

Persistence of Savings

MAESTRO Workshop April 1, 2004

Richard Ridge, Ridge & Associates

Agenda

- Importance of Persistence
- Definitions
- History
- Studies

The Importance of Persistence

- **Used in:**
 - Earnings claims
 - Total Resource Cost Test
 - Integrated resource planning (IRP)

- **Its importance is reflected in :**
 - M&E Protocols specify the programs and measures to be addressed as well as the frequency of studies.
 - A CADMAC Subcommittee was established to address persistence.
 - Significant resources have been devoted since 1994 to this issue.
 - Other states are following the California studies carefully.

Components of Savings Persistence

- Net resource benefit = (First-year measure-level net impact) × (Measure-level EUL) × (Measure-level TDF)
 - EUL=Effective Useful Life
 - TDF=Technical Degradation Factor

Effective Useful Life

- Effective useful life (EUL) is defined as an estimate of the median number of years that the measures installed under the program are still in place and operable.
- Retention studies have been used to estimate EULs

Technical Degradation

- A scalar that accounts for time- and use-related change in the energy savings of a high efficiency measure or practice relative to a standard efficiency measure or practice.
- Technical degradation studies have been done to estimate technical degradation factors (TDF) for key measures and end uses.

History

- *The Protocols and Procedures for the Verification of Costs, Benefits and Shareholder Earnings from Demand-Side Management Programs* (Protocols) contained effective useful life values for major energy efficiency measures (aka *ex ante* estimates).
- These *ex ante* estimates were intended as placeholders until rigorous empirical research could be conducted to confirm or disconfirm them through *ex post* retention studies at the first-year, third-year, fourth-year, sixth-year, and ninth-year.
- The Persistent Subcommittee was established by the CADMAC to set up guidelines and reporting requirements for retention studies.

Data for Retention Studies (Protocols)

- Data should be collected using either *telephone, on site or mail surveys from program participants*.
- The retention studies shall include data from participant groups from *two or more* sequential program years to increase the robustness of the sample and to allow for the estimation of a survival function for a number of different measures.
- This study should include an assessment of the fraction of measures installed in the program year that are *in place and operable* in the designated analysis year.
- This information should then be used to re-estimate the effective useful life of measures based on the data collected on remaining measure fractions, other information on measure retention fractions from previous year studies and other data on the shape of the survival function that may be available from the statewide persistence studies or other sources.

Excerpt from Protocol Table 8A

	REQUIRED IMPACT STUDIES		
PROGRAM (Appendix C reference)	FIRST LOAD IMPACT YEAR (per Appendix C)	PERSISTENCE STUDIES	
	(PROGRAM YEARS)	MEASURE-MENT PERIOD	MEASUREMENT SCHEDULE (1)
RES. WRI & AEI (space conditioning) (Tables C-1 & C-2)	1994, 1996	10 years	1. 4th & 9th year retention 2. 4th year performance
RES. AEI (Table C-3A-lighting)	1994, 1996	7 years	1. 3rd & 6th year retention
(Table C-3B-refrigeration)	1994,1996	10 years	1. 4th & 9th year retention 2. 4th year performance
COMM. EEI (Table C-4)	1994,1995,1996,1997	10 years	1. 4th & 9th year retention study 2. 4th year performance
IND. & AG EEI (Tables C-5 & C-6)	1994,1995,1996,1997	7 years	1. 3rd and 6th year retention 2. 3rd year performance
NEW CONSTRUCTION (Tables C-7 & C-8)	1994,1996	10 years	1. 4th and 9th year retention 2. 4th year performance

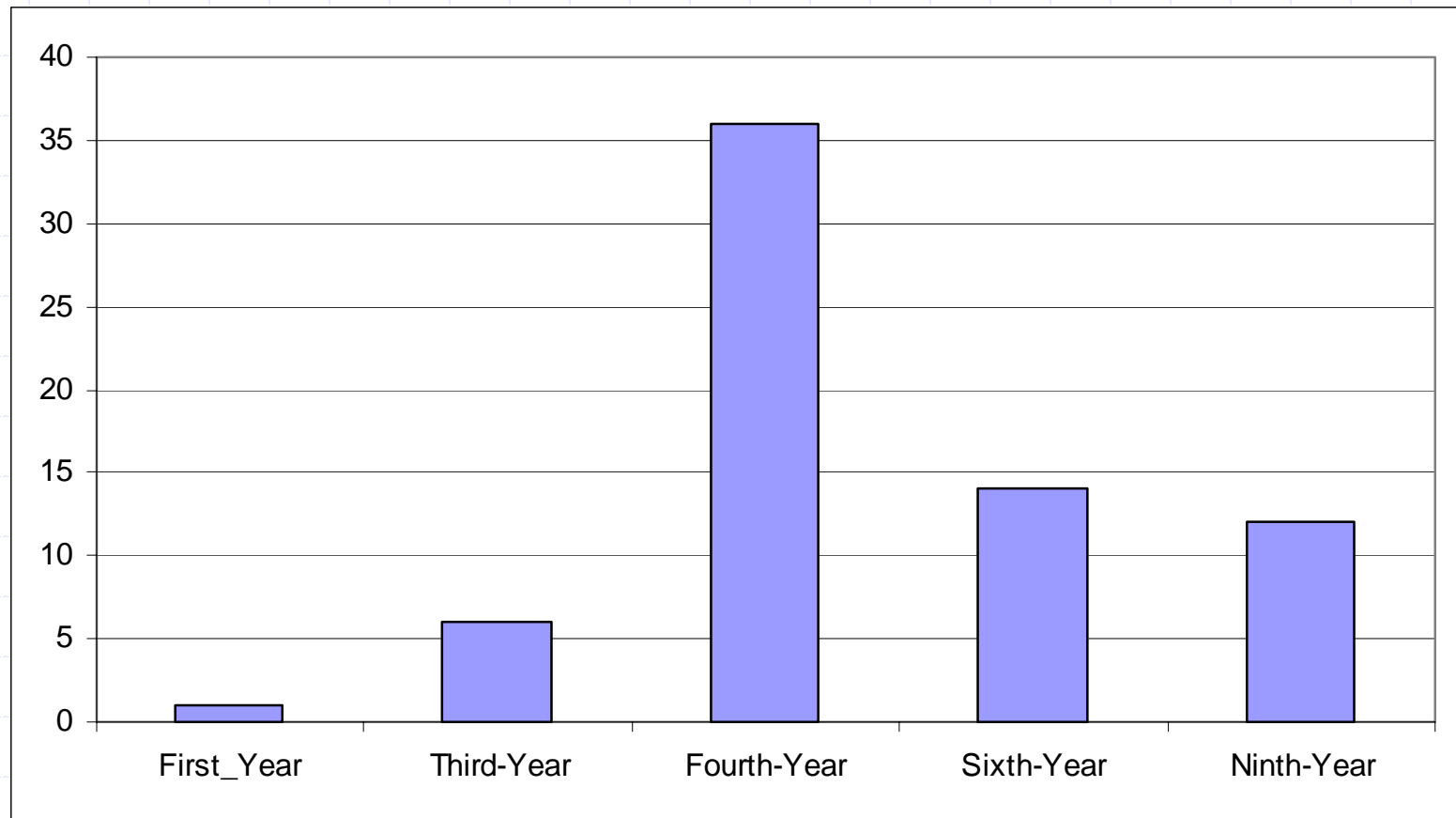
Excerpt from Protocol Table 9A

PROGRAM	MEASURES INCLUDED IN RETENTION AND PERFORMANCE STUDIES
RESIDENTIAL WRI	Top 10 measures*
RESIDENTIAL AEI (Space Conditioning)	Central AC, Heat pump, Room AC, Evap cooler (for combined utilities, also gas space and gas water heating)
RESIDENTIAL AEI (Lighting & Refrigeration)	High Efficiency Lighting High Efficiency Refrigeration
COMMERCIAL/ INDUSTRIAL/ AGRICULTURAL EEI	Top 10 measures*
FUEL SUBSTITUTION	Top 10 measures*
RESIDENTIAL NEW CONSTRUCTION	Top 10 measures*
NONRESIDENTIAL NEW CONSTRUCTION	Top 10 measures*

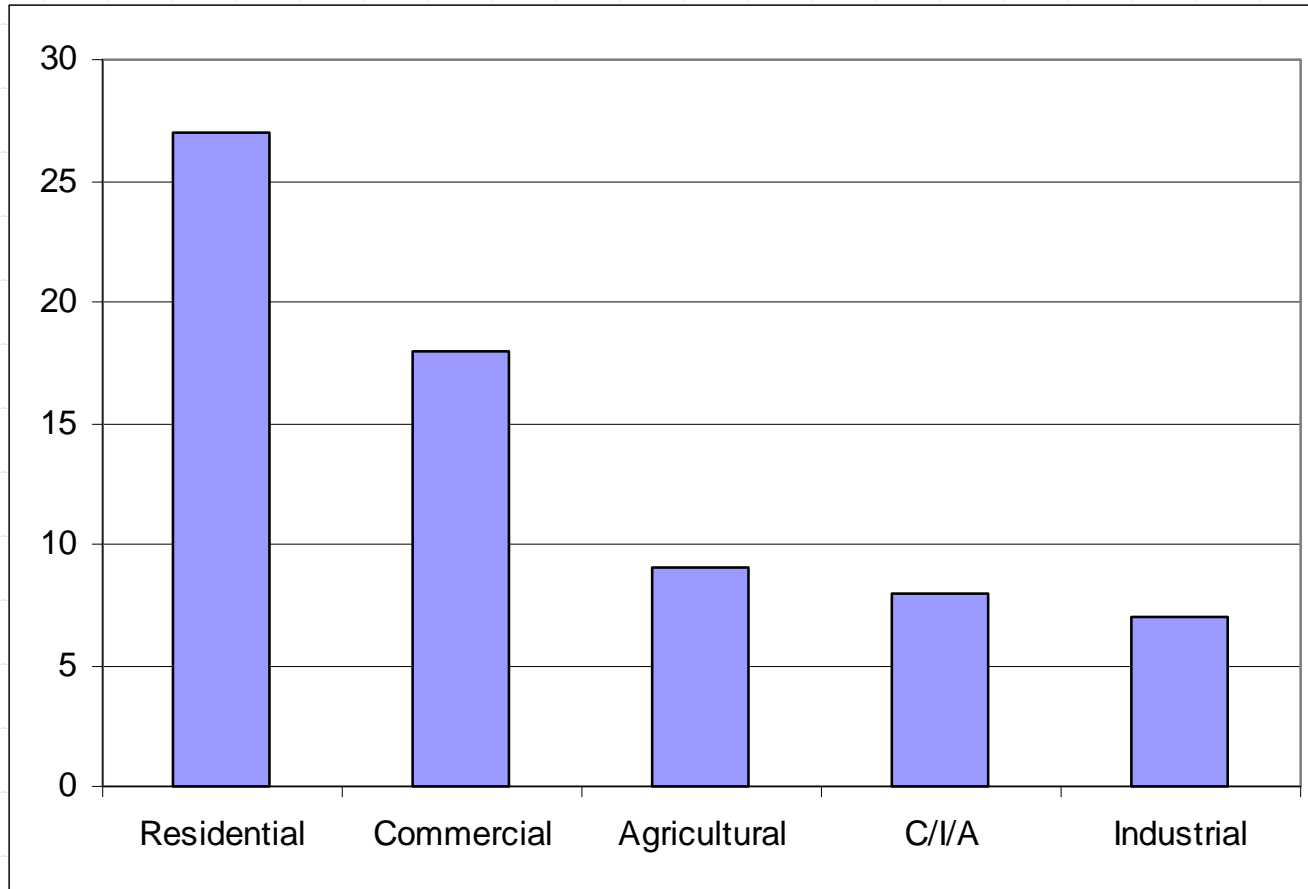
Retention Studies Conducted

- 73 retention and persistence studies conducted in California have been posted on the CALMAC website (WWW.CALMAC.ORG)
- These studies cover program years 1994 through 1997 and address multiple sectors and end uses.

