Projecting Total Energy Use…

How Good Are We?

Ben Adams

VP Program Development

MaGrann Associates

Data

Observations

Questions

WAGs

Opportunities?

Not a formal evaluation or peer reviewed study

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HERS scores can be used to drive performance…

…not just predict it

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HEDIS scores can be used
to drive performance
...but not predict it

Tiers + HERS Index

Incentives by Tier, Code & Index		
	vs. IECC 2006	
HERS	Tier 1 *ENERGY*Efficient Home	Tier 2 ENERGY STAR Home
85	$1,500	$2,500
80	$1,750	$2,750
75	$2,000	$3,000
70	$2,250	$3,250
65	$2,500	$3,500

Energy Saving Home	
85-81	$440
80-71	$500
70-61	$640
60-51	$900
50-0	$1200

HERS	Tier 1 ("En... v2.0	
85		
80	$3...	
75	$500	$1,000
70	$750	$1,250
65	$1,500	$2,000
60	$1,750	$2,250
55	$2,250	$2,750
≤50	$3,000	$3,500

HERS	Tier 1	Tier 2
70-61	$200	$250
60-51	$1,100	$1,300
50-0	$1,500	$1,625

Multi Single x 75%
Multifamily x 50%
Tier 1 programs require min. ES 2.0 w/TBC
Tier 2 programs require ES 3.0

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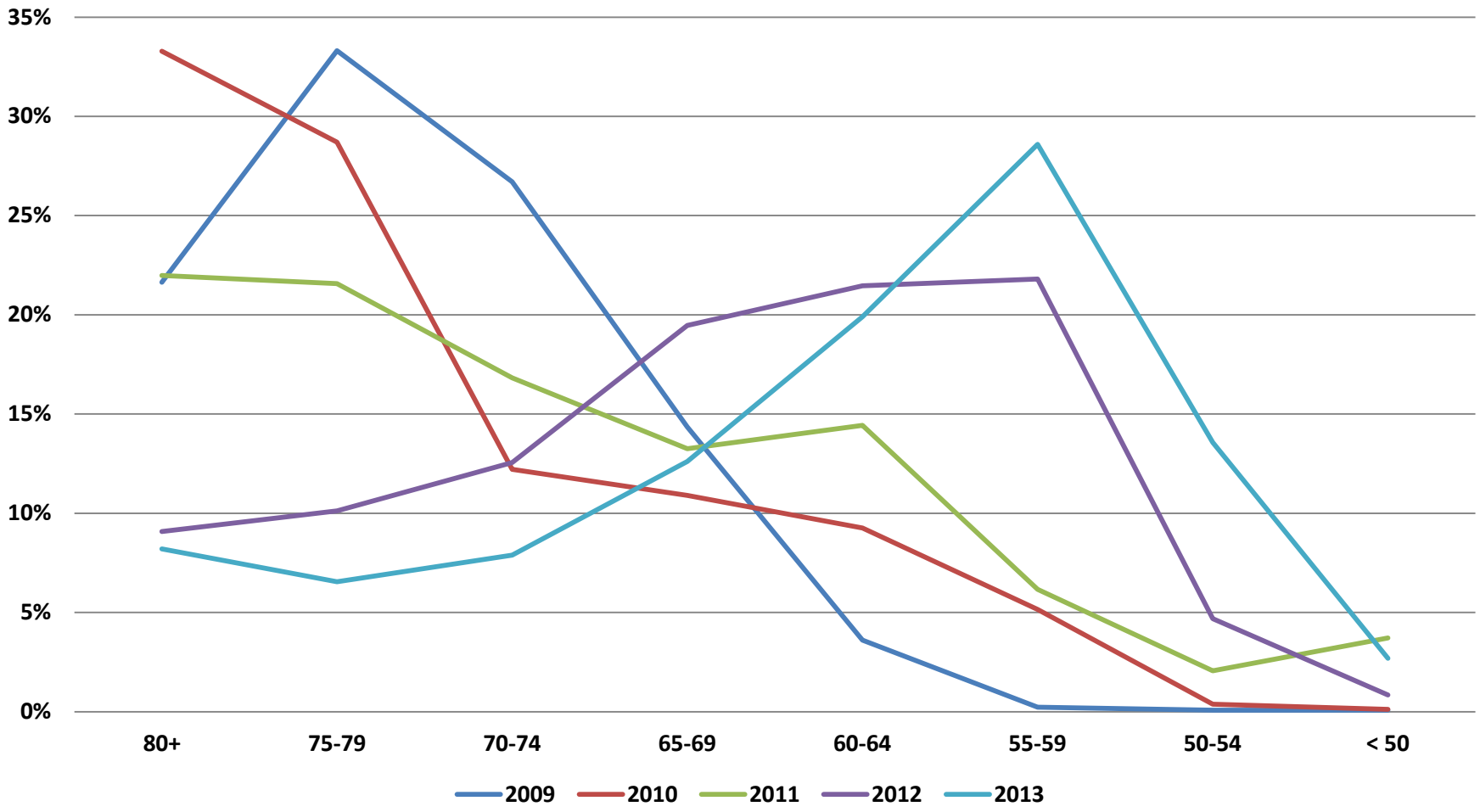
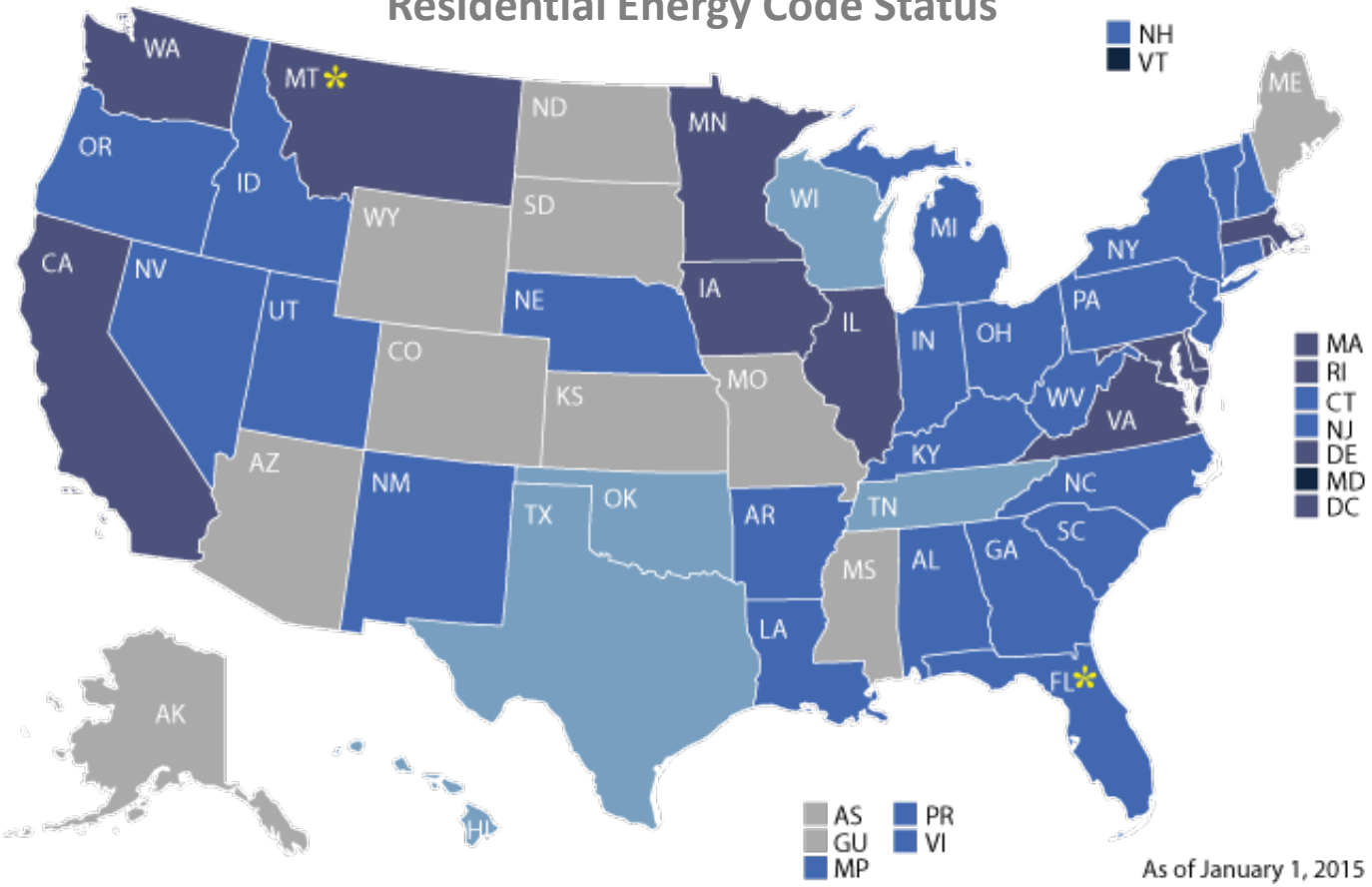
HERS Distribution by Year



Residential Energy Code Status



As of January 1, 2015

MORE EFFICIENT

- meets or exceeds the **2015 IECC** or equivalent (2)
- meets or exceeds the **2012 IECC** or equivalent (11)
- meets or exceeds the **2009 IECC** or equivalent (26)
- meets or exceeds the **2006 IECC** or equivalent (5)
- **no statewide code or precedes** the 2006 IECC (12)

