



For Businesses



For Homes



Renewable Energy



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About Us

EnergyTrust of Oregon

Framing the Audience: Describing Households That Invest in Energy Efficiency

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Purpose

- Study the effectiveness of online and in home audit programs – does it work?
- We need people to do things (save energy)
- Describe target audience by analyzing households who have received incentives for energy saving measures

Actions and motivations may be simple, and unobservable



Home Energy Audits - Nexus

- Nexus Home Energy Analyzer ®
- Online home audit tool
- Calculates how much energy your home can save based upon home and behavior characteristics given
- Makes recommendations for energy saving actions

Home Energy Audits – Home Energy Review

- Energy Trust – CSG Home Energy Review
- Households request a Home Energy Review
- A CSG trained auditor visits home to identify areas where home can potentially save energy

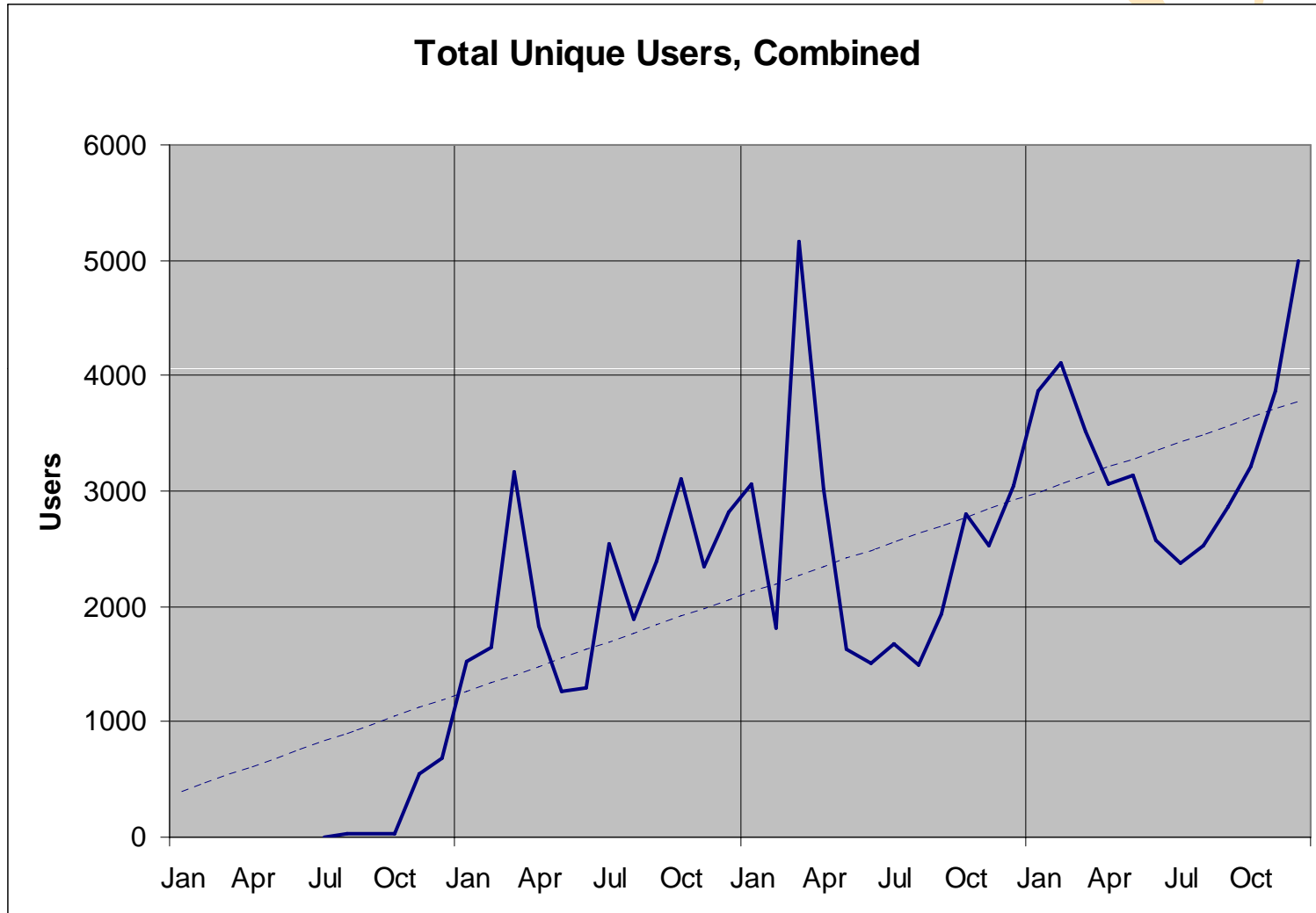
Identifying “Action Takers”

