

HERS Index Score vs. Predicted Energy Use and Modeling vs. Real Life: A Colorado Case Study

Wednesday, February 20, 2008

Session 7 8:30 — 10:00 a.m. Nautilus 2

Moderator: Steve Byers, EnergyLogic, Inc.

Presenters:

**David R. Roberts, P.E.
Architectural Energy Corporation
Robby Schwarz, EnergyLogic**

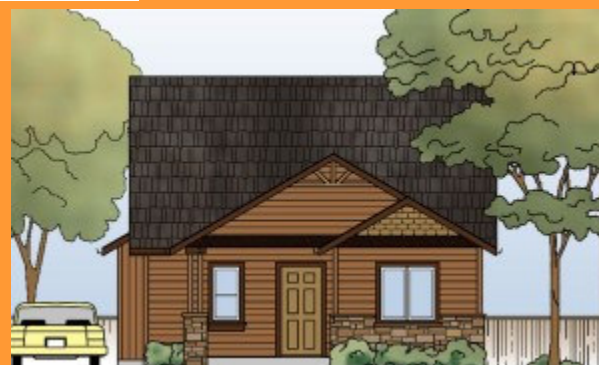


Let Me Tell You a Story



- Colorado HERS Background
 - Centralized Non-Profit Provider
 - Growth and Change in Model
 - The Software
 - One particular builder







The Builder

- Home builder in Colorado
 - Specs
 - Blown 2x4 wall R-15 + R-5 Sheathing Total R-20
 - 92% AFUE Furnace
 - Tankless water heater 82 EF
 - Tight ducts
 - Tight house
 - Supply Ventilation
 - Un-insulated Foundation
 - Avg. 1500-2000 sfft



The Builder

- Average HERS Index 73
- Average Nach 0.10
- 100% Energy Star
- Self funded Utility Guarantee
 - Getting utility releases
- Tax Credit 12% of the time



The Question

- Why are actual utilities not matching predicted.
- Why can't they reach the tax credit more predictably
- Is there an issue with the software methodology (RESNET Technical Standards)?



Goals of the project

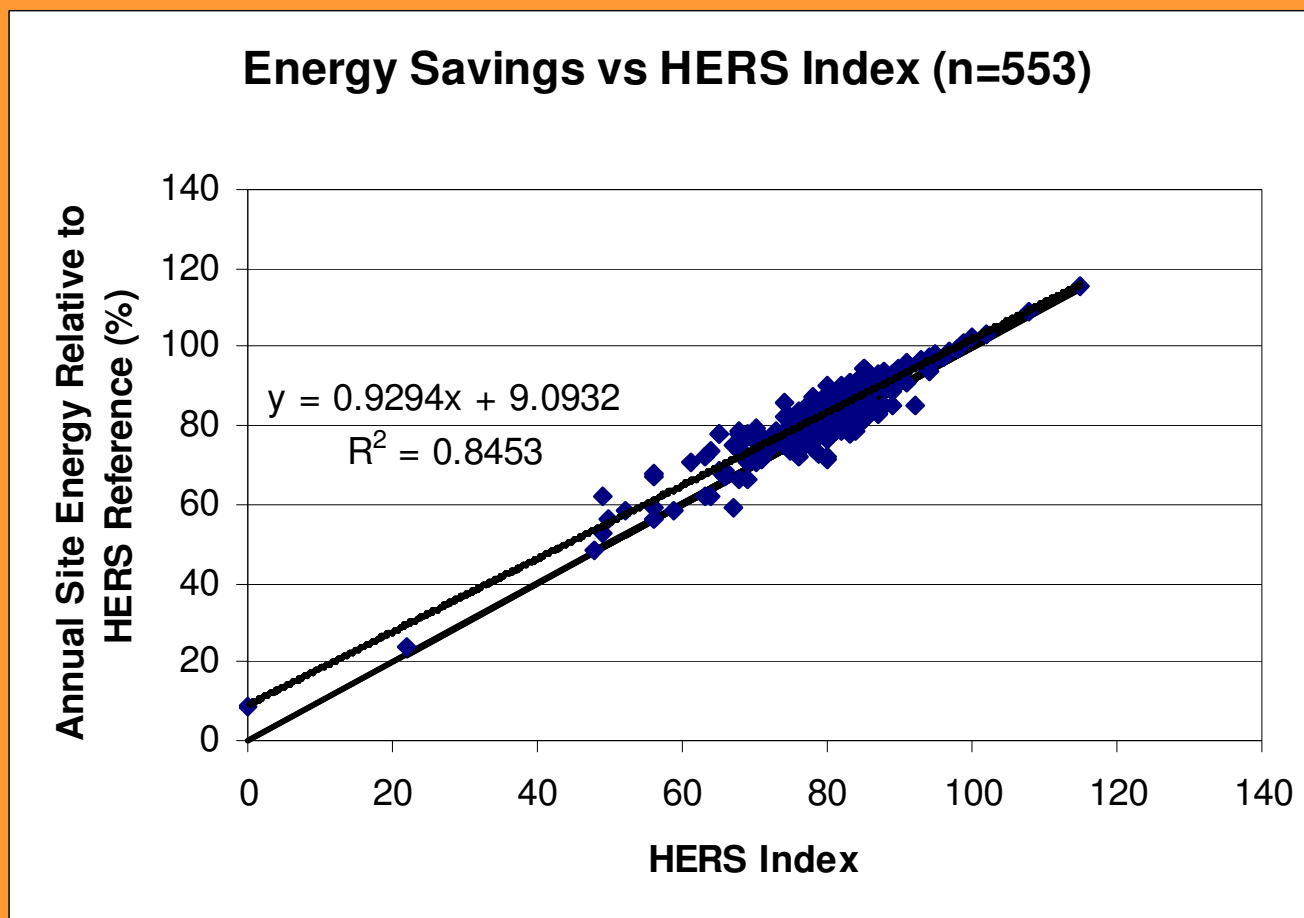


- Start with data set from one builder
 - Use the data we have
 - Confirmed final ratings
 - Gas Utility data
- How well does Index predict savings?
 - Energy savings
 - CO2 savings
- How well does model predict energy bills?
 - Previous studies
 - Colorado study (in progress)