* state has adopted a new code to be effective at a later date

OCEAN

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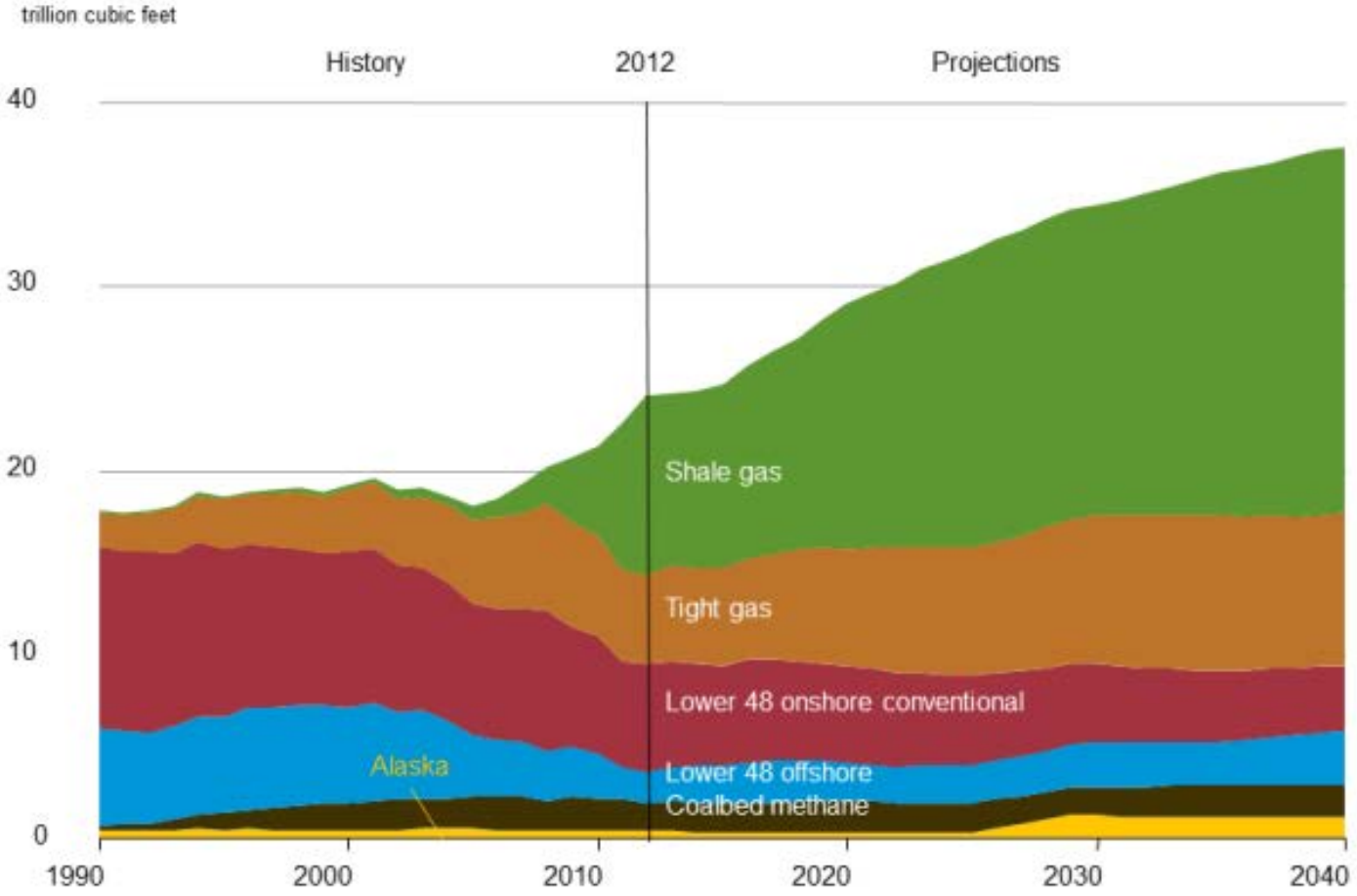
US Natural Gas Production 1990-2014



eia U.S. natural gas production by source in the Reference case, 1990-2040

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DANGER
CLIMATE DESTRUCTION AHEAD
REDUCE CO2 EMISSIONS NOW
(c)Greenpeace

Name:
Account Number:
Phone Number:
Service Address:

01/31/2013

Billing Summary

Bill Date	
Thank you for your payment of $220.59	
Current Period Charges	
Gas	$184.53
Electric	$114.54
Total New Charges	**$299.07**
Total Amount Due on 02/22/2013	**$299.07**

General Information

Next scheduled meter reading: **February 28, 2013**
PECO, 2301 Market St, Philadelphia, PA 19103-1380. If you have any questions or concerns, please call **1-800-494-4000** before the due date.
Si tiene alguna pregunta, favor de llamar al numero **1-800-494-4000** antes de la fecha de vencimiento.

Customer Self Service - Manage Your Account 24/7

Message Center

New charges contain estimated total state taxes of $6.02, including $7.01 for State Gross Receipts Tax.

Your estimated electric price to compare is $0.0869 per kWh.

The amount of this bill will be automatically deducted from your bank account on Feb 22, 2013.

Beyond HERS scores…

…Total usage!

THE FINAL FRONTIER

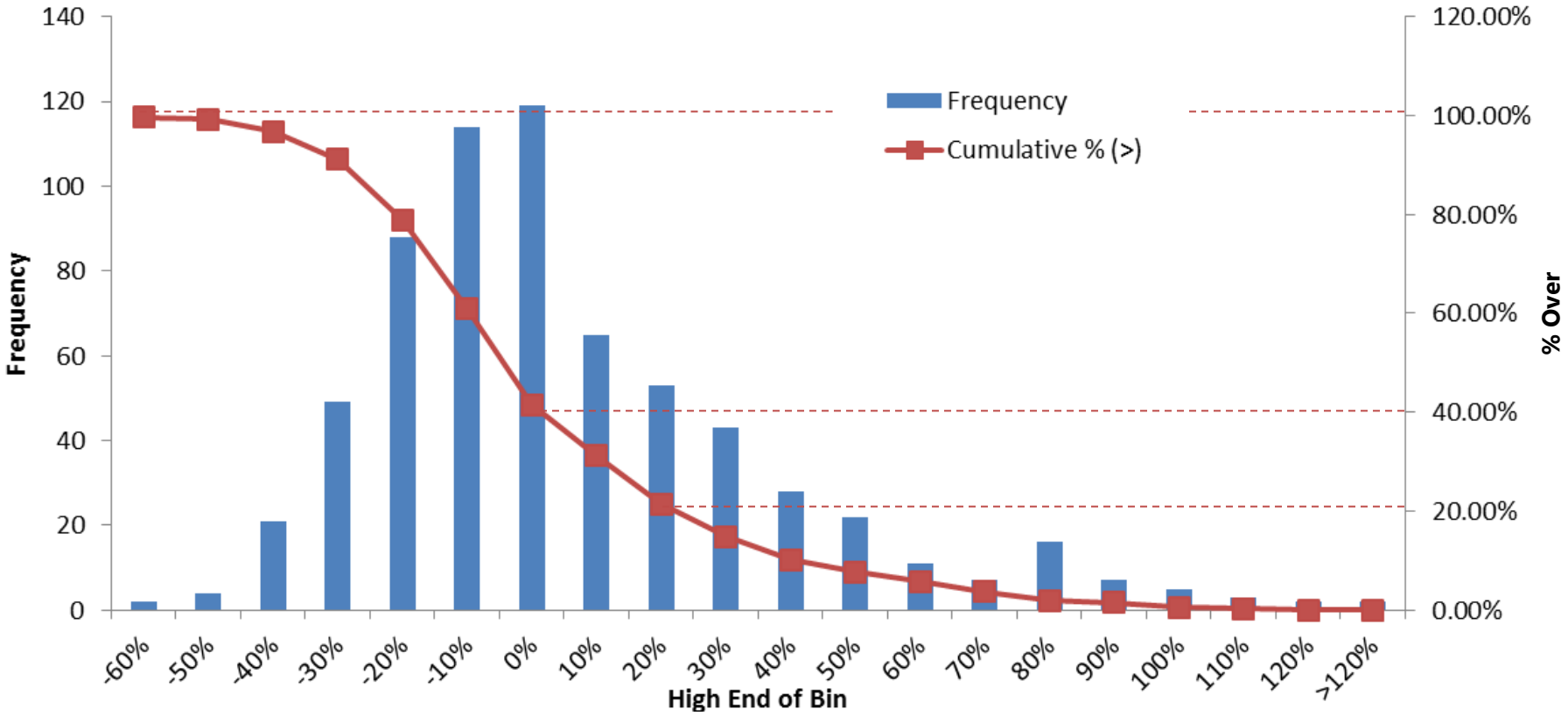
How Good Are We At Projecting Total Energy Use?

?