Retention Studies By Retention Year



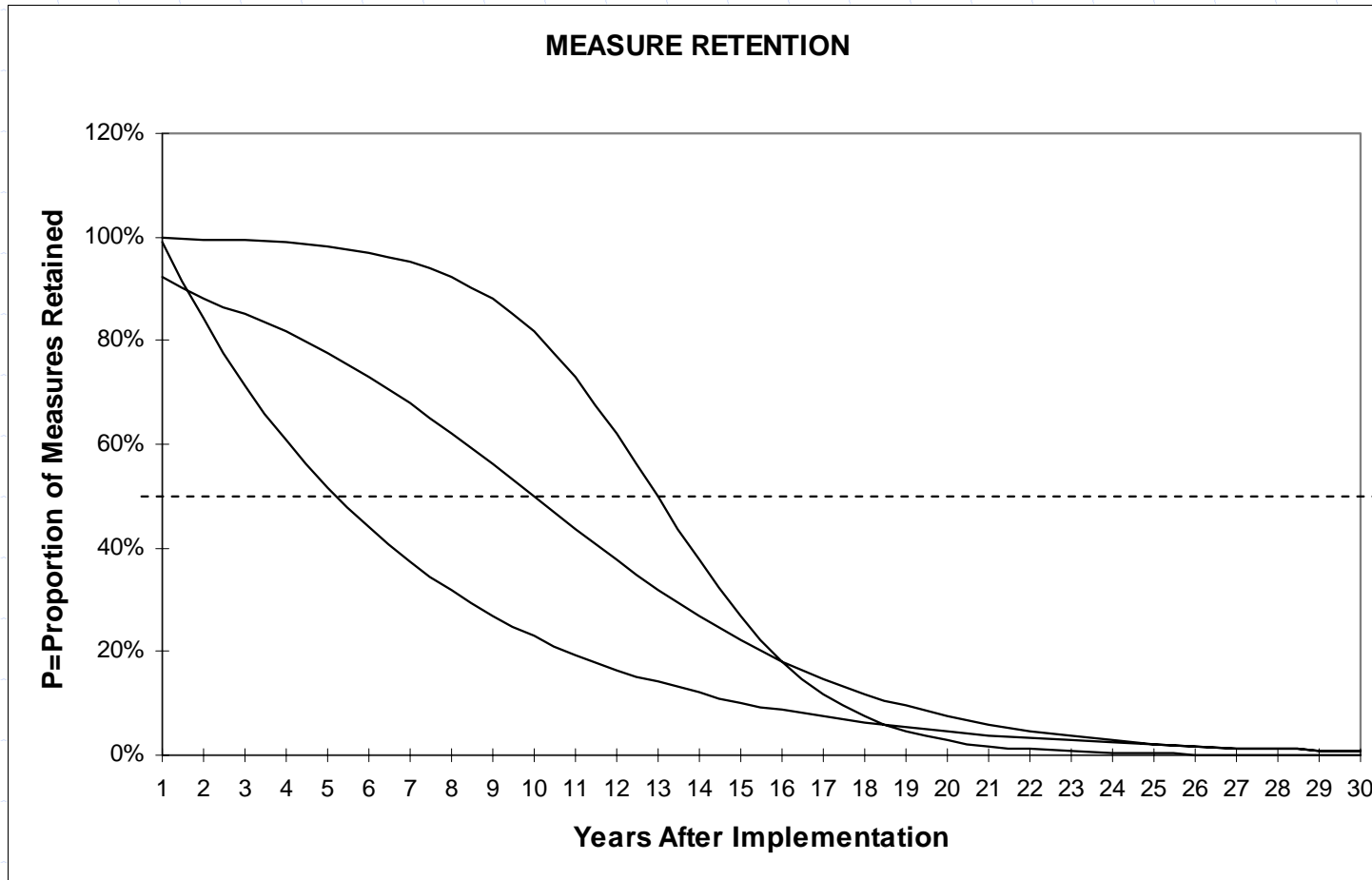
Retention Studies by Sector



Retention Methods

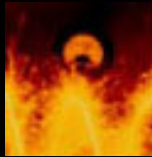
- California has conducted the most rigorous retention studies.
- Samples of participants in a given program year are followed over time and failures are documented
- A variety of state-of-the-art survival analysis techniques have been used to estimate EULs.

Three of an Infinite Number of Possible Survival Curves



Technical Degradation Methods

- **The first stage:**
 - Performed an exhaustive search for existing information from published and unpublished sources and
 - synthesized this information into an engineering analysis of technical degradation rates.
- **The second stage:**
 - Conducted further research for those measures where substantial uncertainty was found in stage one.



Evaluation of the 2002 Statewide Crosscutting Residential Lighting Program

**MAESTRO Evaluation Results Presentation
March 31, 2004**

Prepared for:
Southern California Edison,
Pacific Gas and Electric Company,
San Diego Gas and Electric Company and
Southern California Gas Company

Overview of Presentation

■ Program

- ❖ Objectives and Approach
- ❖ 2002 accomplishments

■ Evaluation

- ❖ Objectives
- ❖ Approach
- ❖ Findings
- ❖ Recommendations

Program Objectives and Approach

- Upstream program designed to increase availability and use of EE lighting products
- 3 key market barriers addressed:
 - ❖ consumer awareness => upstream marketing support, downstream marketing
 - ❖ product pricing => CFL product rebates
 - ❖ product availability => collaboration with retailers and manuf's
- Continues successful aspects of prior multi-year MT program

Program 2002 Accomplishments

- 3.5 million CFL products rebated
 - ❖ 99% CF bulbs
 - ❖ \$7 million incentive budget
- HTR goals:
 - ❖ 15% rural retailers
 - ❖ 10% grocery and drug stores
- 163 GWh and 21 MW savings
- Extensive SW coordination
- Leveraged EPA and Flex Your Power campaigns

Evaluation Objectives

- Assess customer behaviors in response to program activities
- Evaluate the program's approach to delivering customer satisfaction
- Verify program energy savings

Evaluation Approach

■ Market Actor Analyses

- ❖ Retailer and manufacturer in-depth interviews (45)
- ❖ Consumer telephone surveys (1,000)

■ Process Evaluation

■ Measurement & Verification

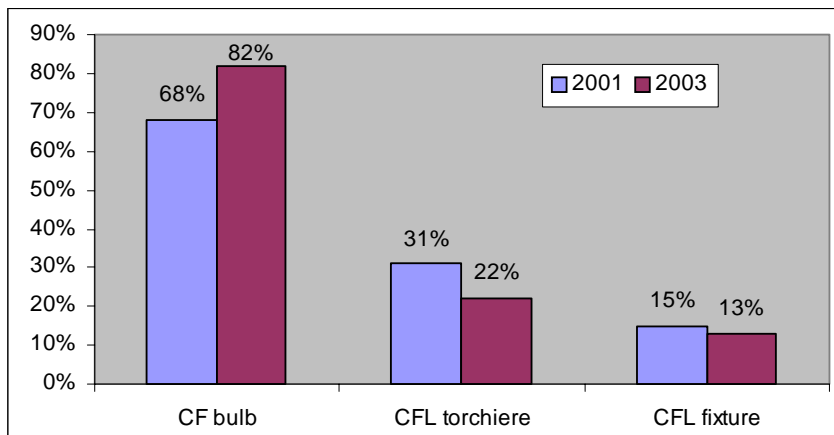
- ❖ Verification of program savings – tracking data versus reported savings
- ❖ Ex post evaluation – onsite data collection using lighting loggers on CFLs at 100 sites

Study Findings

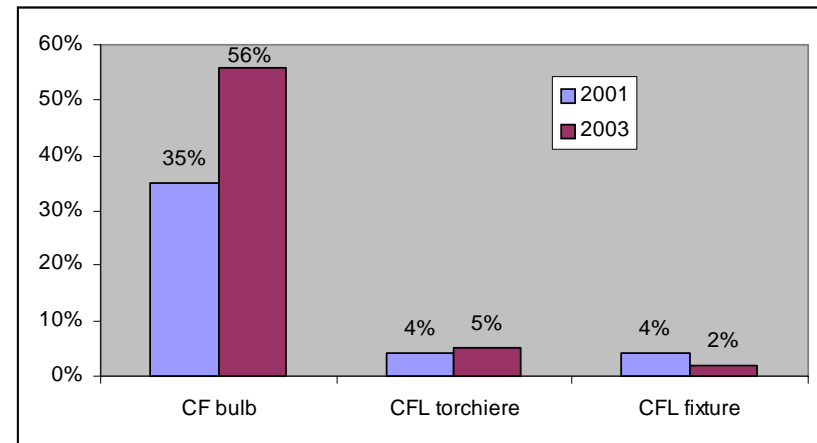
■ Market Actor Analyses

- ❖ General population energy efficiency “climate” continues to be positive
- ❖ CFL awareness continues to increase over time
- ❖ Over half of consumers have used CFLs

CFL Product Awareness



CFL Product Purchases



Study Findings

- Market Actor Analyses, continued
 - ❖ Satisfaction with CFL performance is high
 - ❖ CFL diversity has exploded recently
 - ❖ CFL prices have declined significantly
 - ❖ CFL availability has expanded
 - ❖ Retailer and manufacturer expectations for 2004 CFL sales are mixed

Study Findings

■ Process Evaluation

- ❖ Program administration is effective and efficient statewide
- ❖ Coordination issues were minimal in 2002
- ❖ Program implementation strategies are effective and well received by program participants
- ❖ Customer-level data are unavailable due to POS approach, posing evaluation challenges

Study Findings

■ Process Evaluation, continued

- ❖ Retail CFL promotions were less influential on purchases in 2002 v. prior years
- ❖ Rural HTR goals are set arbitrarily and could be more closely aligned with each IOU's geographic characteristics and self-reported CFL purchase rates for rural customers

Study Findings

■ Measurement and Verification

- ❖ The program's reported accomplishments matched almost exactly with the program tracking data
- ❖ Ex post savings analysis to be conducted – loggers are currently installed in 100 homes
 - 2003 study is extending logger study
 - 100 homes from 2002 study will be metered for 1 year
 - 275 homes will be added for 2003 and will be metered for 6 months
 - Results available in January 2005

Recommendations

- Continue efforts to raise awareness and educate customers on CFLs
- Continue to maximize incentive budgets by using a tiered rebate structure
- Set HTR goals that are in line with utility-specific demographics and historic purchase rates
- Give participating retailers and manufacturers adequate lead time to ensure effective marketing



Residential Appliance Recycling Program 2002 EM&V Results



Presented by:
Shahana Samiullah
Southern California Edison

March 31, 2004

KEMA - XENERGY

KEMA 

Outline

- Review of Objectives and Methods
- Key Findings
 - ❖ Process Evaluation
 - ❖ Net-to-Gross Estimation
 - ❖ UEC Analysis
- Next Steps

Program Statistics for 2002

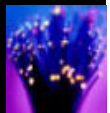
■ Total units collected: 43,170

- SCE – 64%
- PG&E – 24%
- SDG&E – 12%

■ Incentives taken

- 90% – \$35 cash
- 10% – 5-pack of CFLs

Objectives and Methods



Process Evaluation

■ Objectives

- ❖ Feedback on key program process functions
- ❖ Assess adequacy of incentives
- ❖ Assess effectiveness in reaching HTR

■ Methods

- ❖ Staff interviews
- ❖ Participant and Nonparticipant Surveys
- ❖ ARCA site visit

Impact Evaluation

■ Objectives

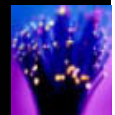
- ❖ Estimate UEC
- ❖ Estimate attribution and part-use

■ UEC Methods

- ❖ Metering sample per DOE lab protocol
- ❖ Combined via modeling with prior DOE metering samples