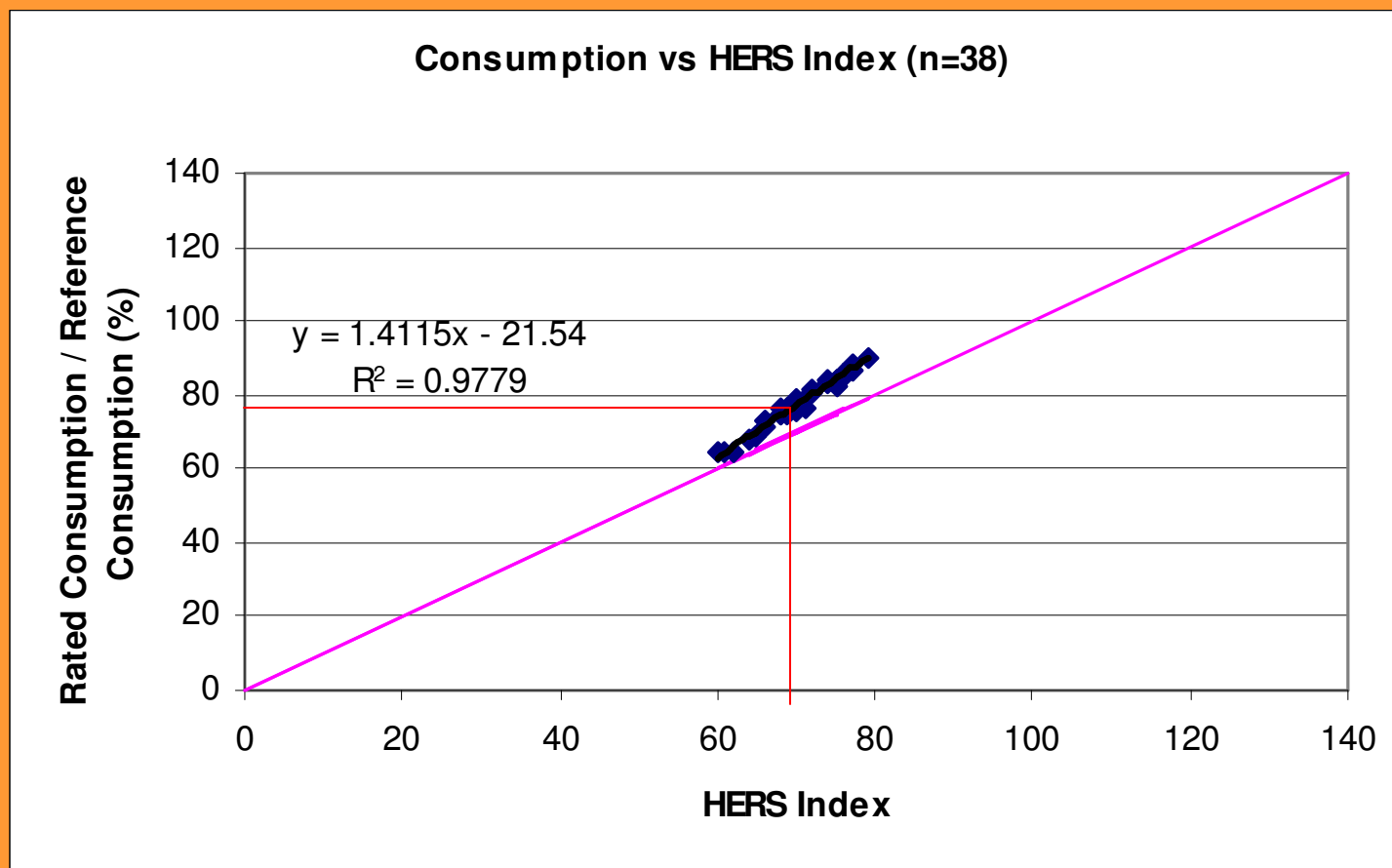
How Well Does Index Predict Savings?

- Two data sets
 - North Carolina Homes
 - 533 homes, variety of providers
 - Mix of gas- and electrically-heated homes
 - Fairly balanced climate
 - Colorado Homes
 - 38 homes, one provider, one builder
 - Very similar, gas-heated homes