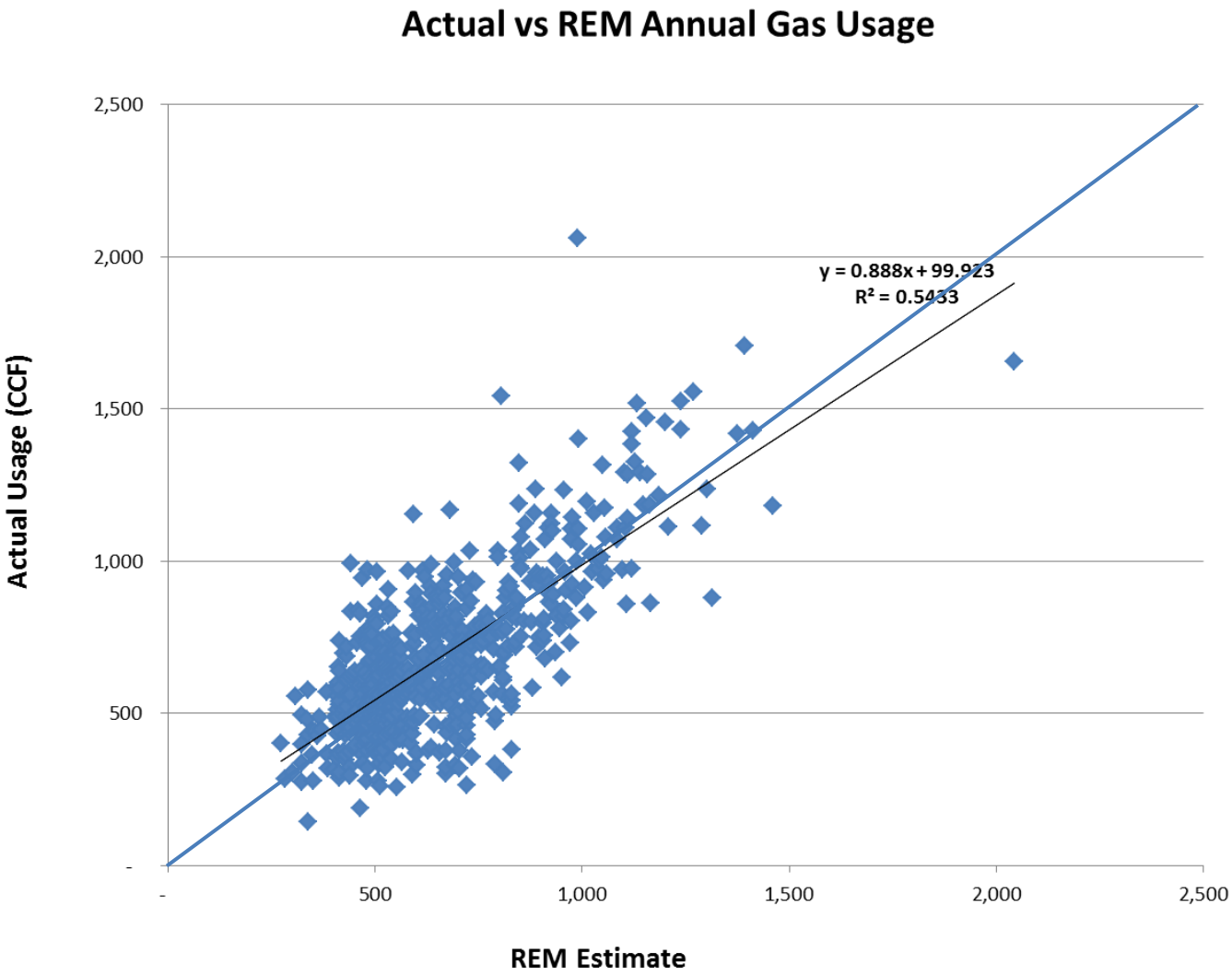
±3%

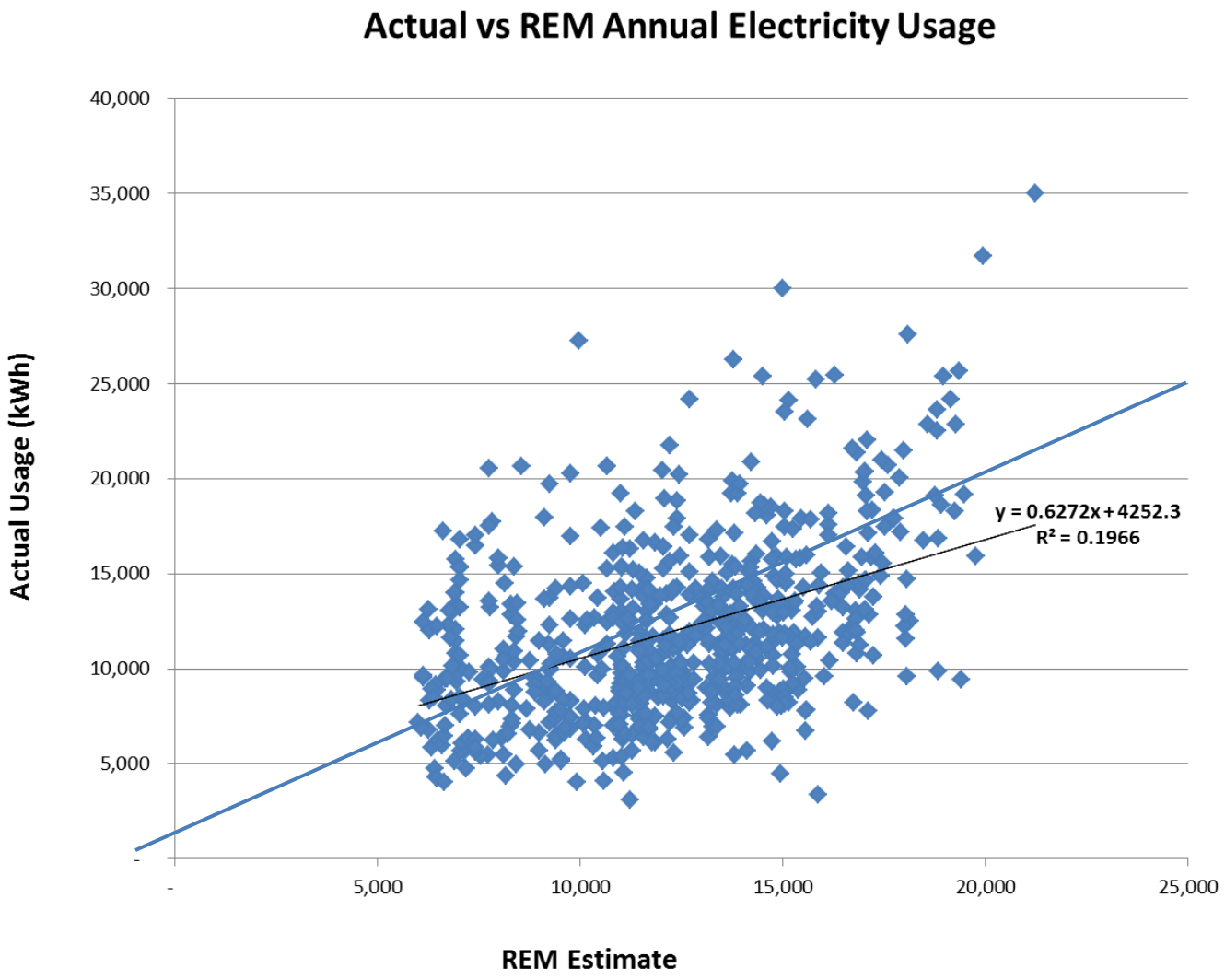
Actual vs REM Total Cost
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Actual Cost
$0
$500
$1,000
$1,500
$2,000
$2,500
$3,000
$3,500
$4,000
$4,500
REM Estimate
y = 0.7038x + 545.01
R² = 0.2915

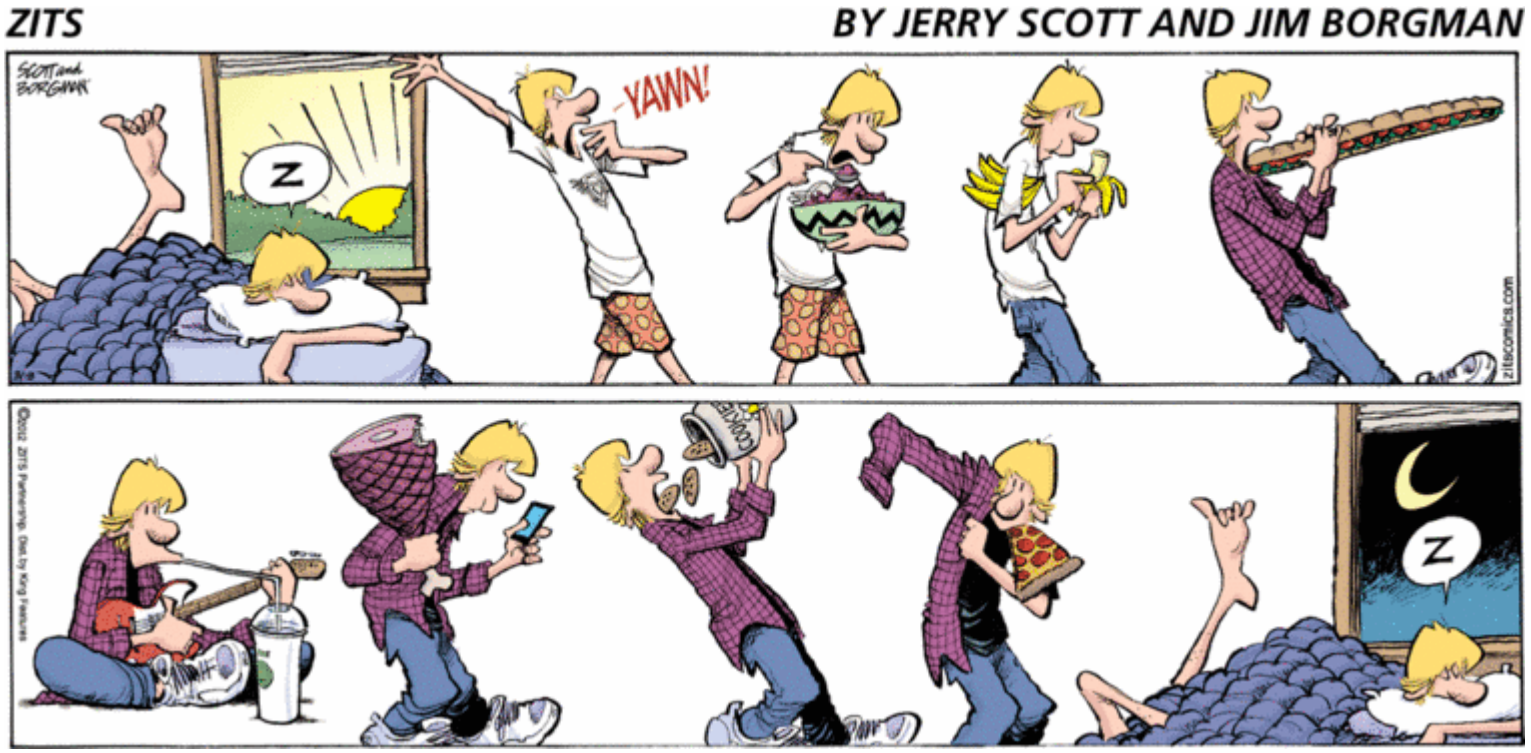
Variability in REM Total Cost Estimation