■ Attribution and part-use methods

- ❖ Participant and Nonparticipant Surveys

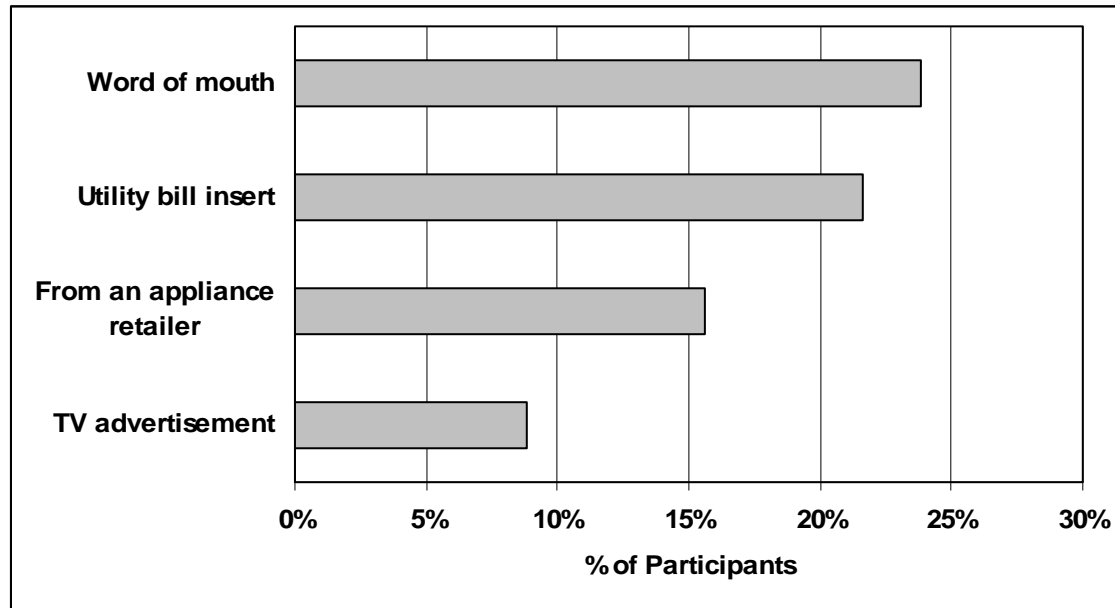


Key Findings

Process Evaluation

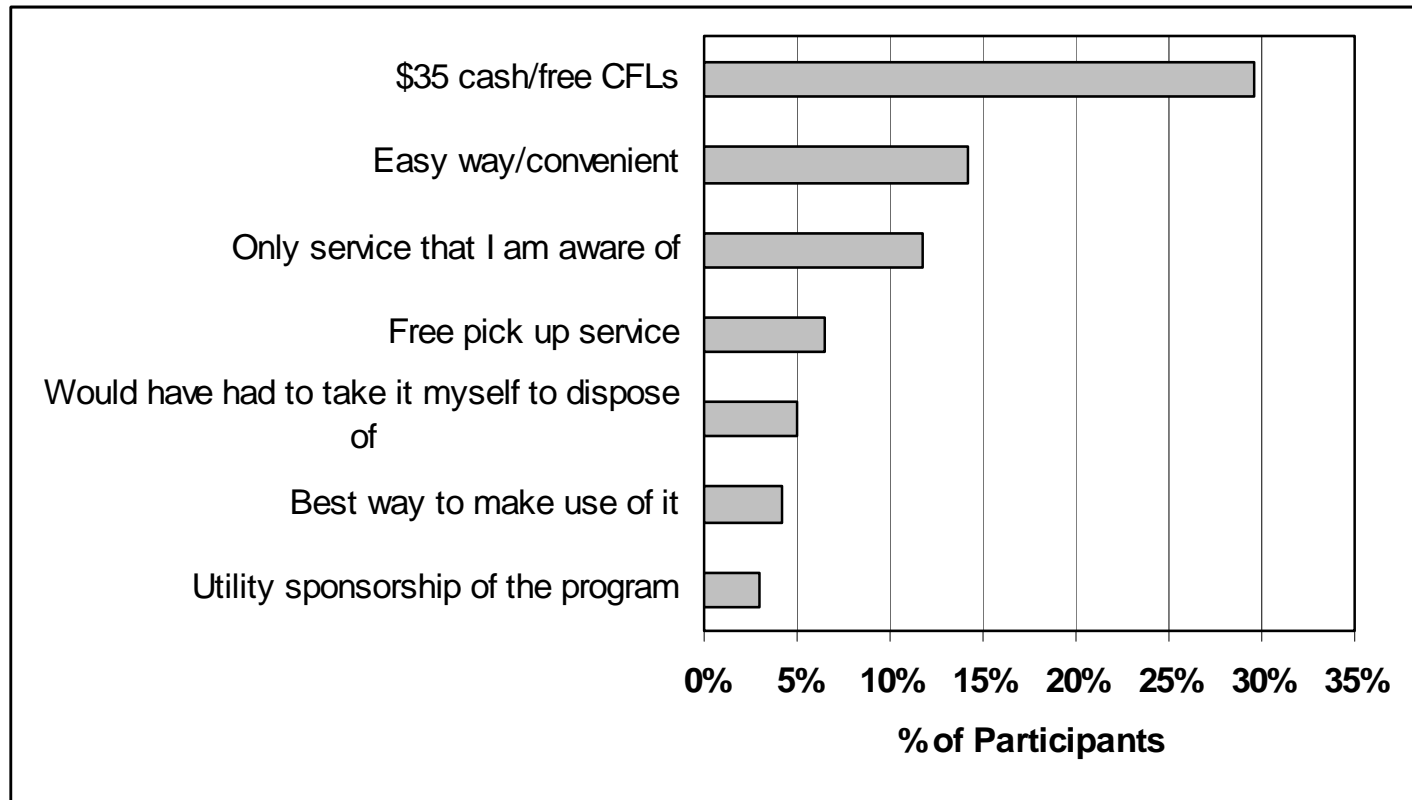
- Who's participating?
 - ❖ Large majority of units recycled are primary units that are replaced
 - ❖ Unlike previous evaluation
- High participant satisfaction
- Communications and funding gaps were the primary program issues
- Utilities have been successful in meeting their program goals, including HTR targets.
- State-of-the-art, comprehensive recycling process used

How They Became Aware of the Program

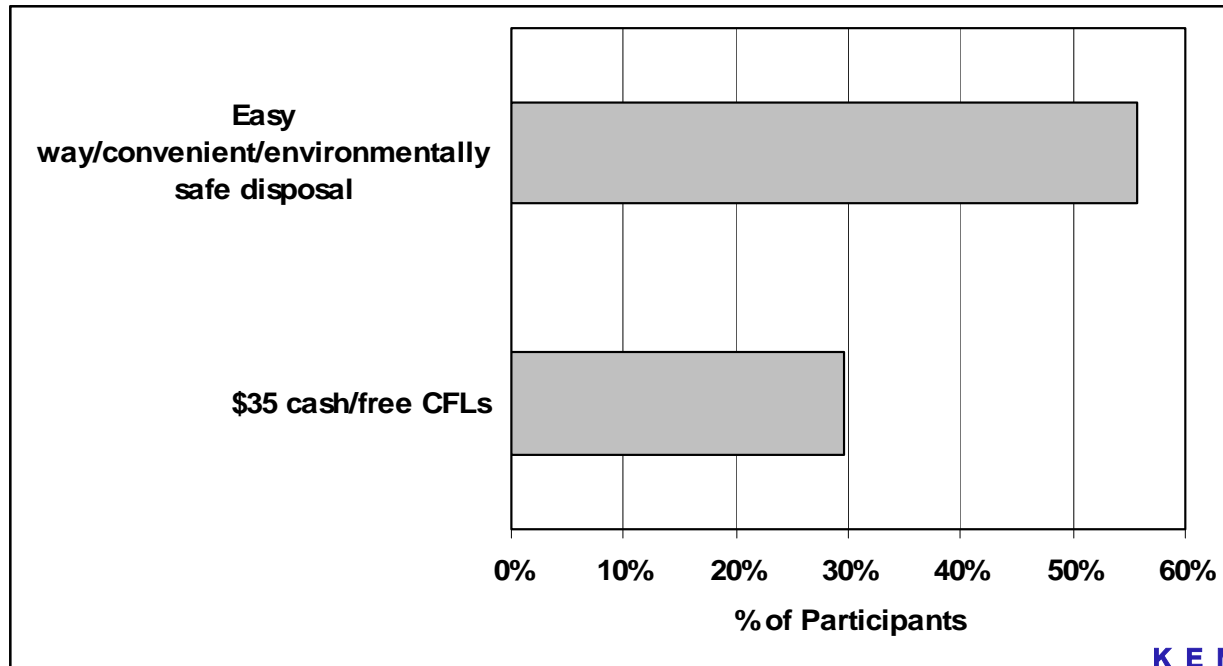


Reasons They Joined the Program

- #1 response - They liked the incentive

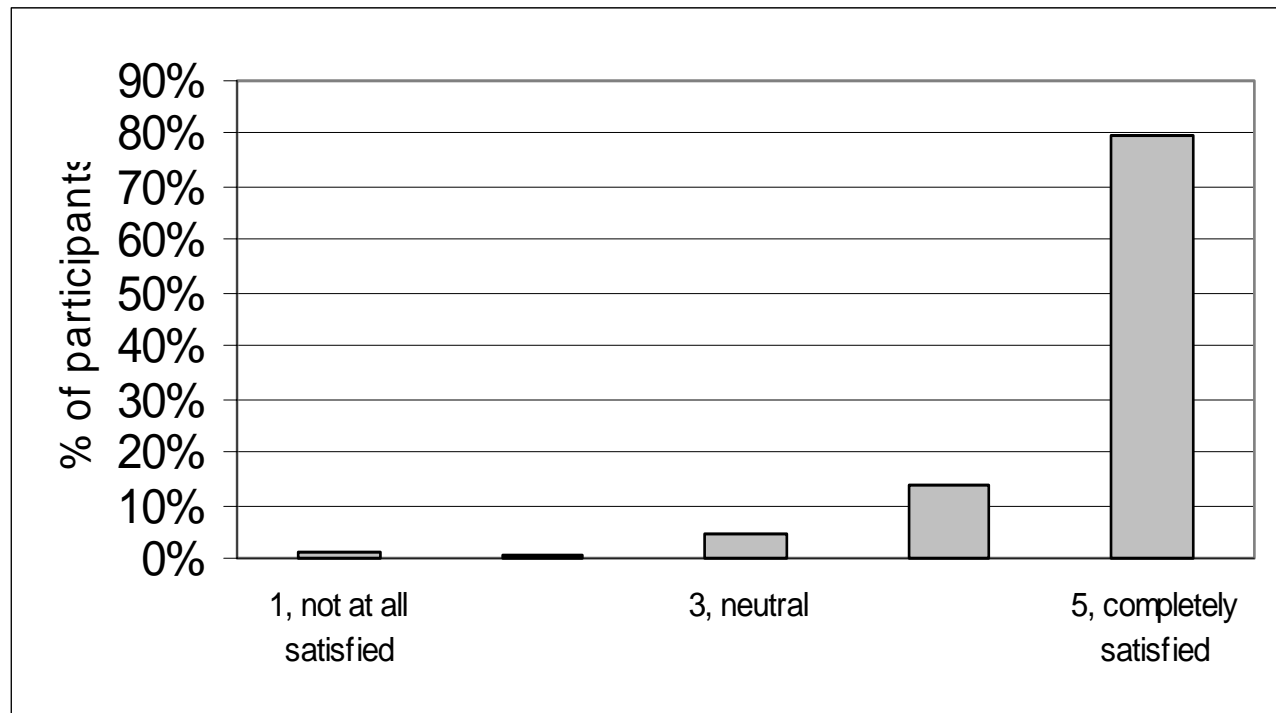


- Various benefits related to disposal are the reason to join for over half



Satisfaction Findings

- Participants view the program VERY positively. . .