HERS Index vs. Energy Savings North Carolina

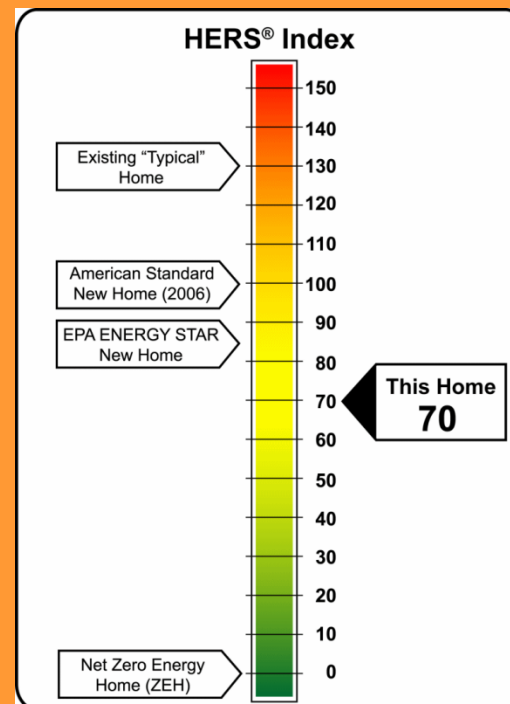


HERS Index vs. Energy Savings Colorado

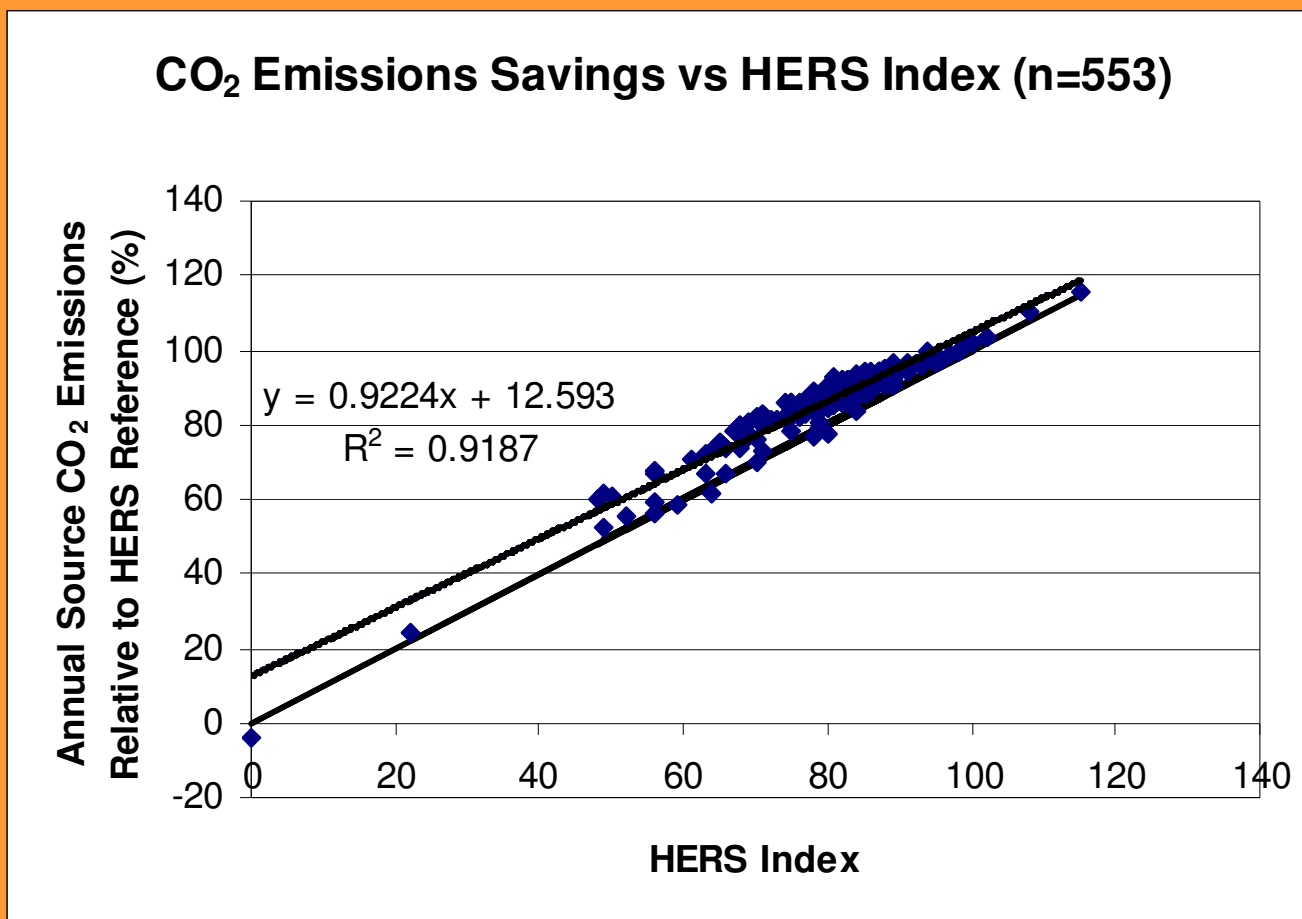


How Well Does Index Predict Savings?

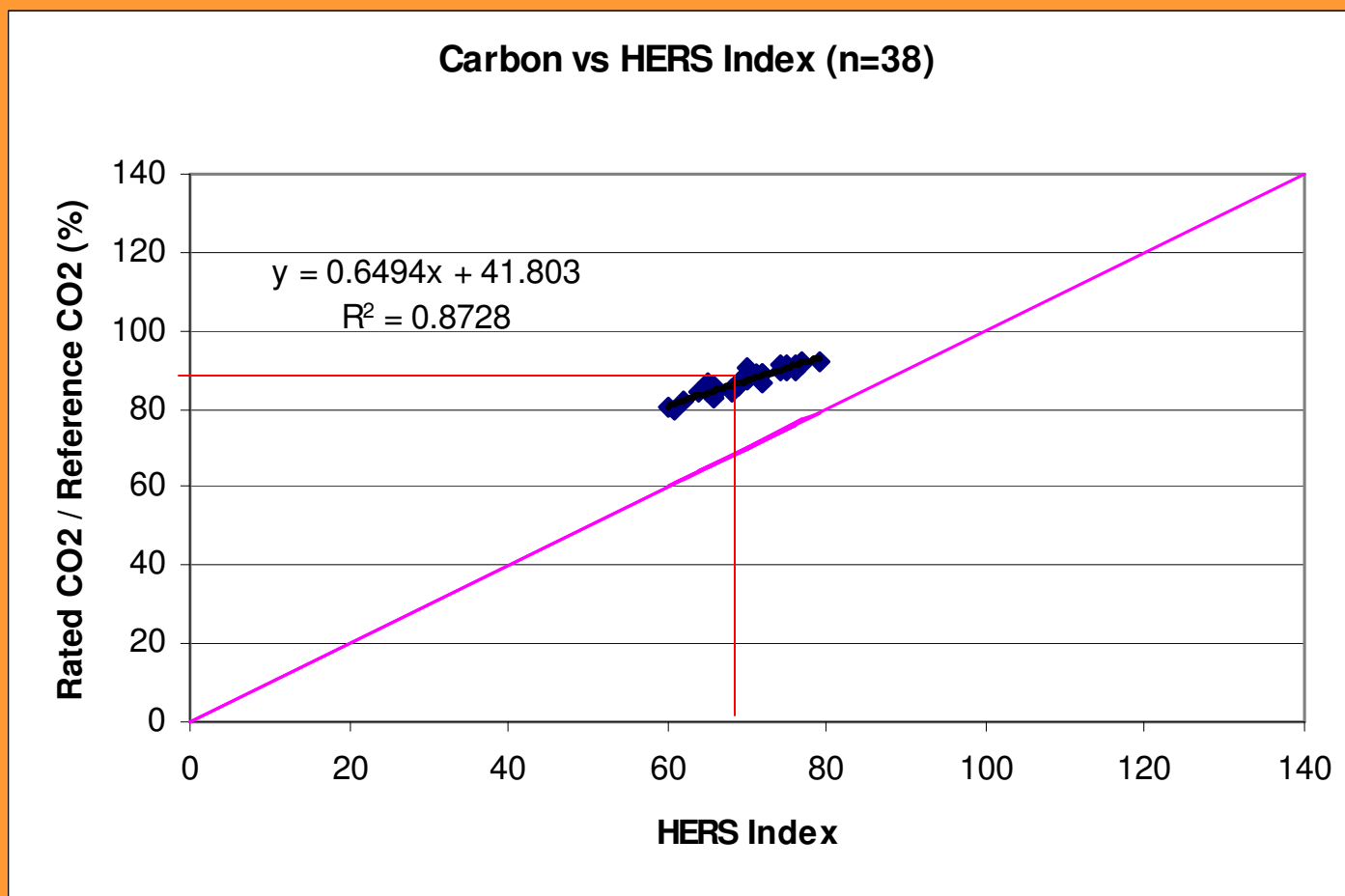
- Energy Savings
 - Index tends to over predict savings slightly
 - More accurate in balanced climate?



HERS Index vs Carbon Savings North Carolina



HERS Index vs Carbon Savings Colorado



How Well Does Index Predict Savings?