$ Over / Month	% Homes Lower
$0	59%
$17	70%
$33	79%
$50	86%
$67	91%
$83	94%


Actual vs REM Annual Gas Usage
Actual Usage (CCF)
REM Estimate
y = 0.888x + 99.923
R² = 0.5433
2,500
2,000
1,500
1,000
500
-
-
500
1,000
1,500
2,000
2,500


Actual vs REM Annual Electricity Usage
Actual Usage (kWh)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
-
-
5,000
10,000
15,000
20,000
25,000
REM Estimate
y = 0.6272x + 4252.3
R² = 0.1966


ZITS
BY JERRY SCOTT AND JIM BORGMAN
SCOTT and BORGMAN
Z
YAWN!
zitscomics.com
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What else?

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Potential Correlations

ENERGY STAR version	-0.07	No correlation
Builder	-0.01	No correlation
Rater	0.22	Low correlation
House size (CFA)	-0.21	Low correlation
HERS score	-0.05	No correlation
A/C efficiency	0.06	No correlation
Number of A/Cs	0.02	No correlation
Furnace efficiency	-0.06	No correlation
Number of furnaces	0.01	No correlation
Water heater efficiency	-0.21	Low correlation
Number of DHWs	-0.07	No correlation

Pearson's Coefficient

High: 0.5 to 1.0 or -0.5 to -1.0

Medium: 0.3 to 0.5 or -0.3 to -0.5

Low/None: 0 to 0.3 or 0 to -0.3

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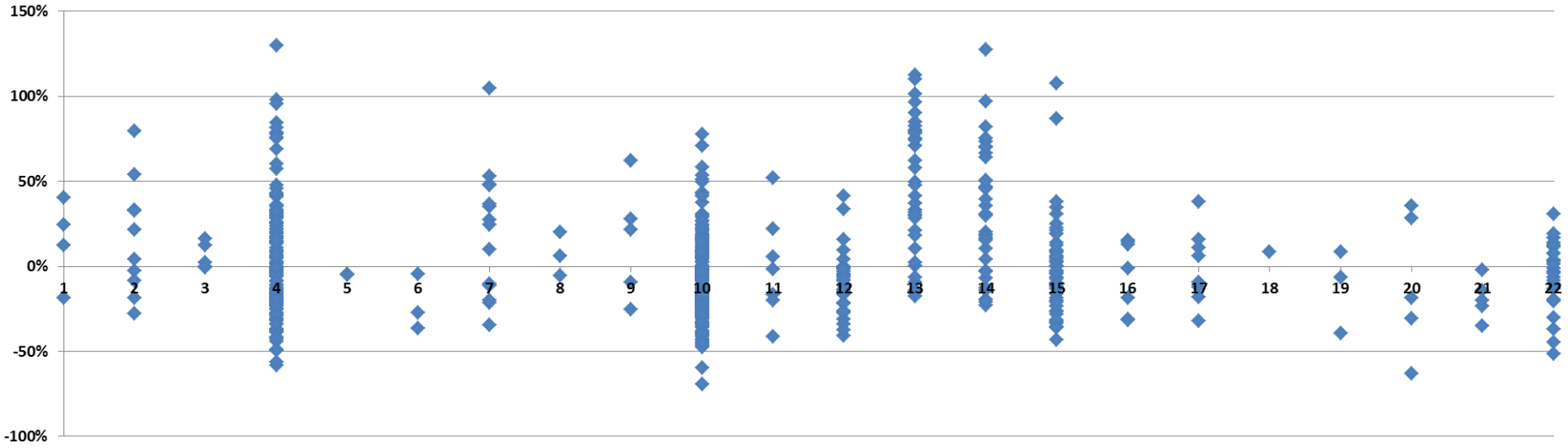
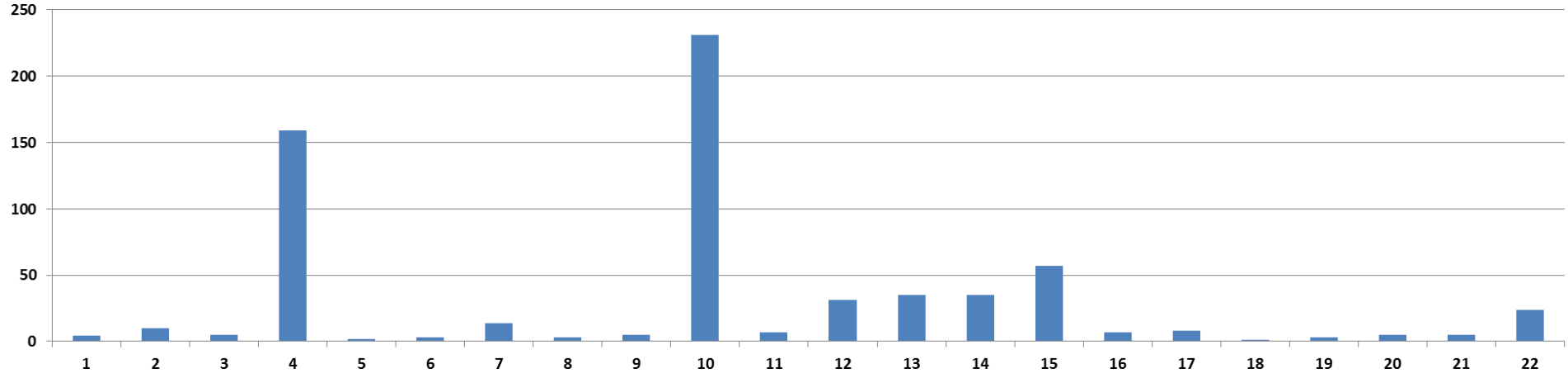
Variability by Builder



Number of Homes by Builder



What about target demographics?

- **Affordability**
  - Down payment; Debt-Income %; PITI+U
  - Less $ after purchase?
- **Move-in characteristics**
  - Appliances & other end uses
  - Efficiency if not builder supplied? Defaults vs. verified?
- **"Occupant intensity"**
  - Families; seniors; age; etc.
  - Smaller homes…
  - Validity of "bedrooms +1"?

In any case,
end use predictability
is only going to get
more difficult.
Right?