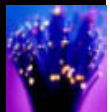


How Important was the Incentive in the Decision to Recycle?

- 75% said they would still have used the recycling service even without an incentive.
- Conclusions:
 - ❖ To customer the main value of the program is in **removal** of the unwanted unit
 - ❖ Many customers are unaware of the cost to operate older, less efficient units – more education is needed
 - ❖ Program funding gaps cause various problems
 - Long wait times → attrition
 - High staff turnover for recycling contractor

Impact Evaluation

- Attribution and Part Use Factors
- UEC



Attribution and Part Use (Refrigerators)

■ Part-Use factor

- ❖ % of year units would have been used if kept in use = 0.88; very similar to previous study

■ Attribution

- ❖ 86% of 2002 program refrigerators would have been discarded anyway (vs. 41% 1996)
- ❖ Part credit is still given for avoided transfer to another user
- ❖ Resulting attribution is 41%

■ Combined NTG = 35%

NTG Method

Question:	Disposition without Program	How Discard	How acquired unit would be used	What acquirer would get if used not available	Part Use	Attribution	NTG	% of units	
Source:	<i>P</i> survey	<i>NP</i> survey (discarders)	<i>NP</i> survey (acquirers)	<i>NP</i> survey (acquirers)	<i>P</i> survey				
	Kept in use				u	1	u	xx	
	Kept unused				0	1	0	xx	
	Discarded	Destroyed					0	0	xx
			Transferred	Main	New	1	a*	a*	xx
		Similar			1	0	0	xx	
		Worse			1	0	0	xx	
		None			1	1	1	xx	
		Spare		New	u	a*	ua*	xx	
				Similar	u	0	0	xx	
				Worse	u	0	0	xx	
None	u			1	u	xx			

$$a^* = 1 - \text{UEC}_{\text{NEW}} / \text{UEC}_{\text{OLD}}$$

What P Would Have Done Otherwise

	2002	1996
Refrigerators		
Keep and Use	9.0%	45.3%
average part-use	0.88	0.86
Keep Unused	4.6%	13.4%
Discard	86.4%	41.3%
Freezers		
Keep and Use	20.8%	40.9%
average part-use	0.77	0.91
Keep Unused	2.6%	19.4%
Discard	76.6%	39.7%

What Kinds of Units?

	2002	1996
Refrigerators		
replaced	85.7%	32.9%
main	78.7%	23.9%
Freezers		
replaced	37.5%	20.5%

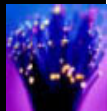
Effect of Removal from Secondary Market

UEC	Refrigerators	Freezers
2002 program	1,946	1,662
New (CEC, 2000 to 2002 models)	583	458
Difference	1,363	1,204
Percent of in-program UEC	70%	72%

NTG Estimates

Parameter	Refrigerators		Freezers	
	Estimate	RSE	Estimate	RSE
Attribution	0.41	10%	0.73	13%
Part-Use				
units otherwise kept in use	0.88	2%	0.77	7%
overall	0.84	2%	0.75	6%
Net-to-Gross	0.35	10%	0.54	14%

UEC Modeling



General Approach

- Combine DOE protocol lab metering data
 - ❖ original ARCA sample
 - ❖ 1998 SCE sample
 - ❖ 2002 statewide sample
- Model $UEC = f(\text{unit characteristics, sample cohort})$
- Apply fitted model to 2002 population of collected units

Basic Data Summary

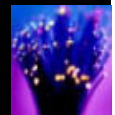
Kind of Unit	Meter Sample	Number of Units	Mean UEC		Weighted Standard Errors
			Unweighted	Weighted to 2002 Program	
Refrigerators	ARCA	1,052	1,947	2,284	40
	1998	100	2,200	2,255	115
	2002	90	2,069	2,000	100
Freezers	ARCA	91	1,747	2,002	80
	1998	36	2,128	2,180	170
	2002	10	1,766	1,817	198

Final Model

Variable	Parameter Estimate	Standard Error	T-Value
Intercept	456	192	2.37
Frost Free Defrost Binary	-49	221	-0.22
Top Freezer Binary	-416	107	-3.89
Frost Free/Side-by-Side Binary	1,196	388	3.08
Manual Defrost/Single Door Binary	-601	128	-4.68
Partial Defrost/Top Freezer	348	126	2.77
Label Amperage	116	22	5.21
Volume in Cubic Feet	43	11	4.09
Amperage/Side-by-Side Interaction	-163	55	-2.99
Freezer Binary	24	122	0.2
Natural Log Truncated Age/Frost Free Interaction	294	68	4.35
1998 Metering Sample Binary	-41	73	-0.57
2003 Metering Sample Binary	-432	83	-5.23

Impact Findings (Refrigerator)

Parameter	2002		1996	
	Estimate	RSE	Estimate	RSE
% discarded without program	86%	1.8%	32%	7.0%
part-use for units otherwise kept in use	0.88	1.7%	0.86	3.5%
attribution	0.41	9.8%		9.0%
Net-to-gross	0.35	10.0%	0.53	9.6%
full-year UEC (kWh/yr)	1946	4.0%	2148	3.7%
net savings (kWh/yr)	673	10.8%	1141	10.3%



Next Steps

Literature Review Summary

Source	Year	DOE/In Situ	Context	Use	# Units
ADL	1982	20% low	Florida	primary	
Barakat & Chamberlin	1996	15% - 22% high	cite of Esource report		
Meier and Jansky	1993	10% - 14% high	cold climates, relatively new	primary	209
RLW	1992	inconclusive	Northeast, frost-free and manual	secondary	58
Meier et al	1993	13% high overall low in summer	Rochester, mostly frost-free	secondary	20
Bos	1993	low	SMUD turn-in program	secondary	79
Quantum Consulting	1994	slightly high	SCE refrigerator rebate program	primary	
Dutt et al	1995	high	new	primary	256
Goett	1995	nearly the same	PG&E and SCE new	primary	
Miller and Pratt	1998	28% low to 11% high	New York multi-family public housing	primary	324
ICF/ADM	2003	90% high	CA Bay Area ("DOE" = model from previous evaluation)	mix. Some empty	22
Mowris	2003	6% low but highly variable	6 cities in Northern California	primary	8

Limitations of Available Studies

- Studies point in different directions
- None include
 - ❖ Old and secondary refrigerators
 - ❖ DOE and long-term in situ for same units
- Conclusion:
 - ❖ No firm basis for adjusting lab up or down
 - ❖ An unequivocal estimate of a gross, aggregate relationship between DOE-based and in situ-based metering results for older, “recycling-prone” appliances is not available
 - ❖ Need a high quality research into the relationship.

2003 EM&V

■ Dual Metering Project

- ❖ A sample of refrigerators will be metered both in situ and in a laboratory setting using DOE protocols.
- ❖ How lab-based DOE estimates for older, recyclable or recycling-prone appliances translate into consumption estimates for appliances as they are used in homes (in situ) prior to recycling (or absent the program).
- ❖ To test the universal validity of DOE metering as a basis for inference to household consumption of such program appliances.



California Statewide Residential Appliance Saturation Survey

MAESTRO Workshop,
Pacific Energy Center,
March 31, 2004

First Statewide RASS Project

- CEC Oversight
- Sponsors:
 - ❖ PG&E – SDG&E – SCE – LADWP – SoCalGas
- Project Status:
 - ❖ Analysis complete
 - ❖ Data to be delivered shortly
 - ❖ Reports in April
 - ❖ Web site access May
 - ❖ Onsite metering load shapes – Fall 2004

Study Implementation Approach

- Electrically based sample design
 - ❖ Utility, dwelling age, electric heat, dwelling type, CEC forecast climate zone
 - ❖ Individual and master metered sites
- Master metered phone screening
- Direct mail survey (two mailings)
- Non-response follow-up
- Onsite metering on 200 homes (AC focus)

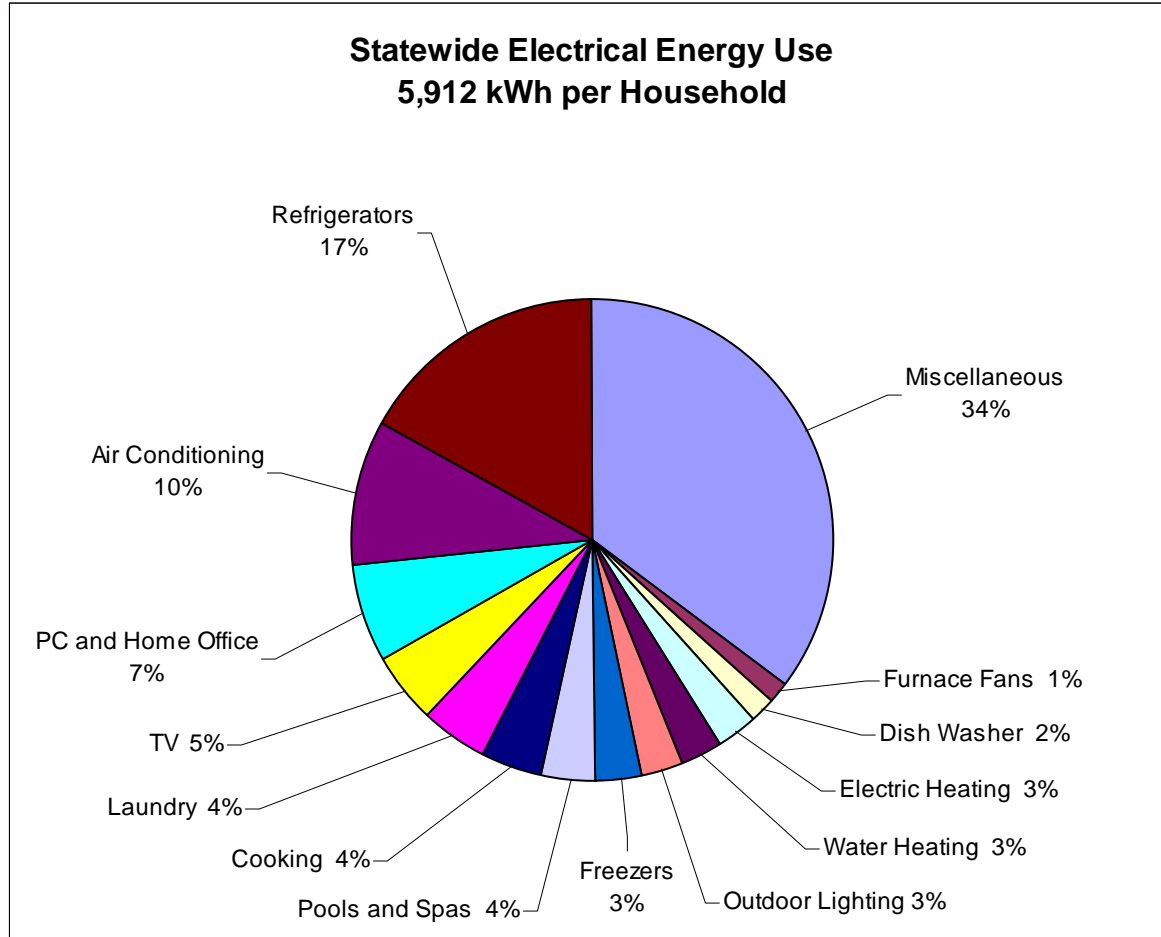
Study Analysis Procedure

- Conditional Demand Analysis
- Bill matching to identify SoCalGas customers
- 2002 billing data – calibration to utility totals
- Weather normalization
- Result: electric and gas UECs for all individually metered customers