- Carbon Savings
 - Index tends to over predict savings
 - More accurate in balanced climate?
 - Error larger in CO sample
 - Gas heating solutions
 - High efficiency furnaces
 - Demand water heaters
 - Gas does not produce as much carbon, carbon savings
 - More work needed

- How well does model predict energy bills?
 - Previous studies
 - Colorado study (in progress)

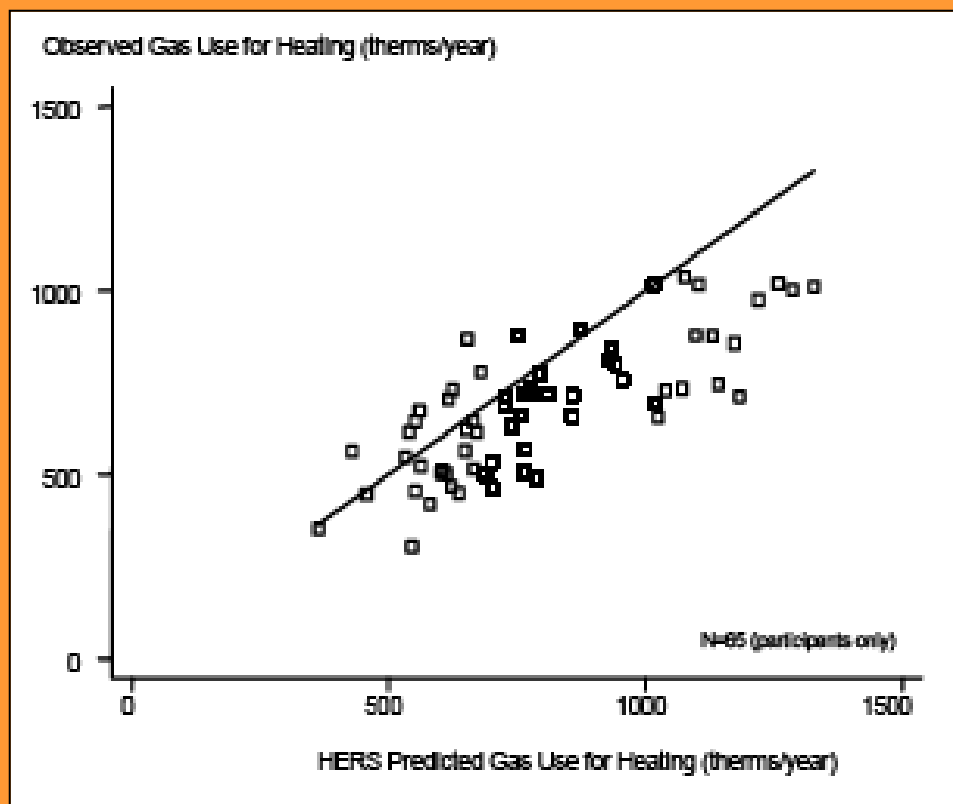




Actual Energy Use vs Billing Data

- Previous Studies
 - Wisconsin Energy Star Homes Program Study
 - Study completed in 2001
 - Scott Pigg, Energy Center of Wisconsin
 - 84 homes
 - Space heating only
 - Billing data adjusted using PRISM

Wisconsin Energy Star Homes Study



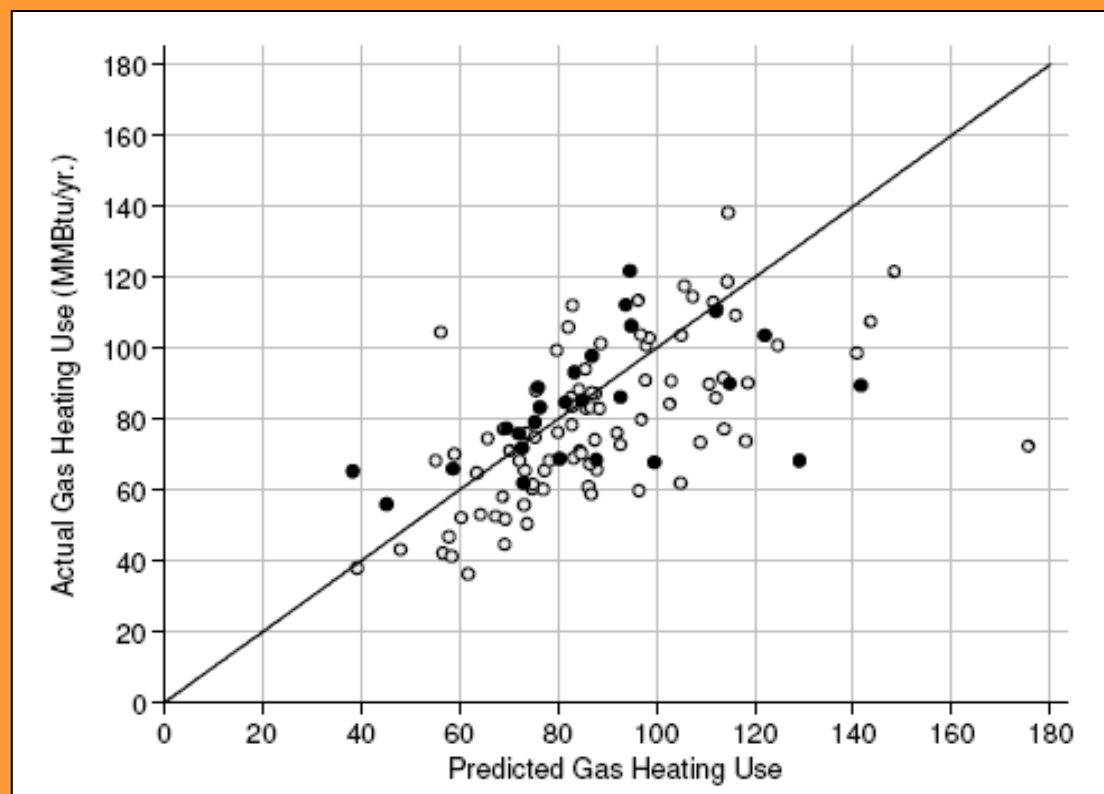
Source: Energy Savings from the Wisconsin ENERGY STAR® Homes Program; October 2002; Scott Pigg, Energy Center of Wisconsin



Actual Energy Use vs Billing Data

- Previous Studies
 - NYSERDA Energy Star Homes Program Study
 - Study completed in 2007
 - Jan Harris, Vermont Energy Investment Corporation; Michael Blasnik, Conservation Services Group
 - 112 homes
 - Gas and electric consumption
 - Billing data adjusted using PRISM-like analysis

NYSERDA Energy Star Homes Study



Source: Reference Design Guide For Highly Energy Efficient Residential Construction; July 2007; Jan Harris Vermont Energy Investment Corporation; Michael Blasnik, Conservation Services Group

Actual Energy Use vs Billing Data

Characteristic	Percentiles of Distribution						
	Mean	$\pm 90\%$ c.i.	10th	25th	Median	75th	90th
Total Gas Use (MMBtu/yr)							
Actual Gas Use	106.9	± 3.9	76.3	89.0	104.8	125.1	141.4
Predicted Gas Use	119.0	± 3.8	90.4	103.1	117.4	131.4	146.3
Actual as % of Predicted	91%	$\pm 3\%$	70%	81%	91%	102%	113%
Heating Use							
Actual Heating Use	80.4	± 3.3	53.1	65.9	77.2	93.7	110.6
Predicted Heating Use	88.1	± 3.7	60.5	73.2	85.3	101.2	115
Reference Heating Use	145.5	± 5.9	98	118.7	143	170.8	189.1
Actual as % of Predicted	93%	$\pm 3\%$	68%	78%	93%	105%	118%
Baseload Use							
Actual Baseload Use	26.5	± 1.7	13.3	18.0	25.5	32.8	39.8
Predicted Baseload Use	30.9	± 0.8	24.9	27.8	29.2	34.0	39.3