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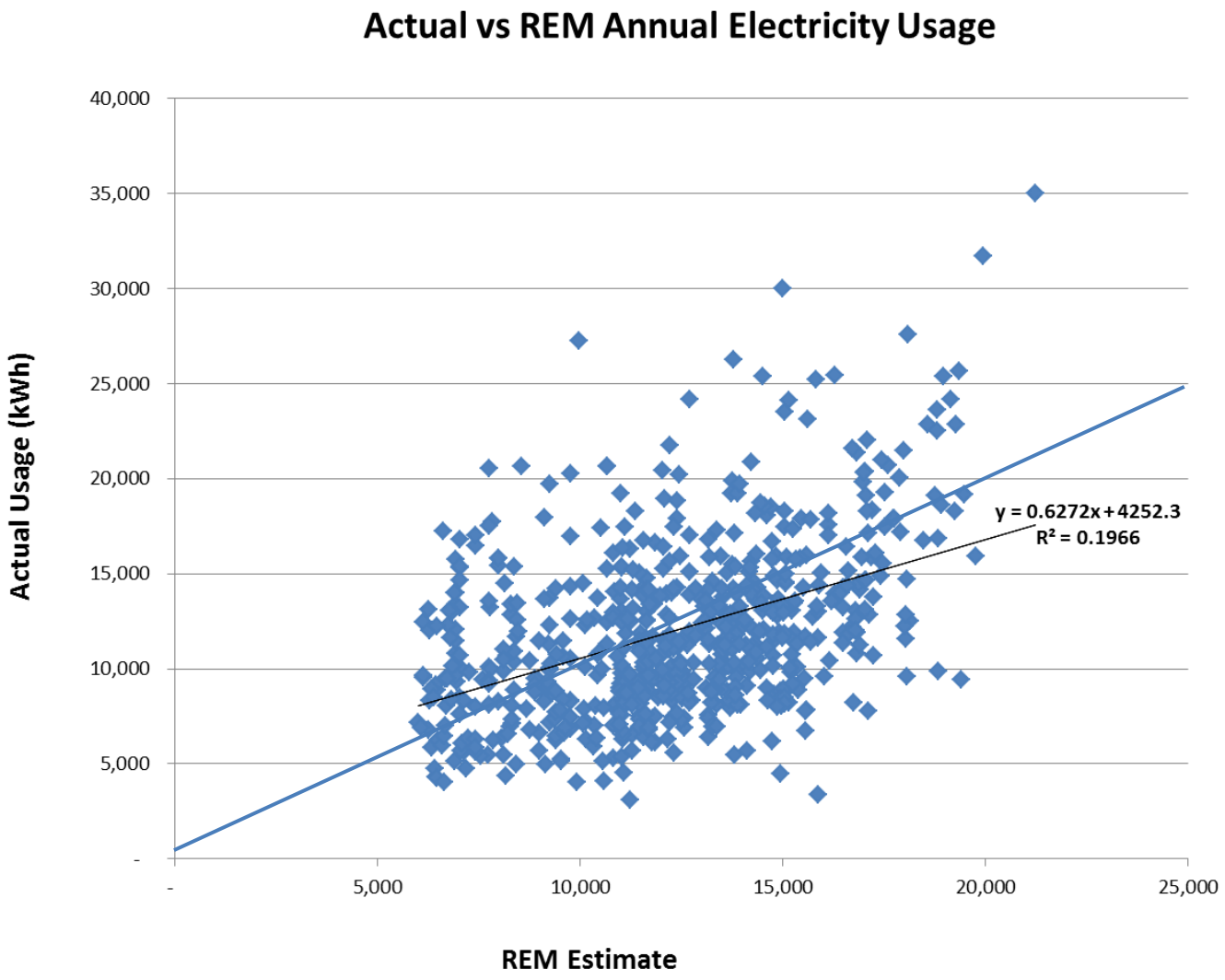
Actual vs REM Annual Electricity Usage
Actual Usage (kWh)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
-
-
5,000
10,000
15,000
20,000
25,000
REM Estimate
y = 0.6272x + 4252.3
R² = 0.1966

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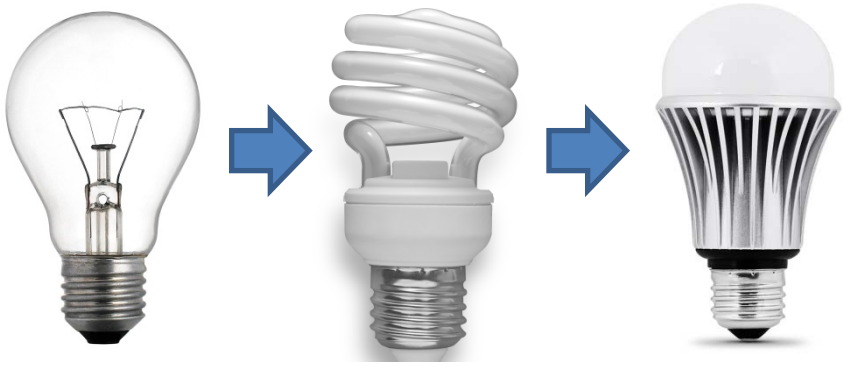
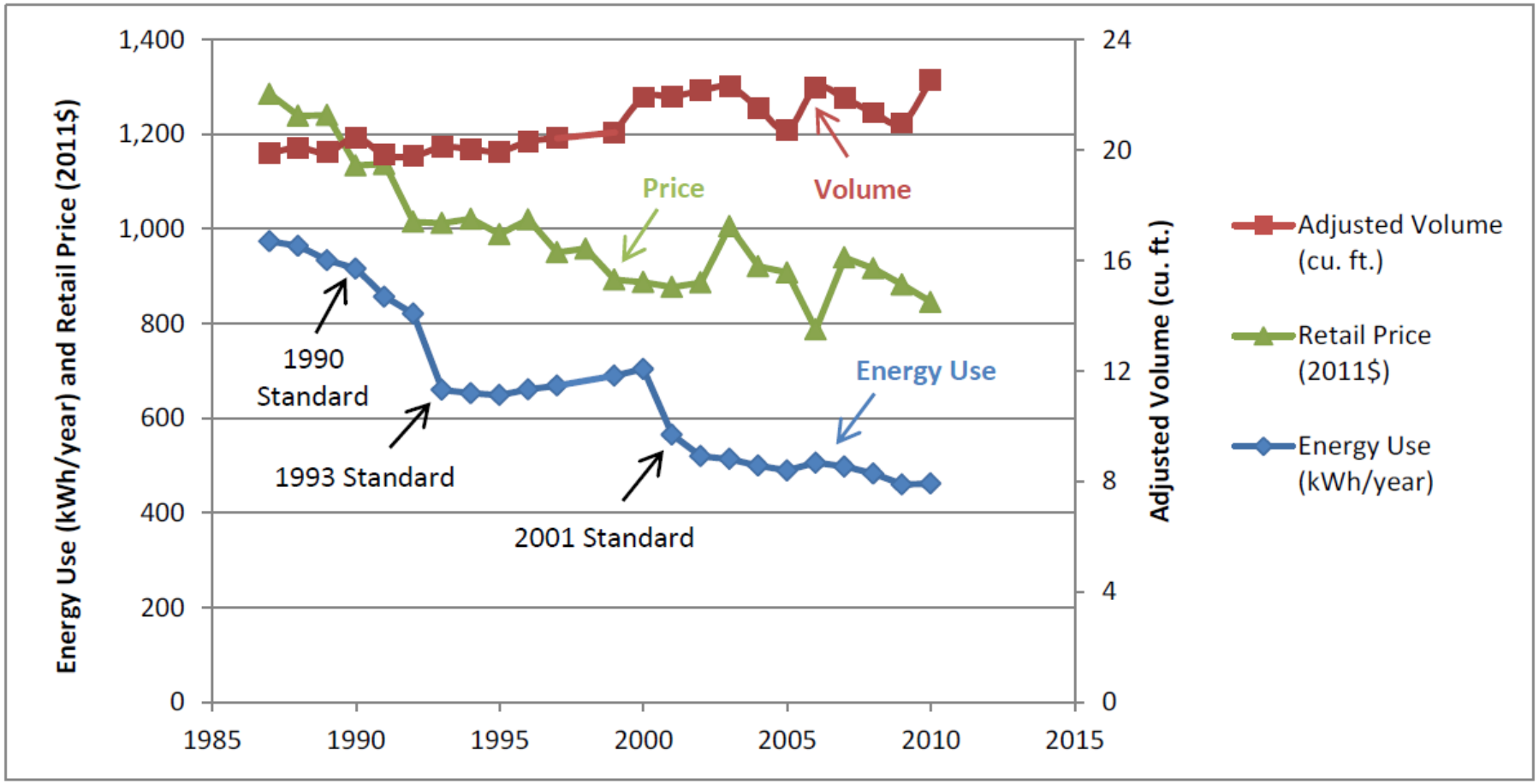
Lighting

Min Lumens	Incandescent Watts	EISA Min Watts	Typical LED-CFL Watts	Effective Date
1600	100	72	19-23	1/1/2012
1100	75	53	15-18	1/1/2013
800	60	43	8-13	1/1/2014
450	40	29	6-9	1/1/2014



Refrigerators



Sources: AHAM (2011) for energy use and volume; authors' analysis of U.S. Census Bureau Current Industrial Reports data for price; DOE (2011d) for markup.