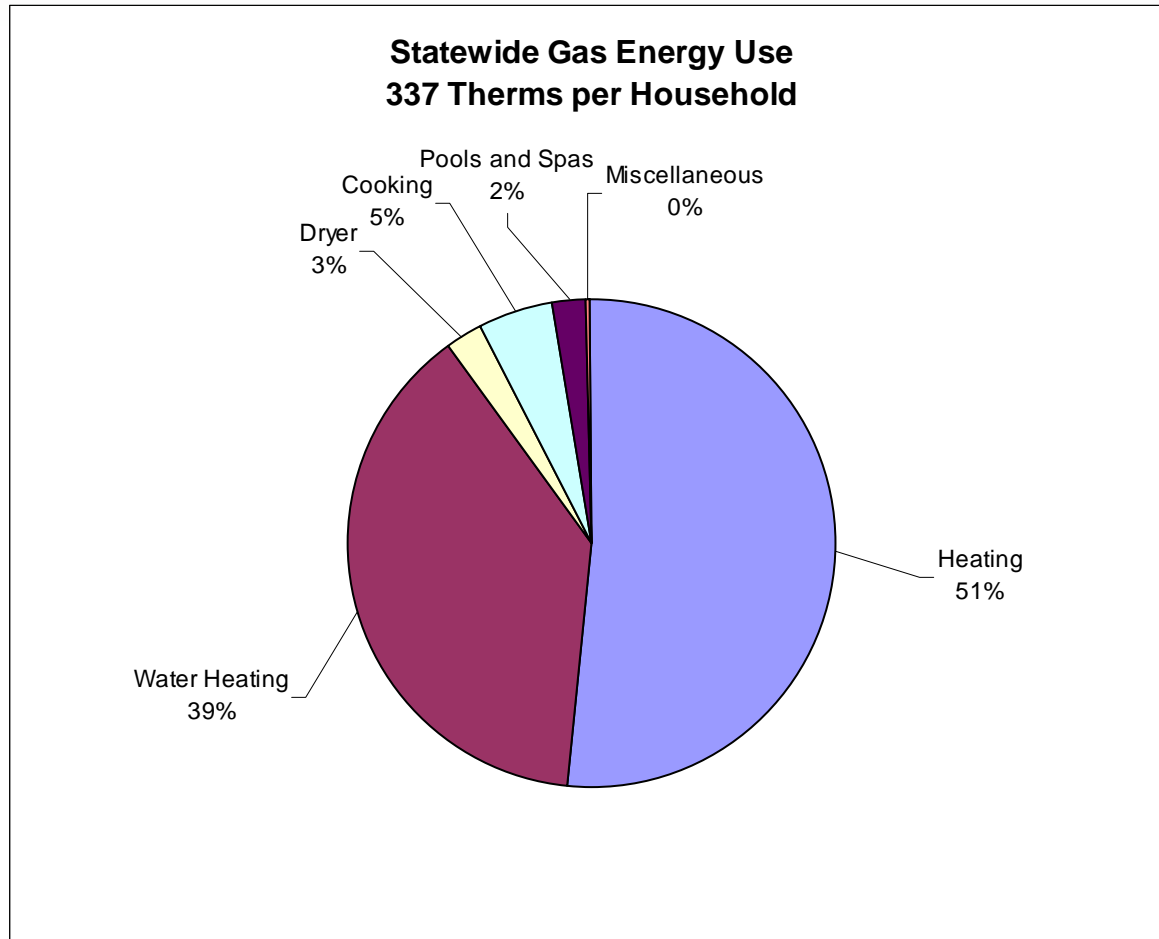
Data Collection Results

- Individually metered direct mail: 18,970
- Non-response follow-up: 2,183
- Master metered customers: 767
- Total survey results: 21,920
- Onsite metering: Expect 190 complete sets of whole house and central AC metering data (fall 2004)