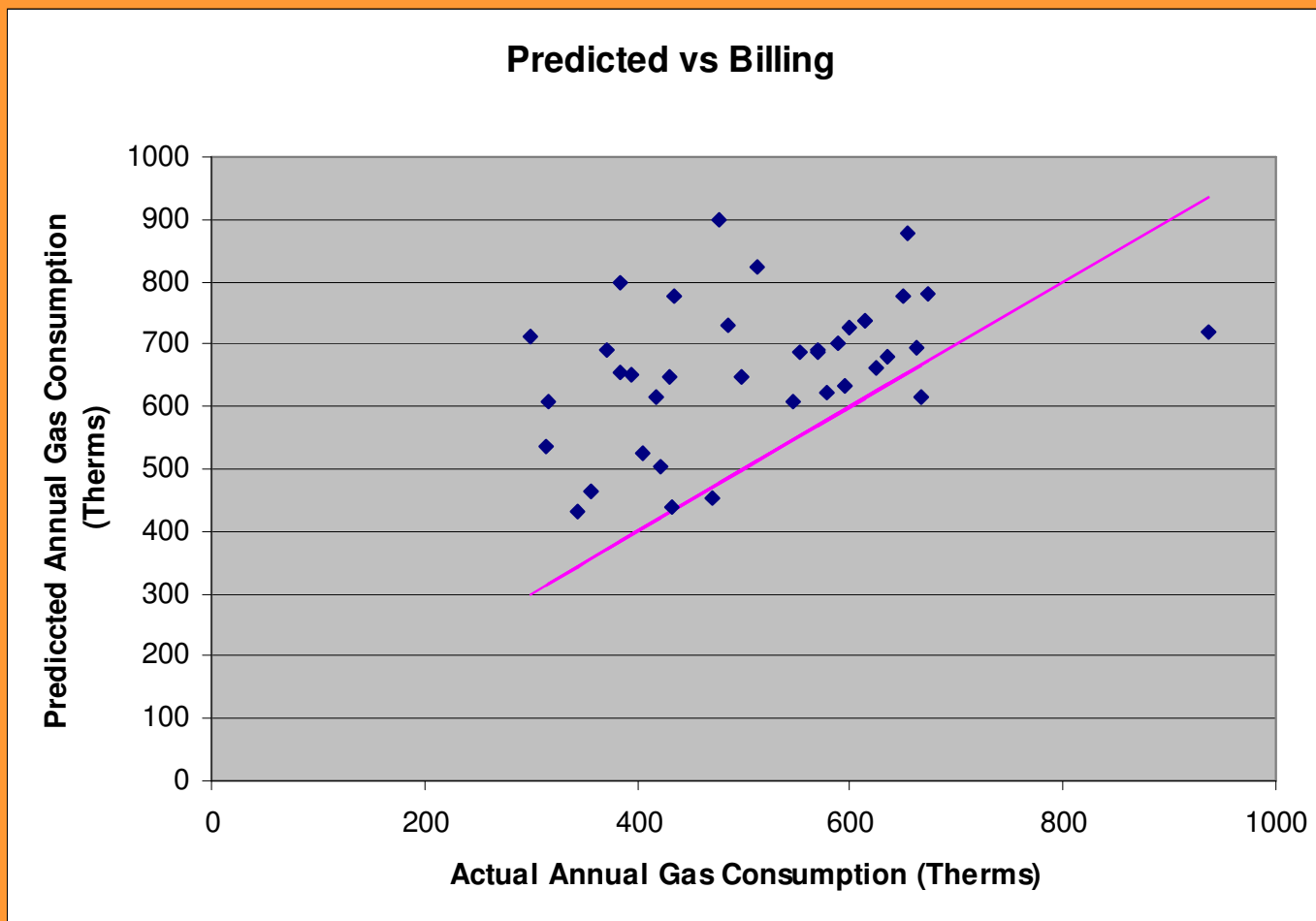
Source: Reference Design Guide For Highly Energy Efficient Residential Construction; July 2007; Jan Harris Vermont Energy Investment Corporation; Michael Blasnik, Conservation Services Group



Actual Energy Use vs Billing Data

- Colorado Study
 - Single builder in Northern Colorado
 - Perception of over prediction of energy use
 - Gas billing data collected for 38 homes
 - Homes are somewhat unique
 - High efficiency furnace
 - Demand water heater
 - Uninsulated floor over uninsulated basement