Better Appliances: An Analysis of Performance, Features, and Price as Efficiency Has Improved

Joanna Mauer, Andrew deLaski, Steven Nadel, Anthony Fryer, and Rachel Young

May 2013
Report Number A132

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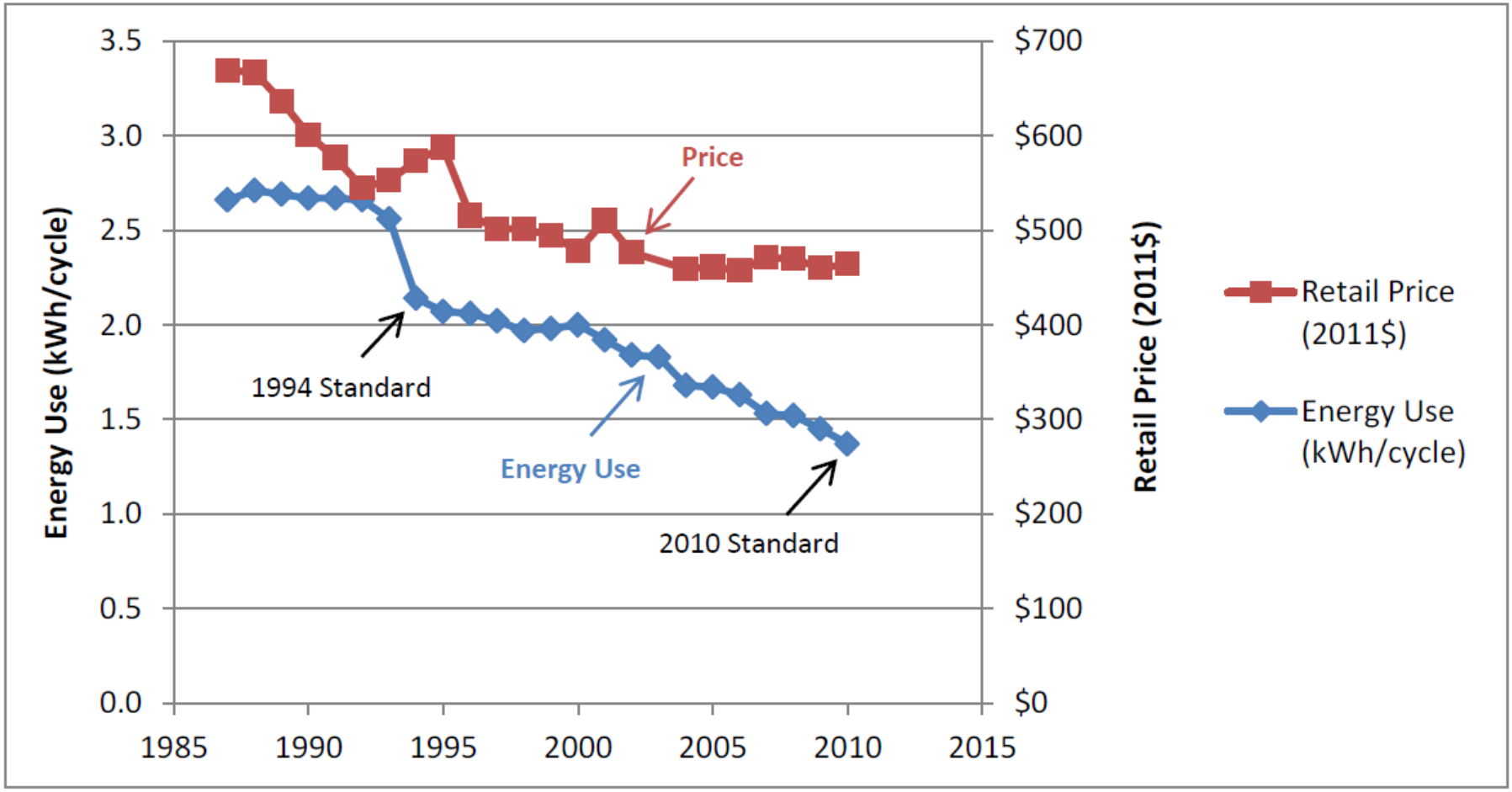
Dishwashers



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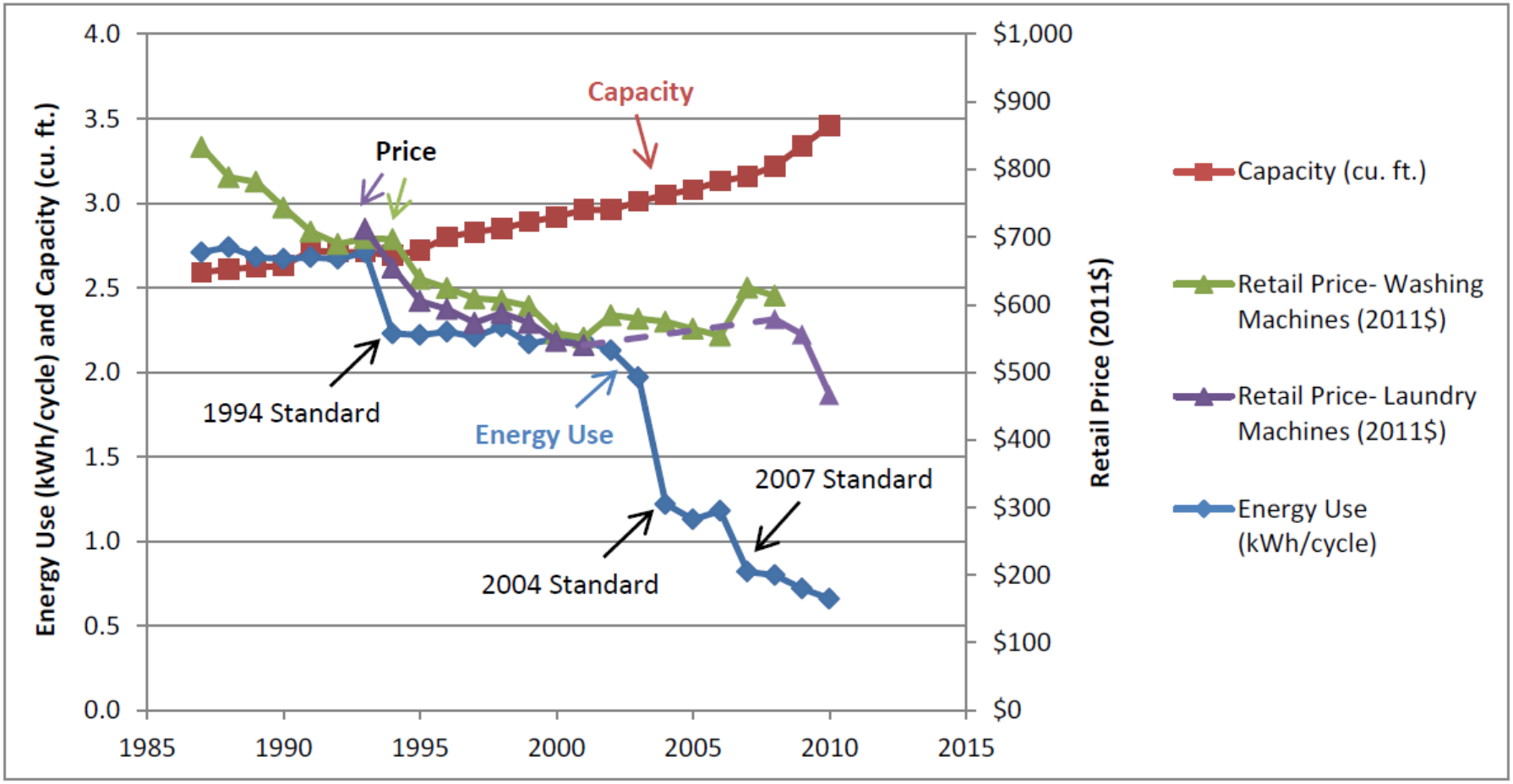
Clothes Washers



Sources: AHAM (2011) for energy use and capacity; authors' analysis of U.S. Census Bureau Current Industrial Reports for price; DOE (2012c) for markup.

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TVs

Screen Size	LED	LCD	CRT	Plasma
15 inches	15	18	65	---
17 inches	18	20	75	---
19 inches	20	22	80	---
20 inches	24	26	90	---
21 inches	26	30	100	---
22 inches	30	40	110	---
24 inches	40	50	120	---
30 inches	50	60	---	150
32 inches	55	70	---	160
37 inches	60	80	---	180
42 inches	80	120	---	220
50 inches	100	150	---	300

http://energyusecalculator.com/electricity_lcdleddisplay.htm

MELs

Miscellaneous Electric Loads

2012 Voluntary Agreement for Ongoing Improvement to the Energy Efficiency of Set-Top Boxes

↘ $168-350m

Tier 2 in 2017

https://www.ncta.com/sites/prod/files/VoluntaryAgreementforOngoingImprovementtotheEnergyEfficiencyofSet-TopBoxes.pdf