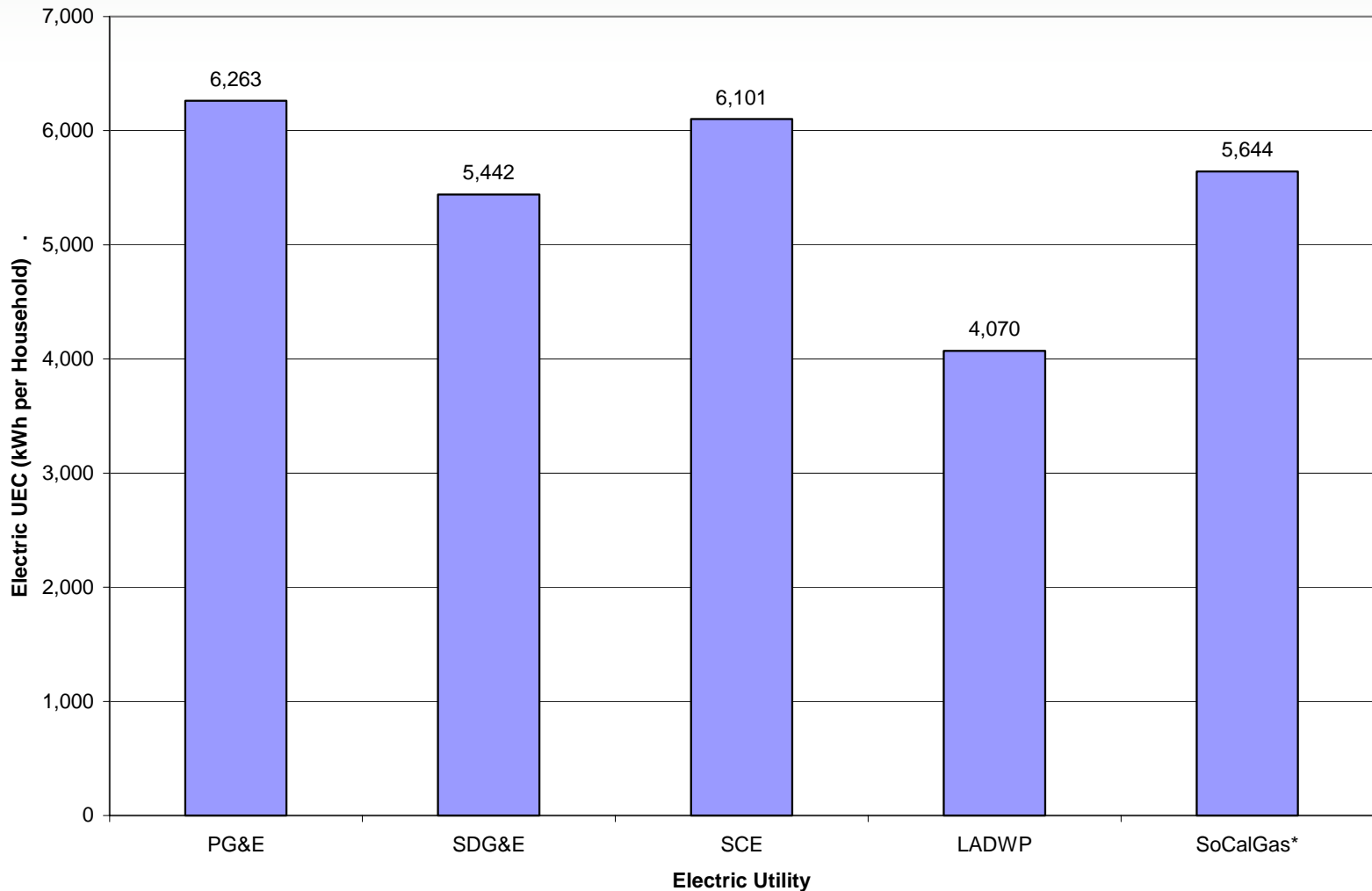
Statewide Electric UEC



Statewide Natural Gas UEC

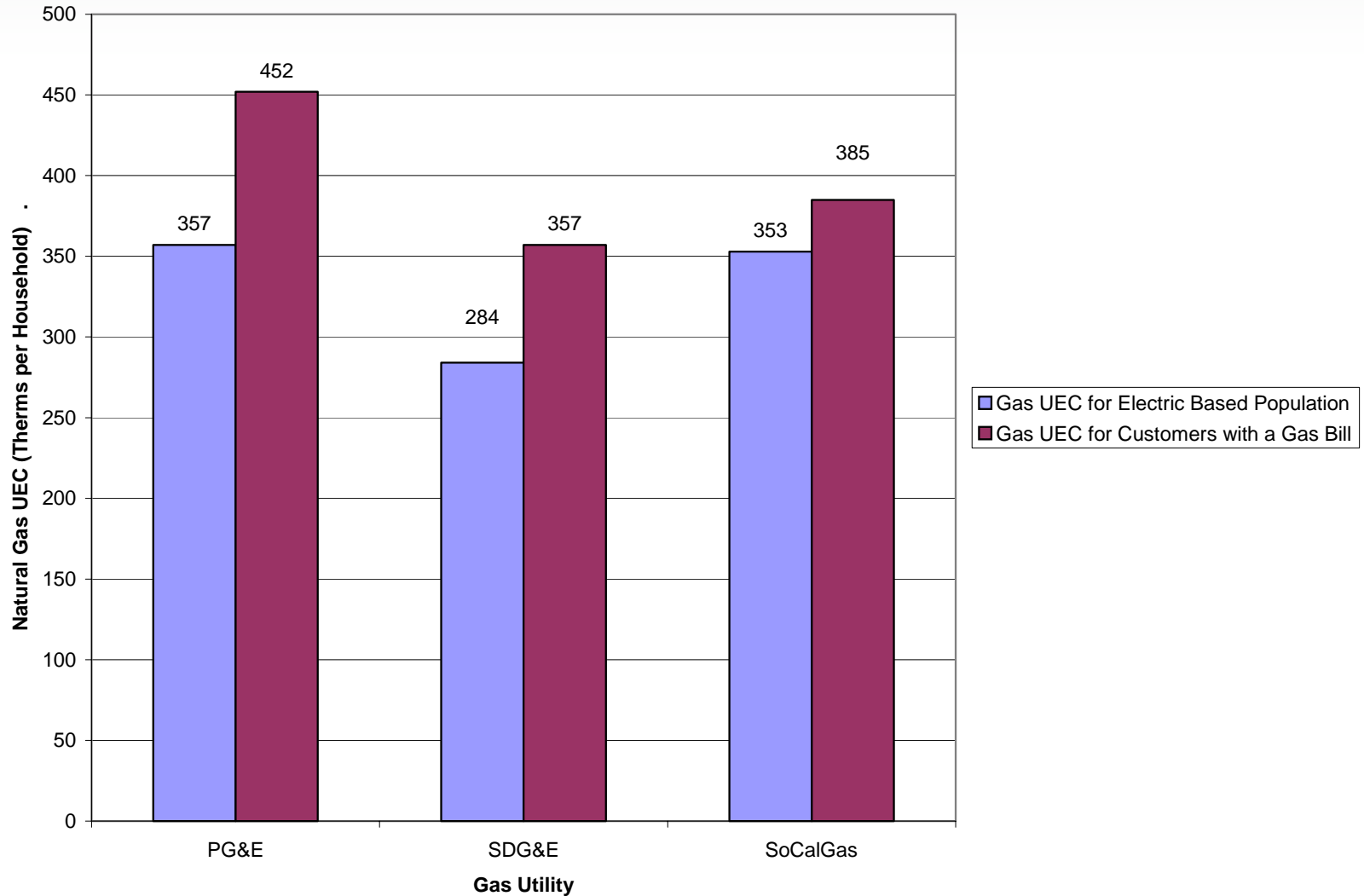


Electric UECs by Utility

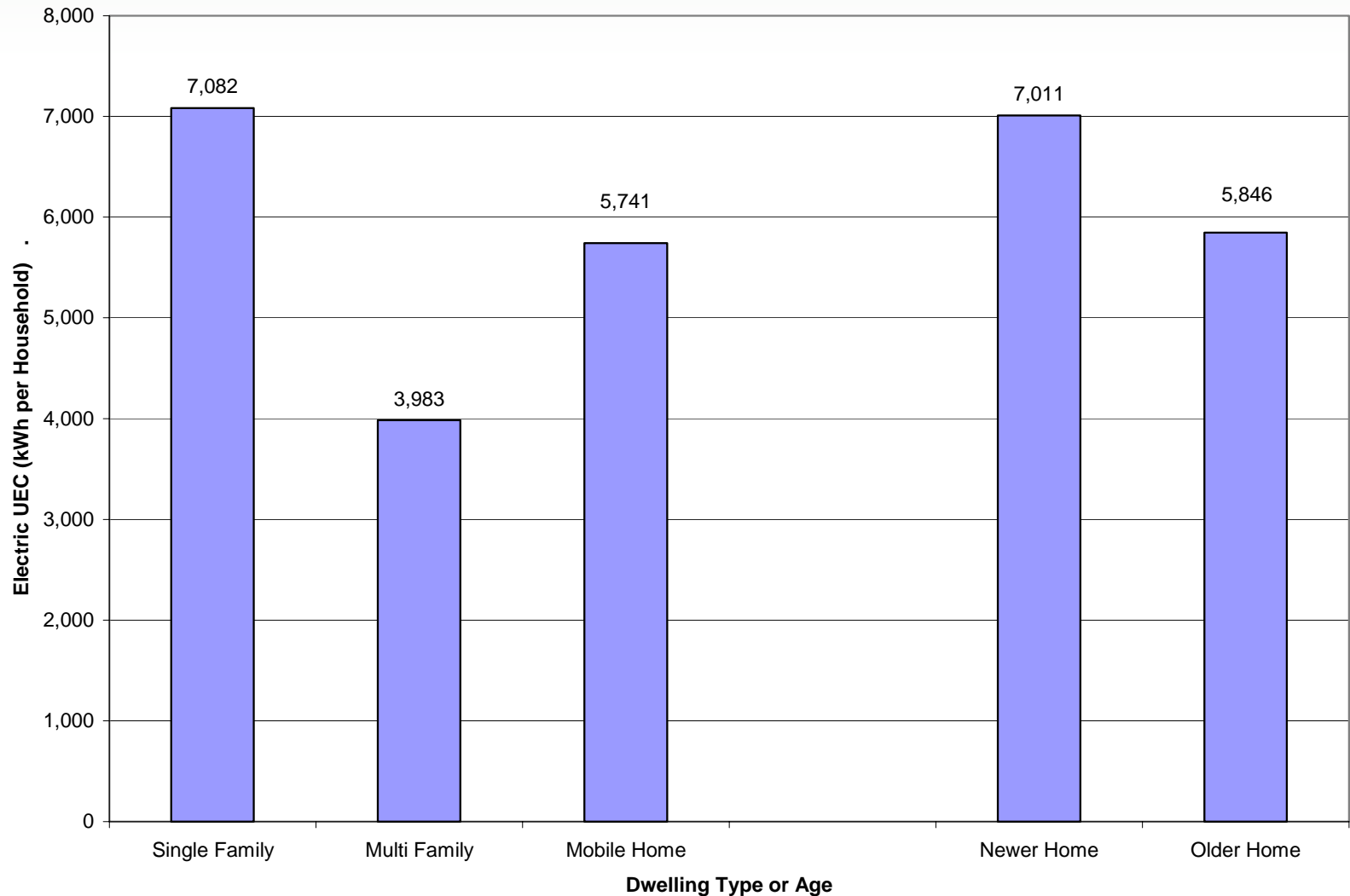


(*SoCalGas result is based on aggregated electric UECs for customers who are SoCalGas Customers)

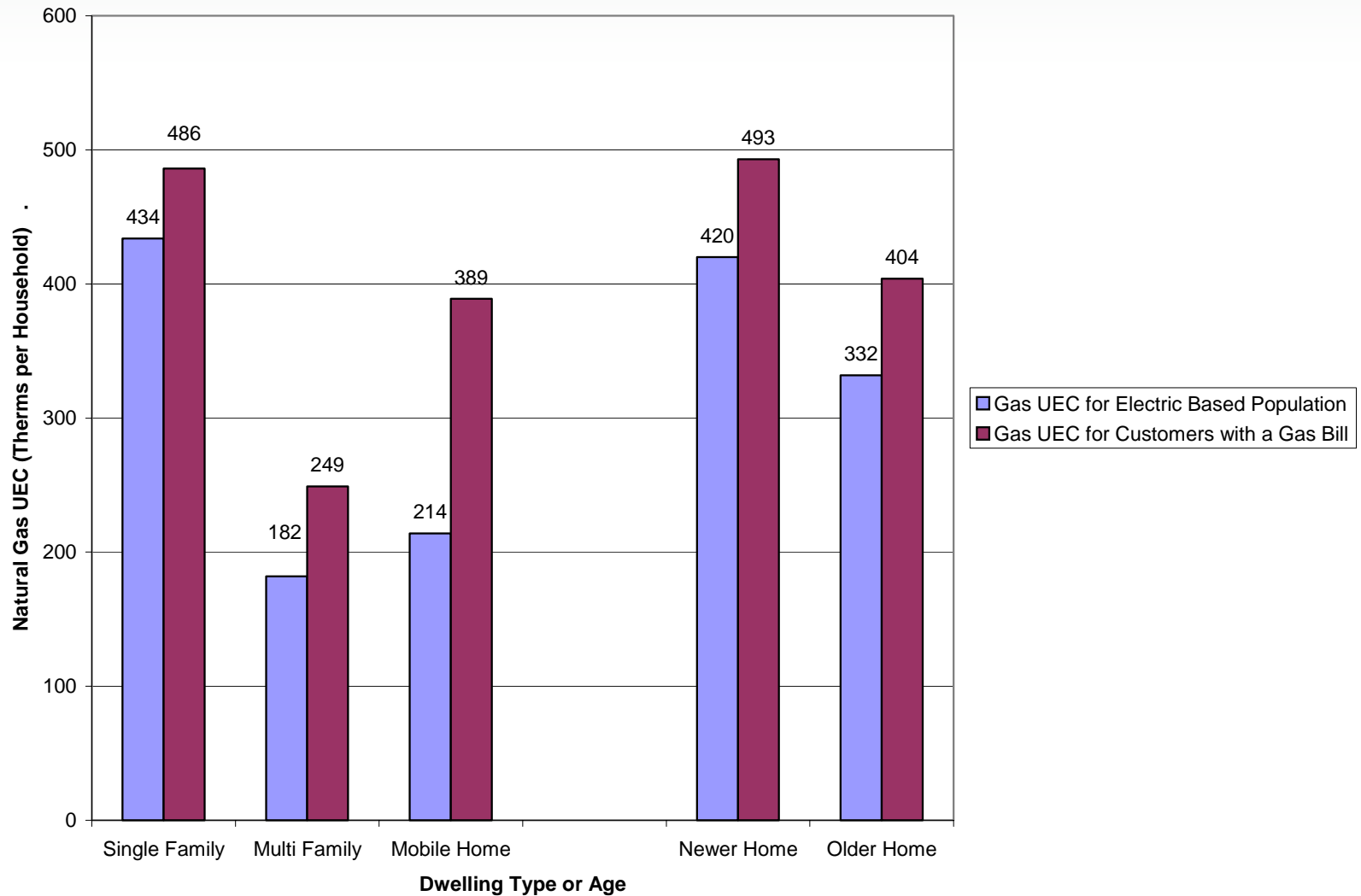
Natural Gas UECs by Utility



Electric UECs by Dwelling Type or Age



Natural Gas UECs by Dwelling Type or Age



Residential Market Share Tracking Study

California MAESTRO Workshop

March 31, 2004

Rachel Harcharik
Itron, Inc.

Richard Pulliam, Southern California Edison
Project Manager



Knowledge to Shape Your Future

Background

- **Tracking market shares of energy efficient measures for residential use**
 - **HVAC Equipment**
 - Central AC
 - Central Furnaces
 - Central Heat Pumps
 - **Appliances**
 - Refrigerators
 - Dishwashers
 - Clothes Washers
 - Room AC
 - **Compact Fluorescent Lamps (CFLs)**
- **Consistent data collection since 1999**
- **Consistent reporting of results since 1999**
 - Utility service area segmentation where possible

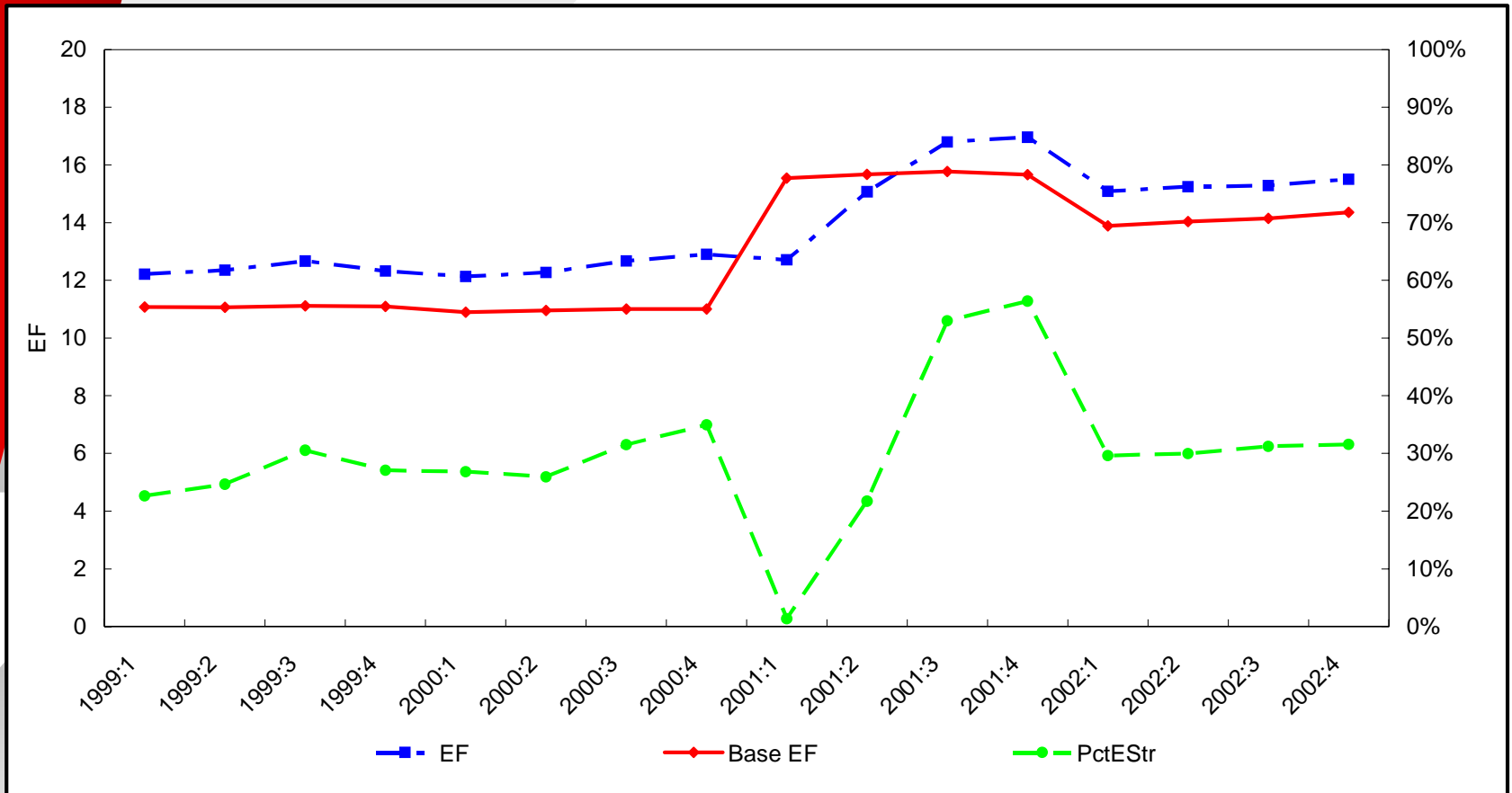
Data Collection Approach

- **Appliances: retail point-of-sale data**
 - ENERGY STAR national retail partners
 - Retail chains and independent retailers in CA
- **HVAC equipment: distributor sales data**
- **Lamps: retail point-of-sale data**