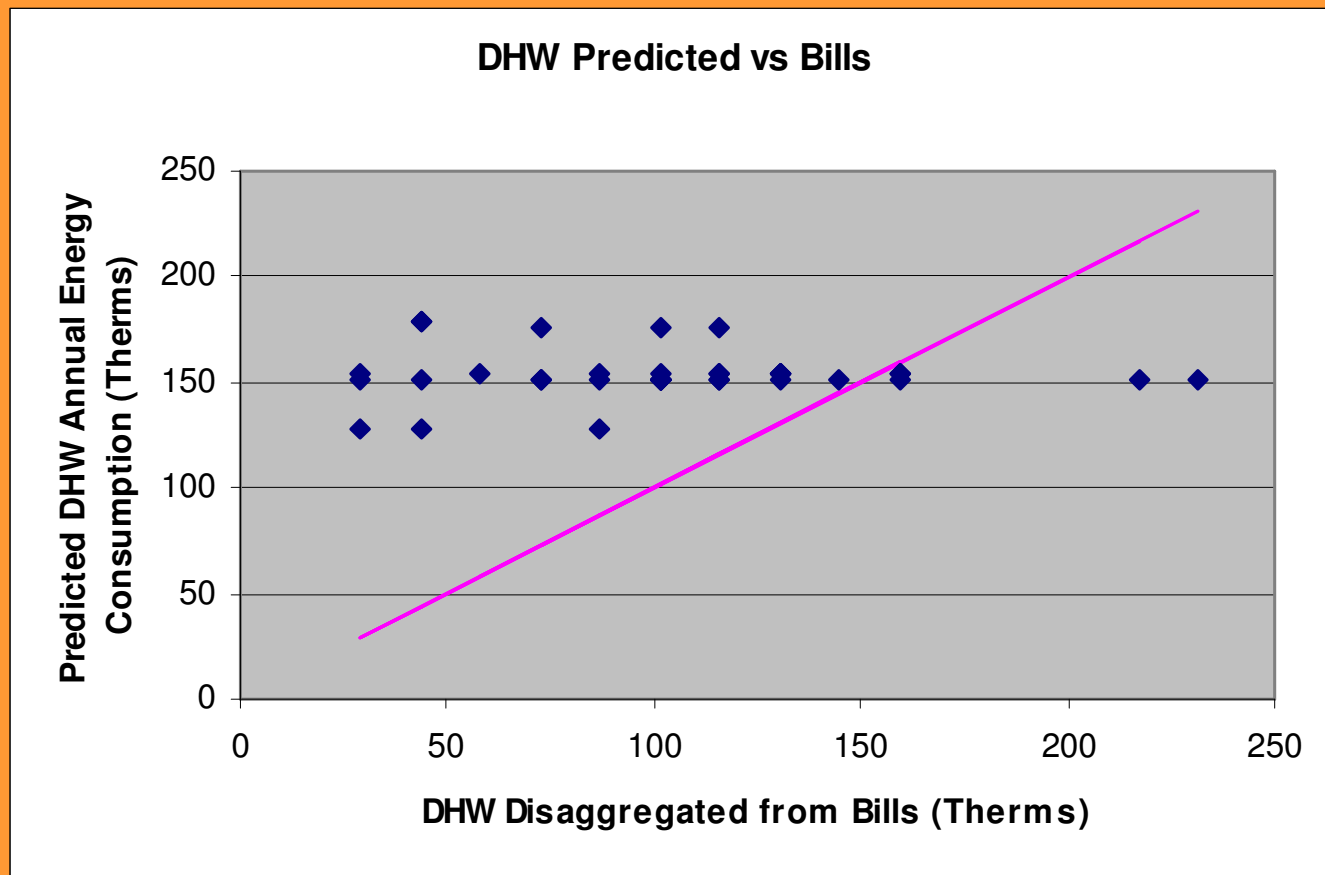
Colorado Study



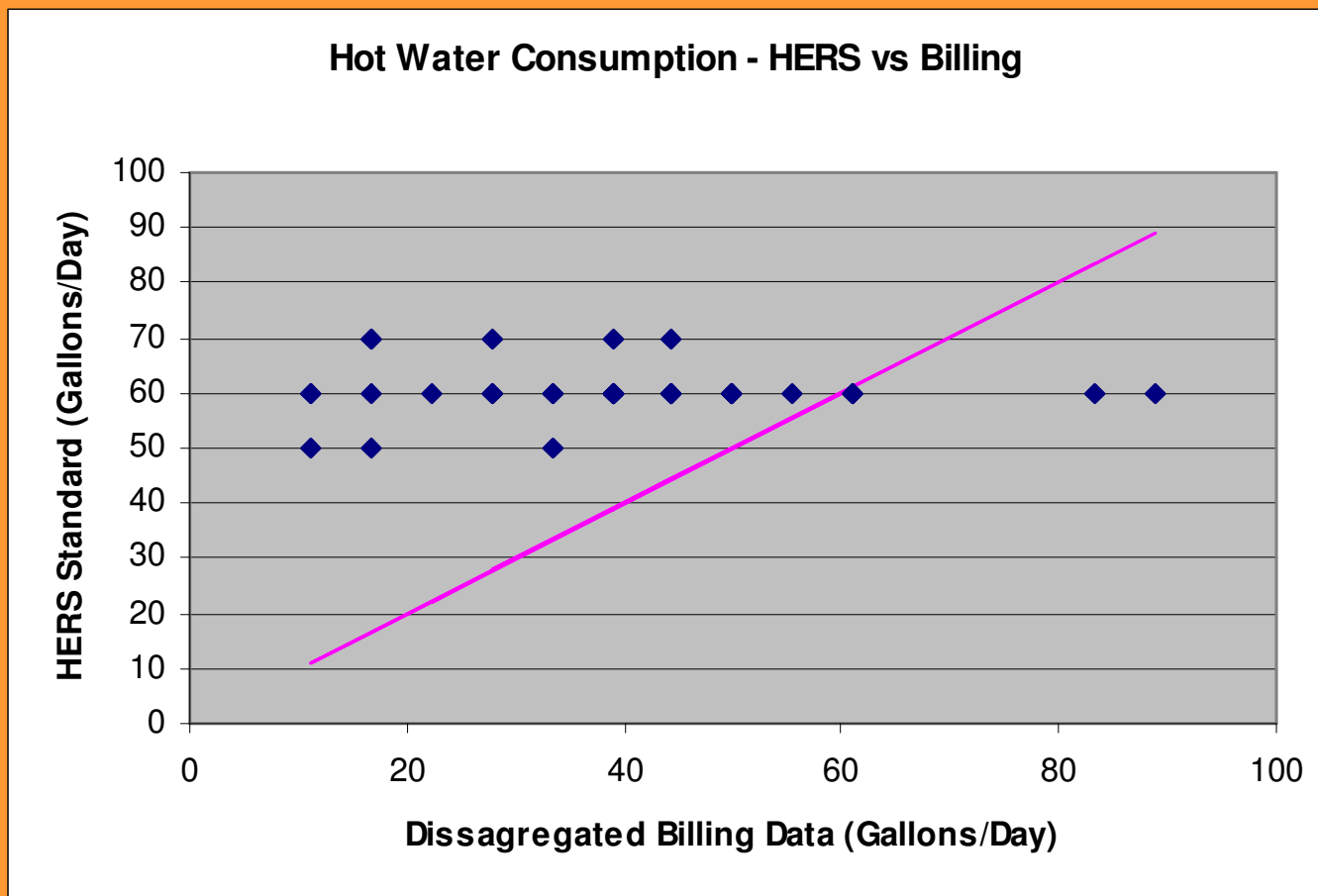
Actual Energy Use vs Billing Data

- Disaggregate DHW/space heating
 - Minimum monthly gas use is DHW
 - Adjust monthly for ground temperature
 - Balance is space heating

