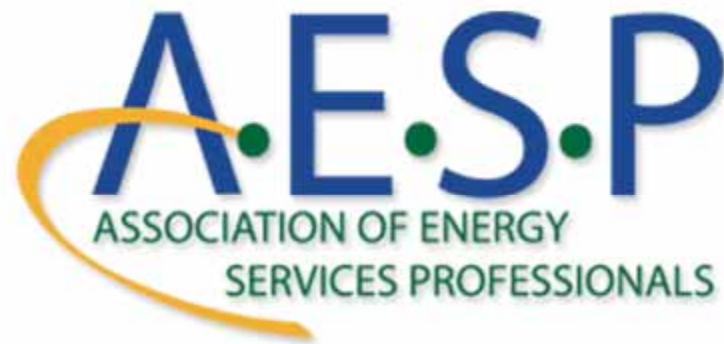


# Lessons Learned

- ENERGY STAR may have helped facilitate code compliance in Houston.
- Most builders in Houston are working with a home-performance contractor – either to build to a program or to comply with the code.

# Lessons Learned

- Billing analysis provides the most accurate measurement of program results and clarifies what specs provide savings.
  - Also allows you to benchmark current building practices and develop standards that fit your marketplace



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