- **New construction**
 - Not available all study years
 - Coordinated with statewide RNC studies
 - Onsite surveys
 - Title 24 forms filed with building departments

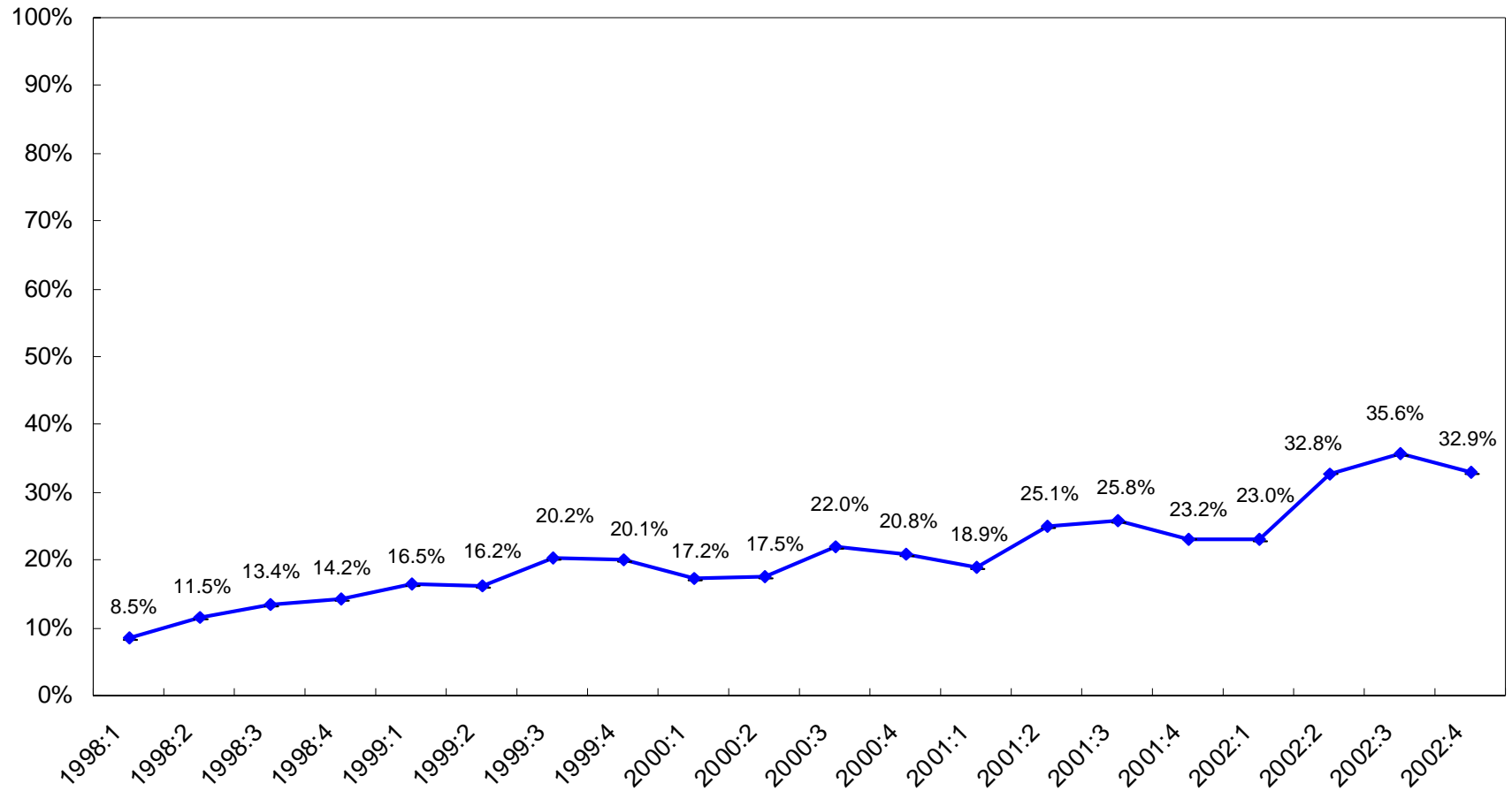
Refrigerators

Energy Factor and Percent of ENERGY STAR Qualified Units



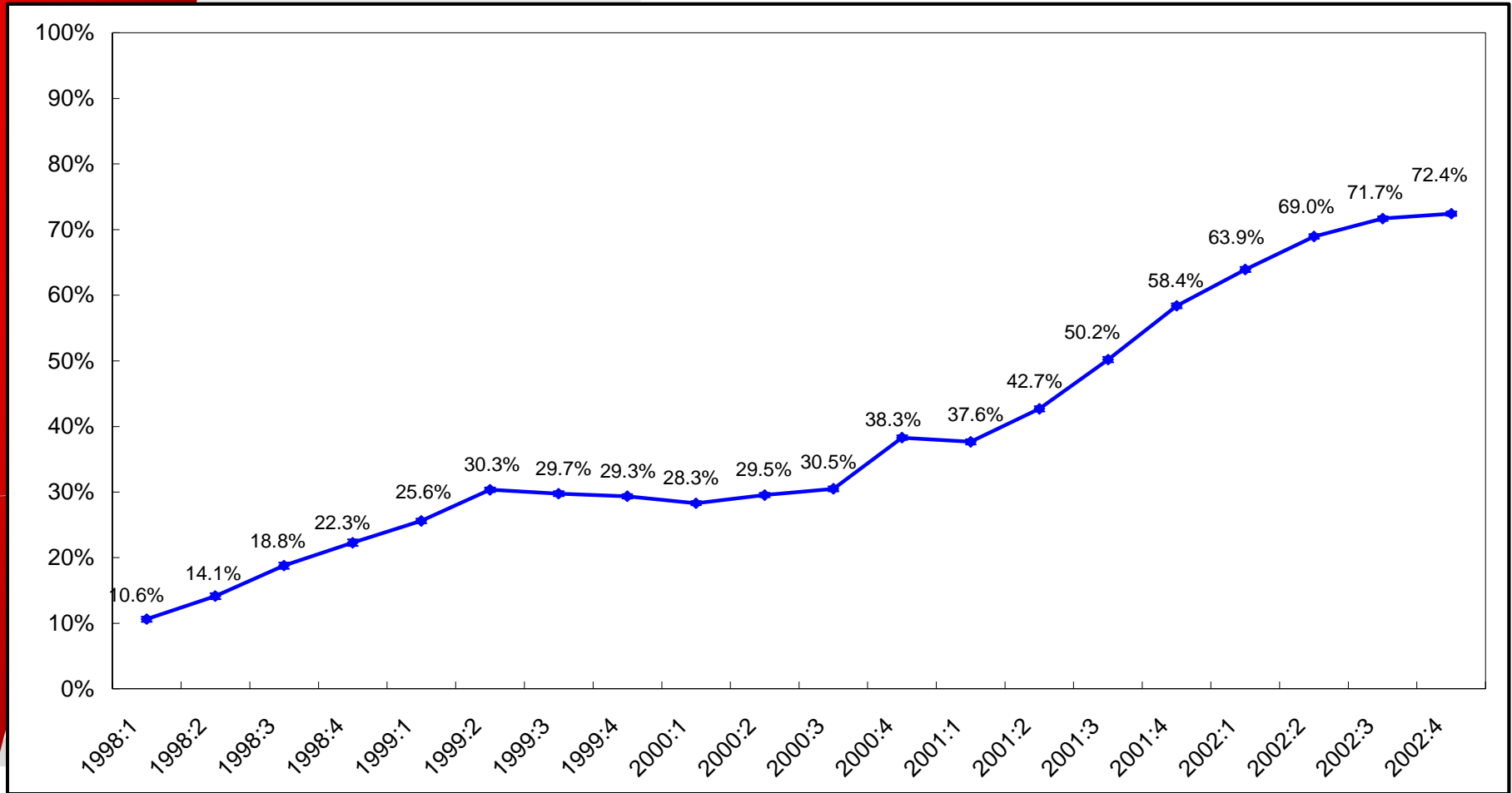
Clothes Washers

Percent of ENERGY STAR Qualified Units



Dishwashers

Percent of ENERGY STAR Qualified Units