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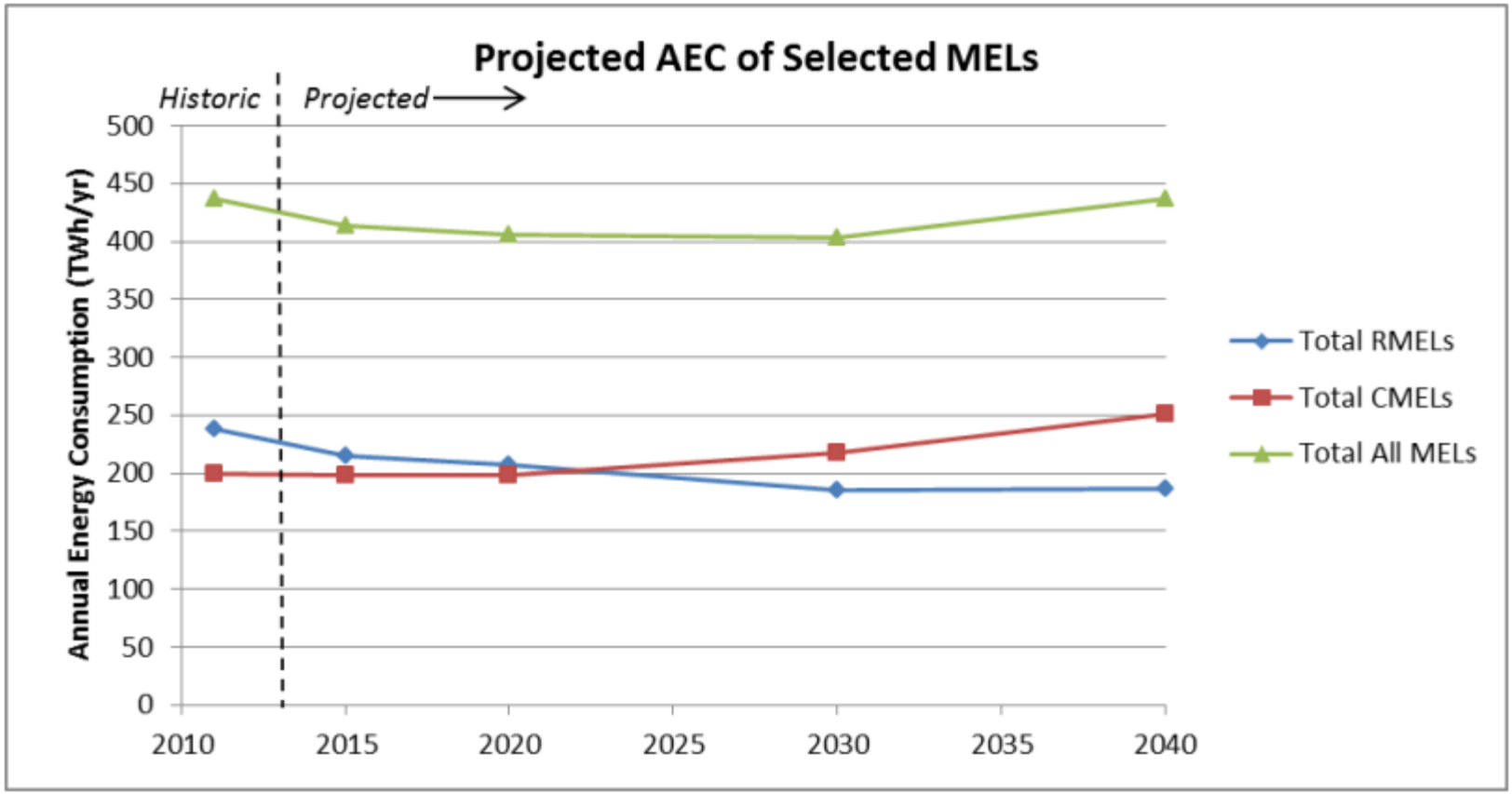


Residential MELs ↘ 22%

EIA Analysis and Representation of Miscellaneous Electric Loads in NEMS by Navigant, December 2013
http://www.eia.gov/analysis/studies/demand/miscelectric/pdf/miscelectric.pdf

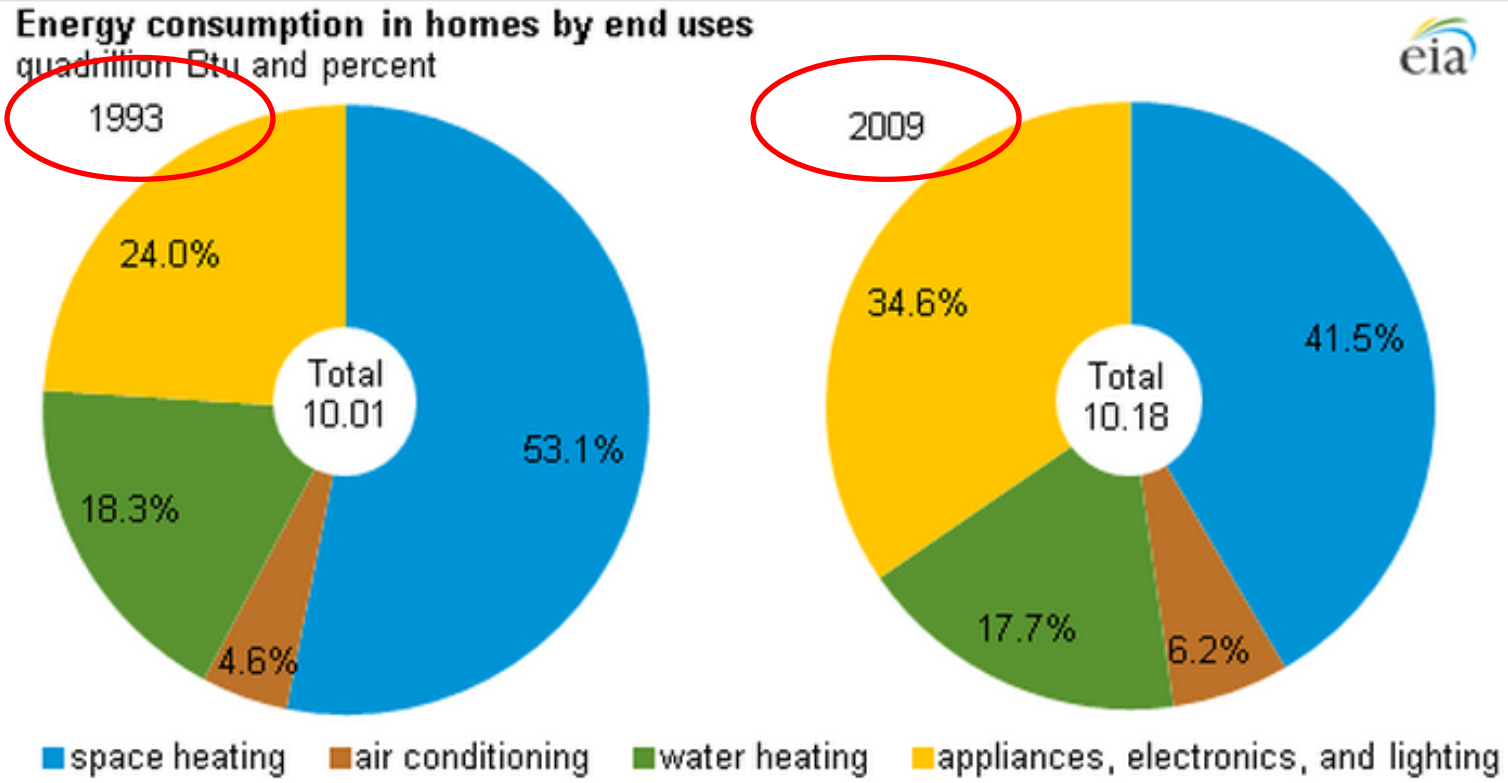
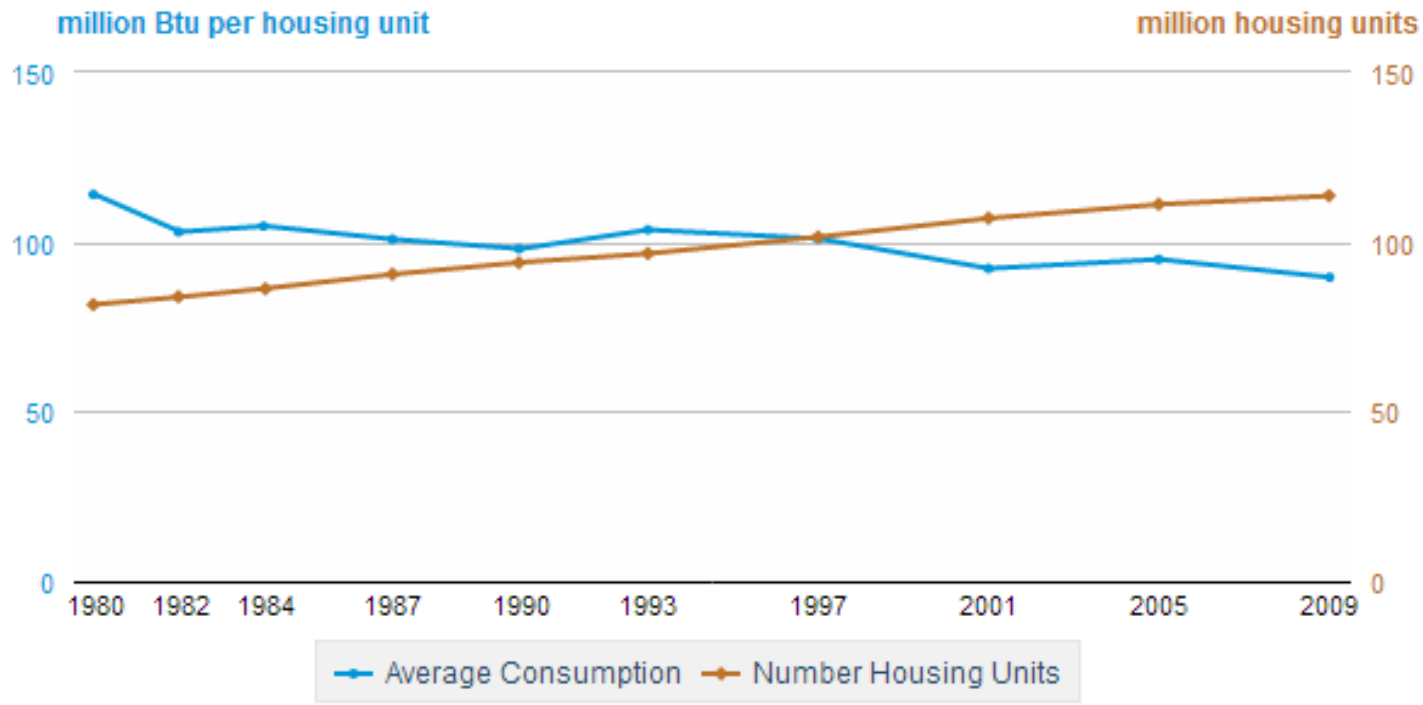

Energy consumption in homes by end uses
quadrillion Btu and percent
eia
1993
24.0%
Total
10.01
53.1%
18.3%
4.6%
2009
34.6%
Total
10.18
41.5%
17.7%
6.2%
space heating
air conditioning
water heating
appliances, electronics, and lighting

Figure 1. Average energy consumption per home and number of housing units, 1980-2009



eia Source: Residential Energy Consumption Survey. Includes occupied primary housing units only.