- Audit participants are matched to Energy Trust incentive participants and Oregon Residential Energy Tax Credit (RETC) recipients.
- Households that have received incentives for energy saving measures are “action takers”
- Households who have not received incentives are “participants”

Energy Efficiency Measures

Measure	Number of Measures Installed	Percent of Measures
Clothes Washer	937	30%
Free CFL's*	571	18%
Home Energy Review	314	10%
Dishwasher	259	8%
Lighting	197	6%
Gas Furnace	196	6%
Duct Sealing / Insulation	143	5%
Insulation	134	4%
Faucet Aerator / Showerhead	123	4%
Weatherization	67	2%
Heat Pump	42	1%
Windows	42	1%
Water Heater	38	1%
Fridge	28	1%
Boiler	1	0%
Total	3,092	100%

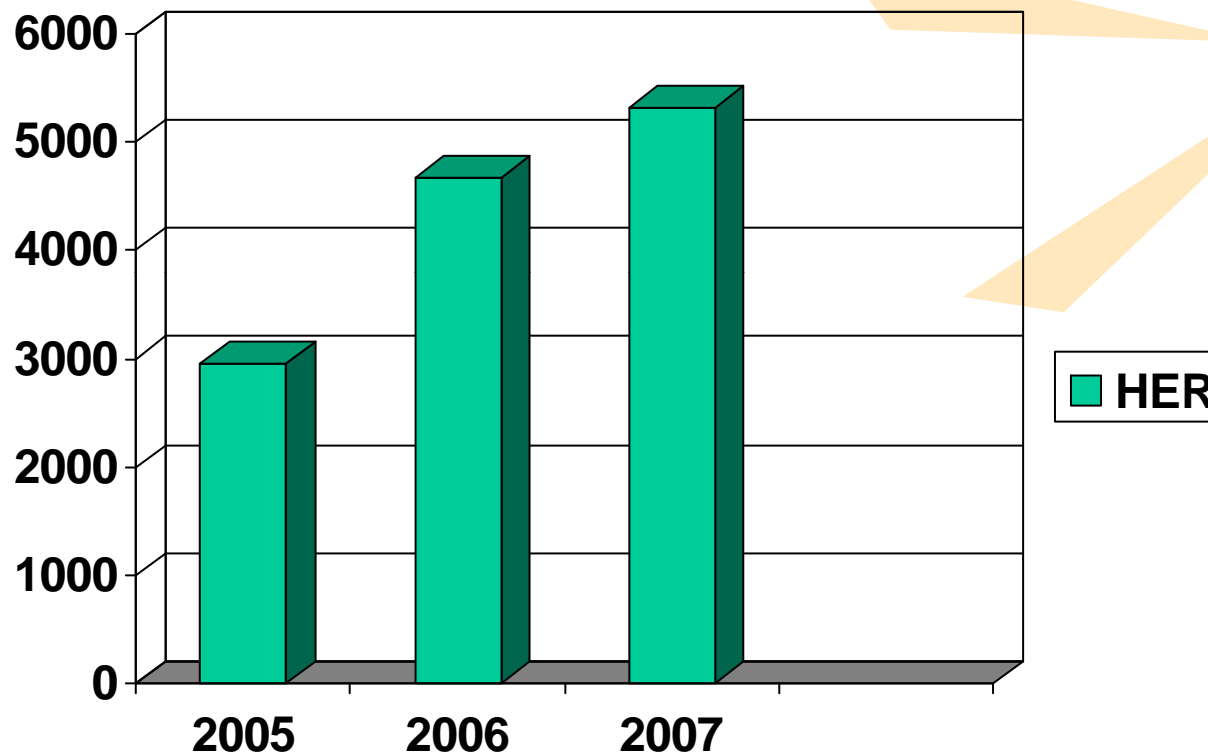
Nexus Home Energy Analyzer



Nexus Home Energy Analyzer

- 13,094 completed all or part of the Home Energy Analyzer from August 2004 – May 2006
- 7,457 provided an address (60%)
- 5,840 are single family detached (45%)
- 964 Action Takers (13%)

Home Energy Reviews



Home Energy Reviews

- 7,733 households received HER's in 2005 & 2006
- 1,692 (22%) received an Energy Trust or Oregon Residential Energy Tax Credit (RETC) incentive for energy saving measures
- Rate of Action increases with time, 35% in 2005 and 17% in 2006
- Mostly insulation (45%) and HVAC (28%) measures

Household Characteristics



Household Characteristics

- Action takers have larger homes
- Action takers are more likely to space heat with natural gas
- Action takers are more likely to have a fireplace, and more likely to have a gas fireplace
- Action takers have a significantly higher quantity of light fixtures in the house (8.33 to 7.90)
- Action takers are more likely to state that they sometimes leave unnecessary lights on and are less careful to turn unnecessary lights off

Household Characteristics

- Action takers are more likely to have central AC, but less likely to have a room air conditioner
- If combined, action takers are less likely to have air conditioning

Electric and Gas Consumption

- Two theories of energy consumption
- Consumption data is not adjusted for weather, and is during the same period of time (October 2005 – September 2006). Want to see the price effect.
- Energy costs are calculated using the residential rates for each utility
- Normalized to 365 days.