Colorado Study



Colorado Study

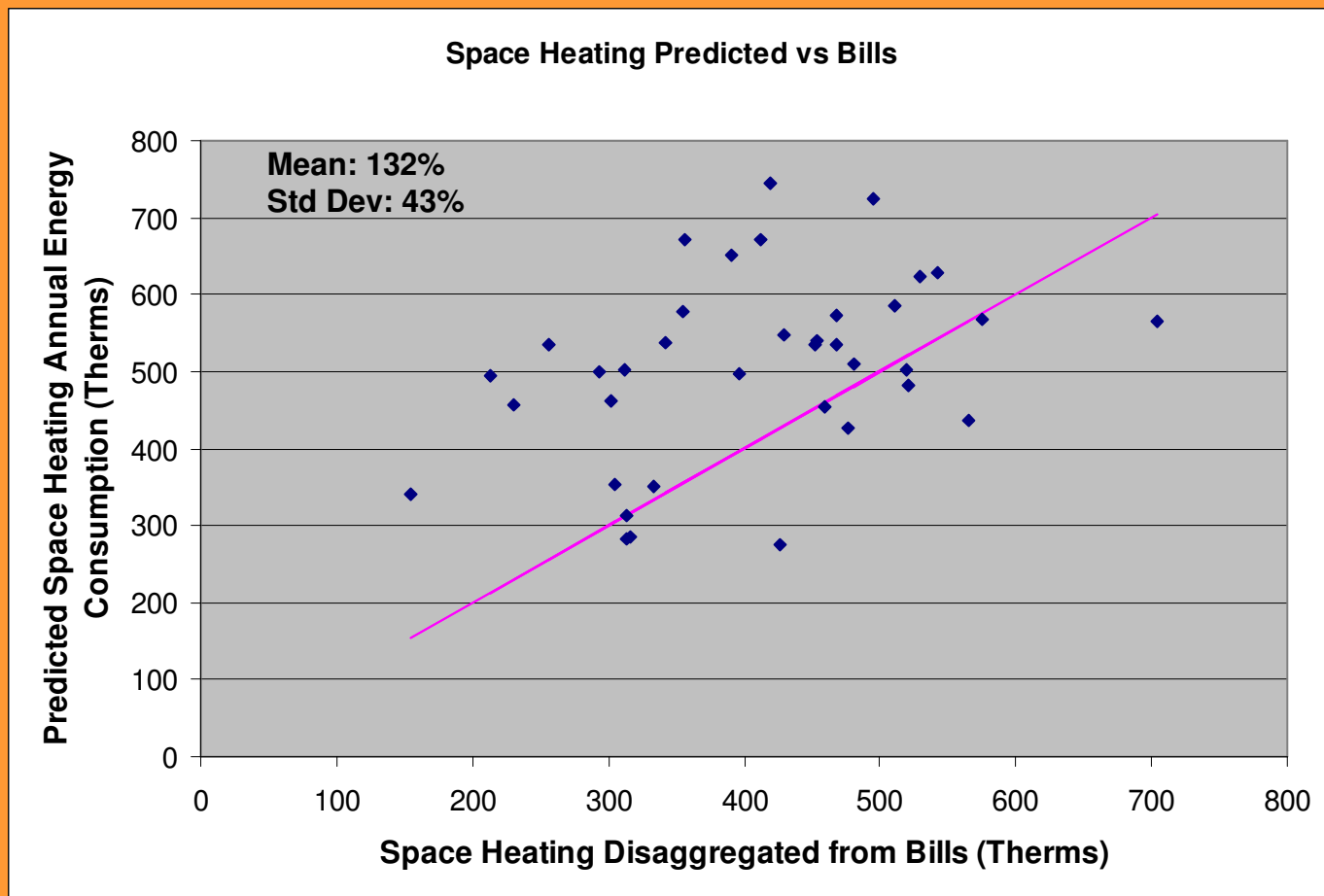


Actual Energy Use vs Billing Data

- HERS assumption of hot water appears to be high for these homes
- Due to occupancy patterns?
- Does demand water heater have an impact?