GAME
CHANGERS
AHEAD

IOT

The Internet of Things

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http://blog.smartthings.com/iot101/what-is-the-internet/

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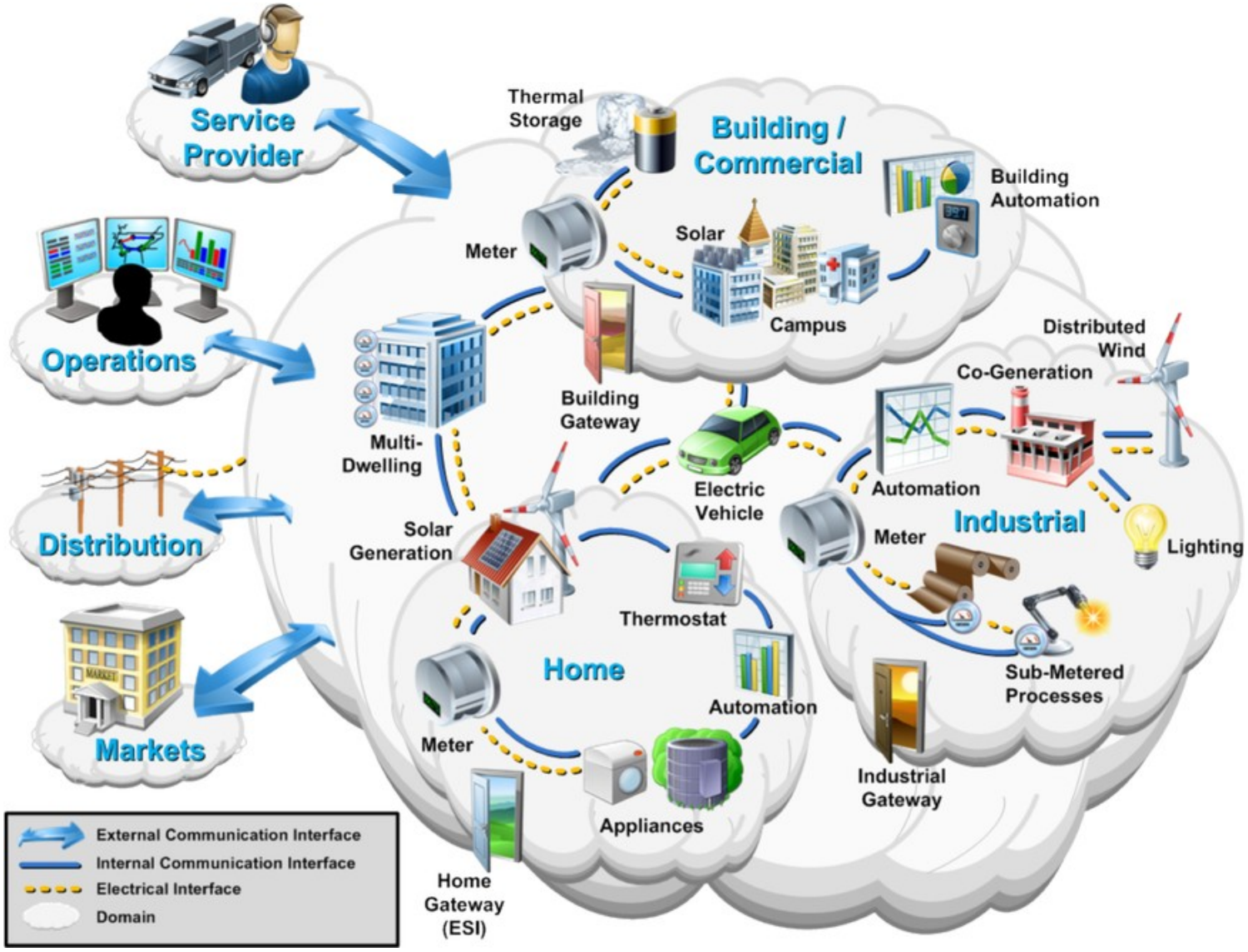
“Smart Fridge”?



http://www.dreamreport.net/reporting-as-a-service-raas-a-subset-of-software-as-a-service-saas-for-the-internet-of-things-iot/

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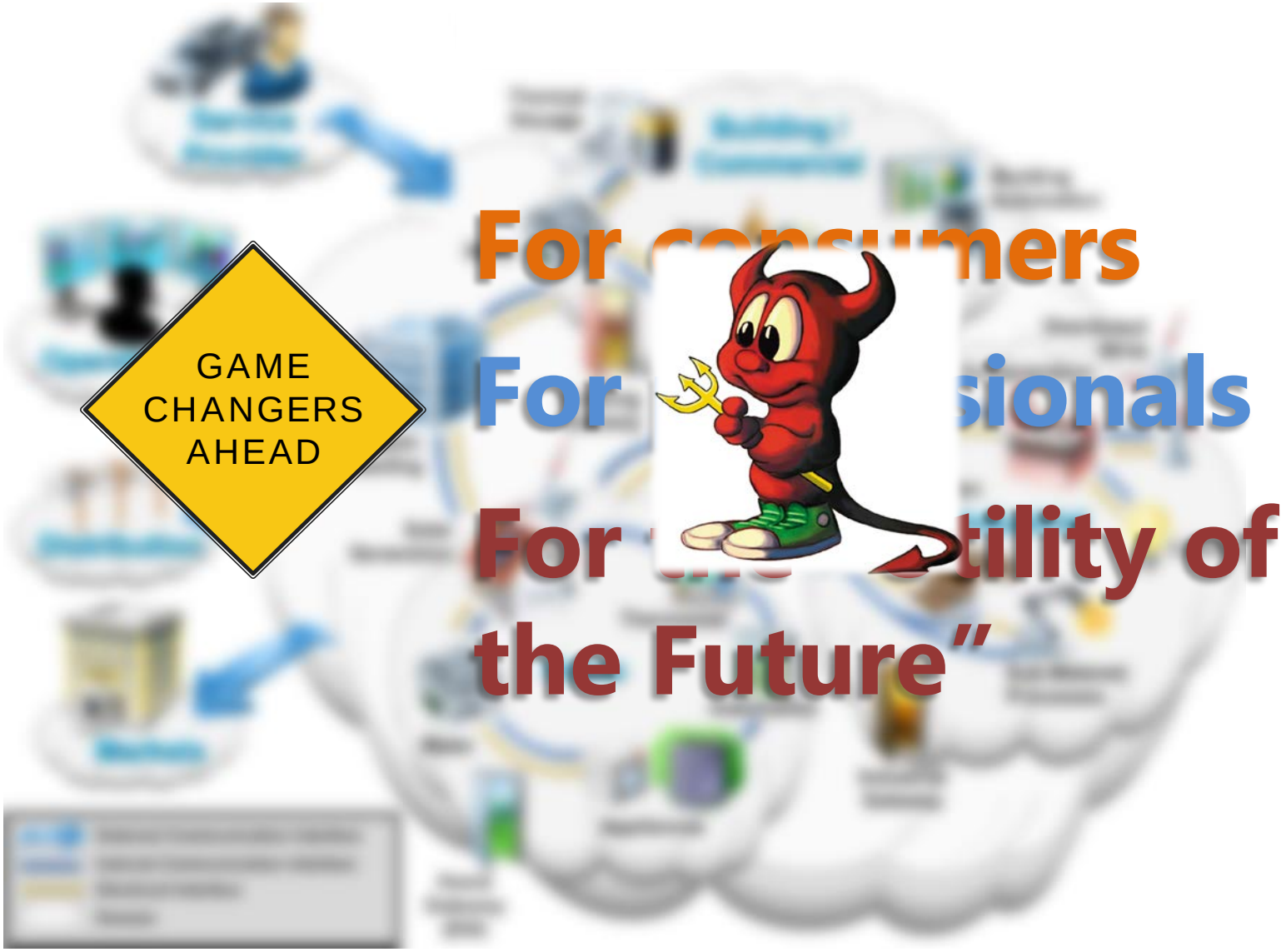
nest
67
IN 25 MIN
72



http://www.dreamreport.net/reporting-as-a-service-raas-a-subset-of-software-as-a-service-saas-for-the-internet-of-things-iot/

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Conclusions…?

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Projecting Total Energy Usage

- We may be better than we thought
  - 80/20 rule does seem to apply
- Variability is real
  - And can be significant for the outliers
- But may not be correlated with the asset rating
  - Not a "QA" indicator (at least when robust QA in force)
- New end uses and behavioral factors are key
  - Need to be assessed on an individual household basis
- But other demographic forces may also be in play
  - "Occupant intensity" needs study
- We should be ready to adjust rating assumptions
  - Be proactive to incorporate the game changers

Other Implications

- Total energy use guarantees
- The smart, connected home
- New roles and value for raters and ratings
- Customized non-asset ratings
- New customers

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Thank you

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