Electric and Gas Consumption

- Action taking homes with gas heat consume 10% less electricity
- No difference found in gas consumption
- No difference found in all electric homes

Energy Intensity

- Action takers average cost per sqft is \$0.92
- Participants average cost per sqft is \$0.98
- A statistically significant difference
- Participants also have a number of large outliers

The Model



The Model

- The basic analysis informs at the aggregate level, analysis at the individual household level will reveal more about the influence of household characteristics and consumption
- Two non-linear regression models are used to estimate a household's probability of taking action based upon their:
 - 1) Energy Consumption and Household Characteristics
 - 2) Household Characteristics

Qualitative Choice Model

- Probit model is an econometric model that attempts to model human behavior
- This model attempts to predict the probability that a household will take action based upon the explanatory variables
- The behavior the model is attempting to explain is did the household take action? Yes or No?
- Using the sample, the model can calculate the effect of each explanatory variable on the probability of taking action

Qualitative Choice Model

- The effect of each variable on the probability after a small change is the marginal effect
- Using these calculated marginal effects, the model can predict what the probability of taking action will be for a given household
- The model is estimating the qualitative choice of each household

Model One: Energy Consumption

- **Action = $\alpha + \beta_1$ (Total Energy Cost / Square Footage) + β_2 Rent + β_3 Pool + β_4 Old House + ε**
- **The Variables are:**
- **Action = 1 or 0, 1 if took action to implement energy efficiency measures, 0 otherwise**
- **Total Energy Cost = Annual household energy cost for electric and gas consumption. This is the Normalized Annual Consumption multiplied by the marginal cost of fuel for each fuel source summed together**
- **Square Footage = The square footage of house**

Model One: Energy Consumption

- **Rent = 1 or 0, 1 if inhabitant rents house, 0 if inhabitant owns house**
- **Pool = 1 or 0, 1 if inhabitant owns a pool, 0 otherwise**
- **Old House = 1 or 0, 1 if house older than 40 years, 0 if otherwise**

Model One: Energy Consumption

Marginal Effects for Consumption Model
Average Probability of Taking Action = 32%

Variable	Change in probability of taking action	T – Ratio (>2 = significant)
Energy Cost / Sqft	- 12%	-2.94
Pool	-10%	-1.21
Old House	4%	1.17
Rent	- 28%	-2.58

Model Two: Household Characteristics

- **Action = $\alpha + \beta_1 \log(\text{Square Footage}) + \beta_2 \text{ AC's} + \beta_3 \text{ Gas Heat} + \beta_4 \text{ Rent} + \beta_5 \text{ Second Fridge} + \varepsilon$**
- **The Variables Are:**
- **Action = or 0, 1 if took action to implement energy efficiency measures, 0 otherwise**
- **Square Footage = Square footage of the house**
- **AC's = The number of room air conditioners in the household**

Model Two: Household Characteristics

- **Gas Heat** = A dummy variable for space heating type, 1 if gas heat, 0 if otherwise
- **Rent** = 1 or 0, 1 if inhabitant rents house, 0 if inhabitant owns house
- **Second Fridge** = 1 or 0, 1 if household has a second fridge, 0 otherwise

Model Two: Household Characteristics

Marginal Effects for House Characteristics Model
Average Probability of Taking Action = 30%

Variable	Change in probability of taking action	T – Ratio (>2 = significant)
Square Feet	5%	2.63
Air Conditioners	- 3%	-2.34
Second Fridge	-4%	-2.01
Gas Heat	10%	7.57
Rent	-20%	-7.19

Findings

- Action Taking homes exhibit the following characteristics that differ from participant homes:
 - Homes are larger
 - Homes have lower total energy costs per square foot
 - Household is very unlikely to rent
 - Household is less likely to use air conditioning
 - Household is less likely to have a second fridge
 - Home is more likely to be heated with natural gas
 - Household is less likely to have a pool

Implications

- Action takers appear to be middle income energy conscious households
- Not conspicuous consumers, less appliances
- Unobservable forces are at work

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