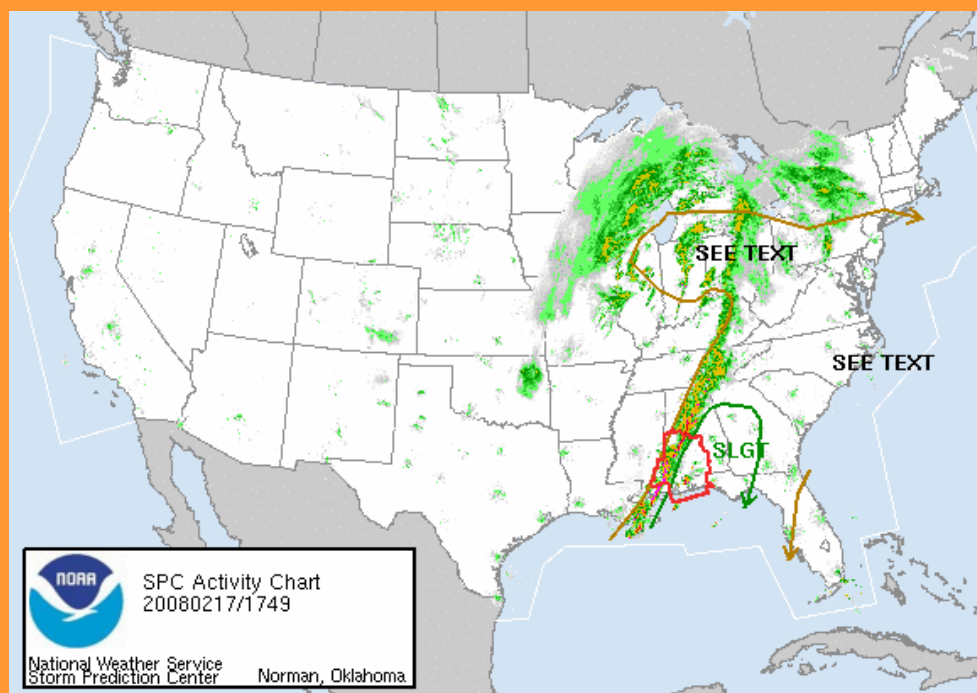


Colorado Study



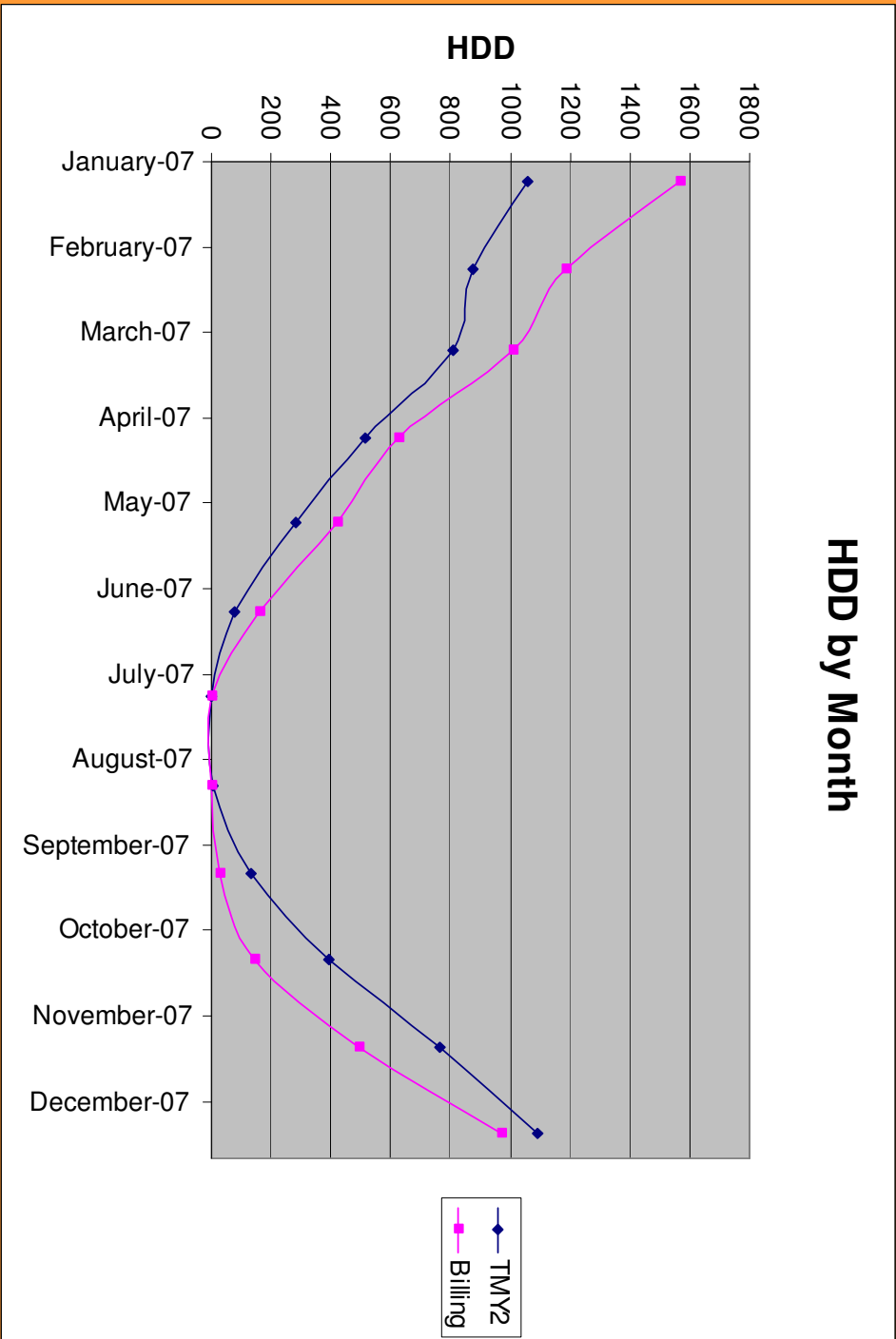
Actual Energy Use vs Billing Data

- Predicted space heating appears to be high
- Look at weather during billing period



Colorado Study

HDD by Month

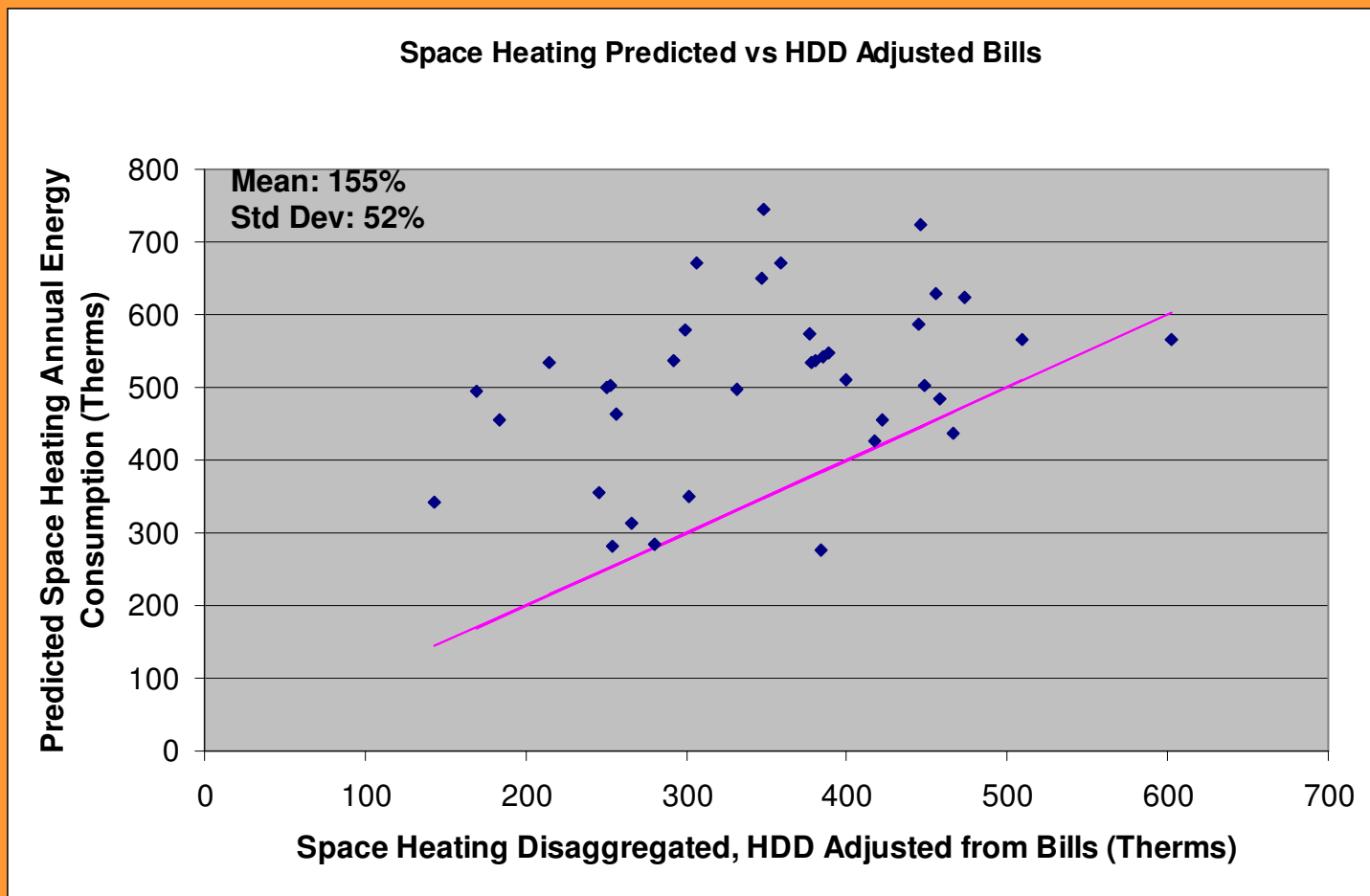




Actual Energy Use vs Billing Data

- HDD about 10% higher than TMY2 during 2007
 - Typical Meteorological Year (TMY)
 - Data sets derived from the 1961-1990 National Solar Radiation Data Base (NSRDB) are the second set thus the 2
- Disaggregated space heating adjusted for HDD by month

Colorado Study



Actual Energy Use vs Billing Data

- Colorado Study
 - Conclusions
 - HERS DHW loads appear high for these homes
 - Predicted space heating loads appear to be high

Where we are going

- More work to do
 - Surveys for these homes (i.e. DHW patterns)
 - Additional billing data
 - More houses from other builders
 - Is there a regional difference?

- Call for data
 - REM/Rate File
 - 12 months of gas and electric utility bills

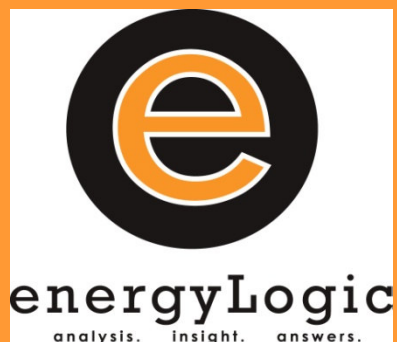


Thanks!

2008 RESNET Conference

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