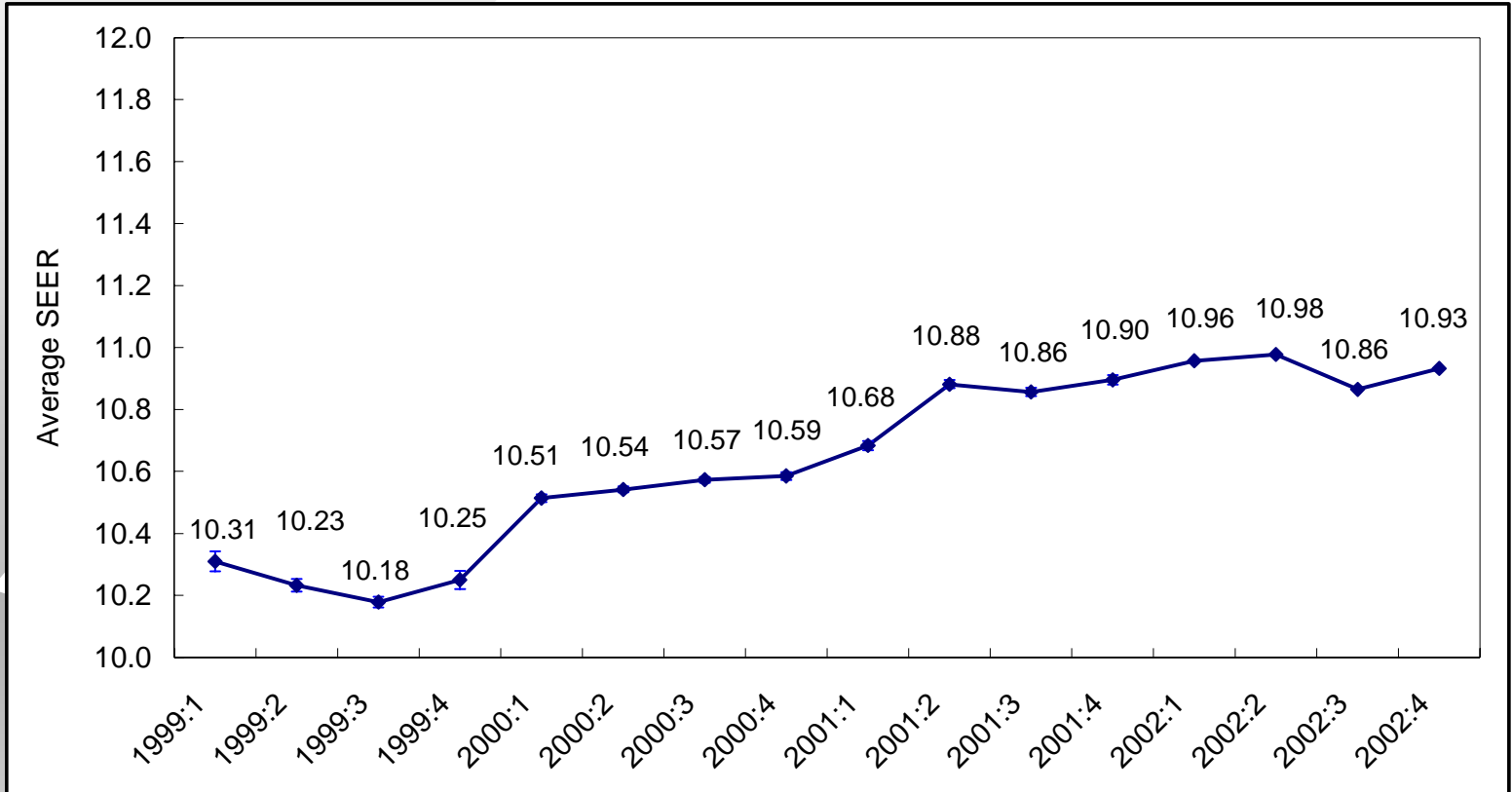


Knowledge to Shape Your Future

Electric / Gas / Water
Information collection, analysis and application

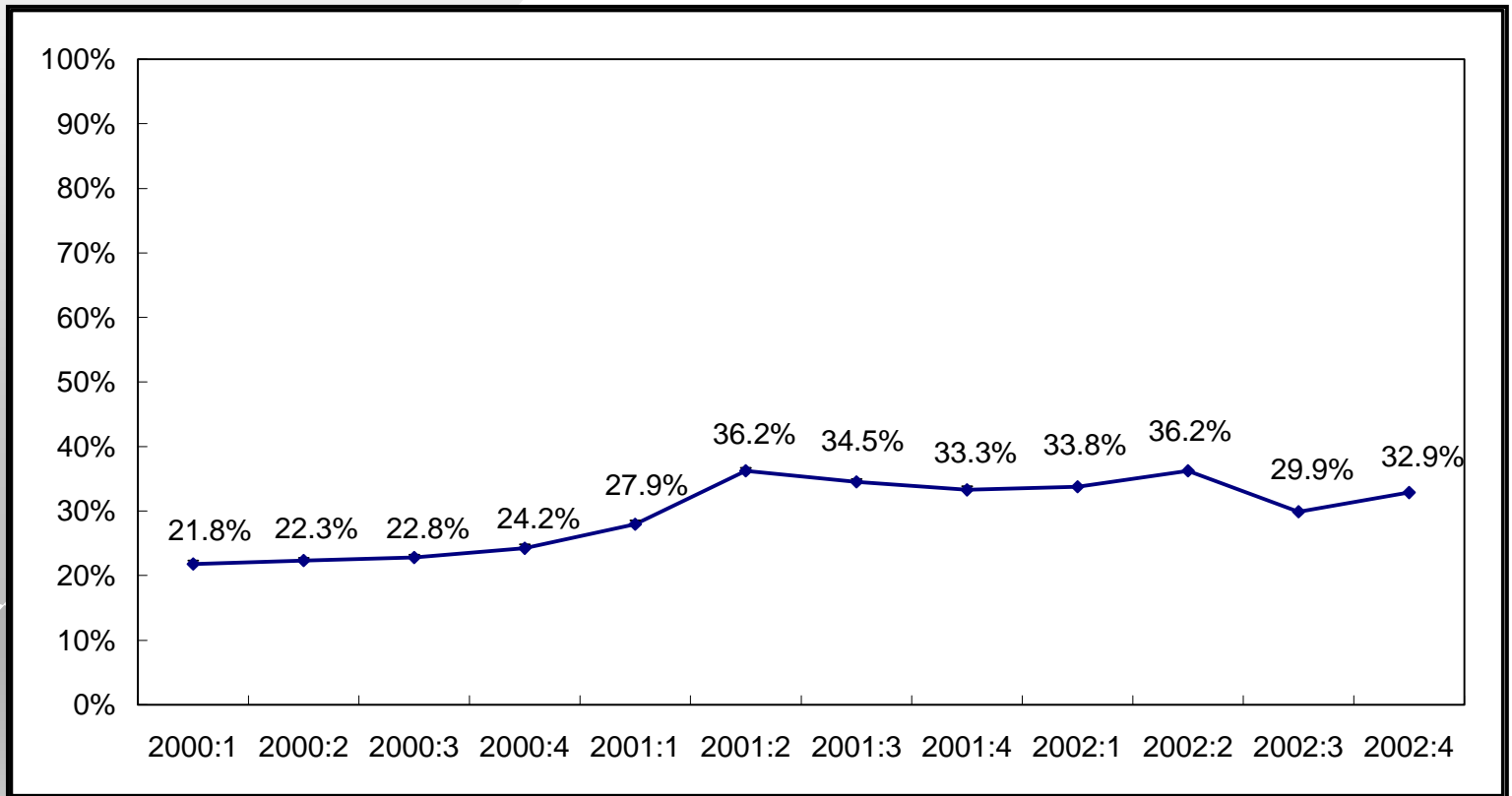
Central Air Conditioning

Average SEER



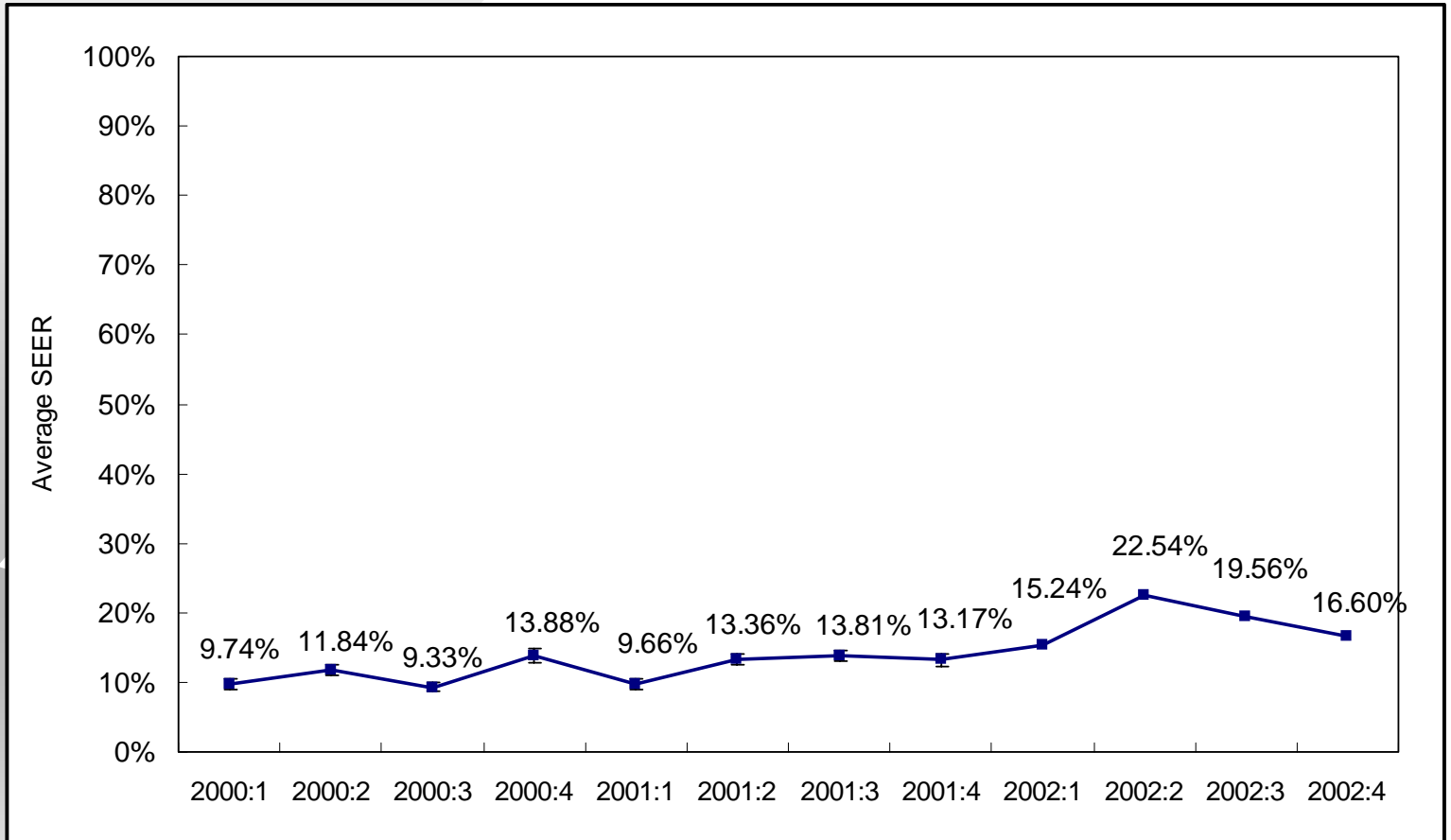
Central Air Conditioning

Percent of ENERGY STAR Qualified Units



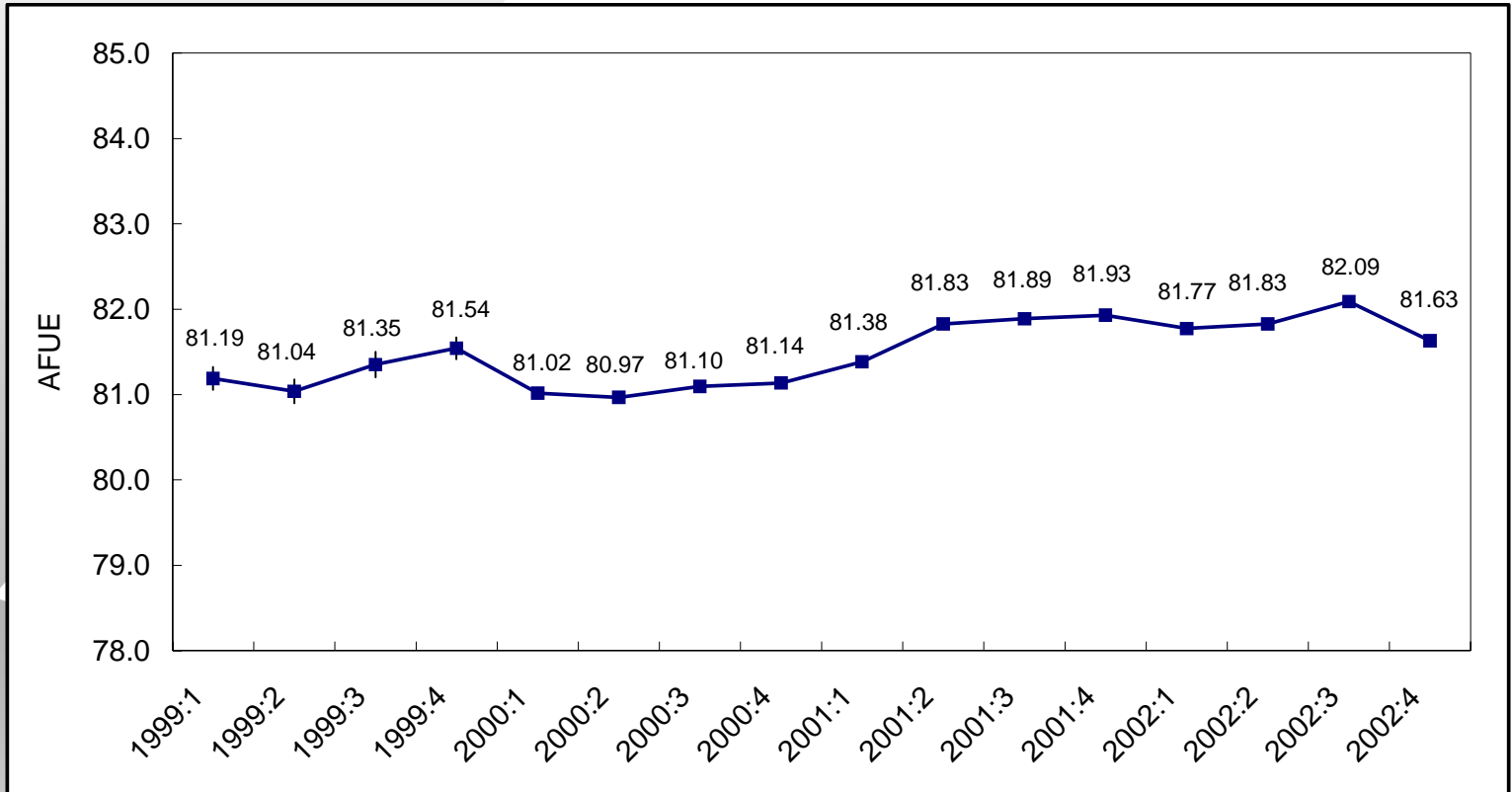
Heat Pumps

Percent of ENERGY STAR Qualified Units



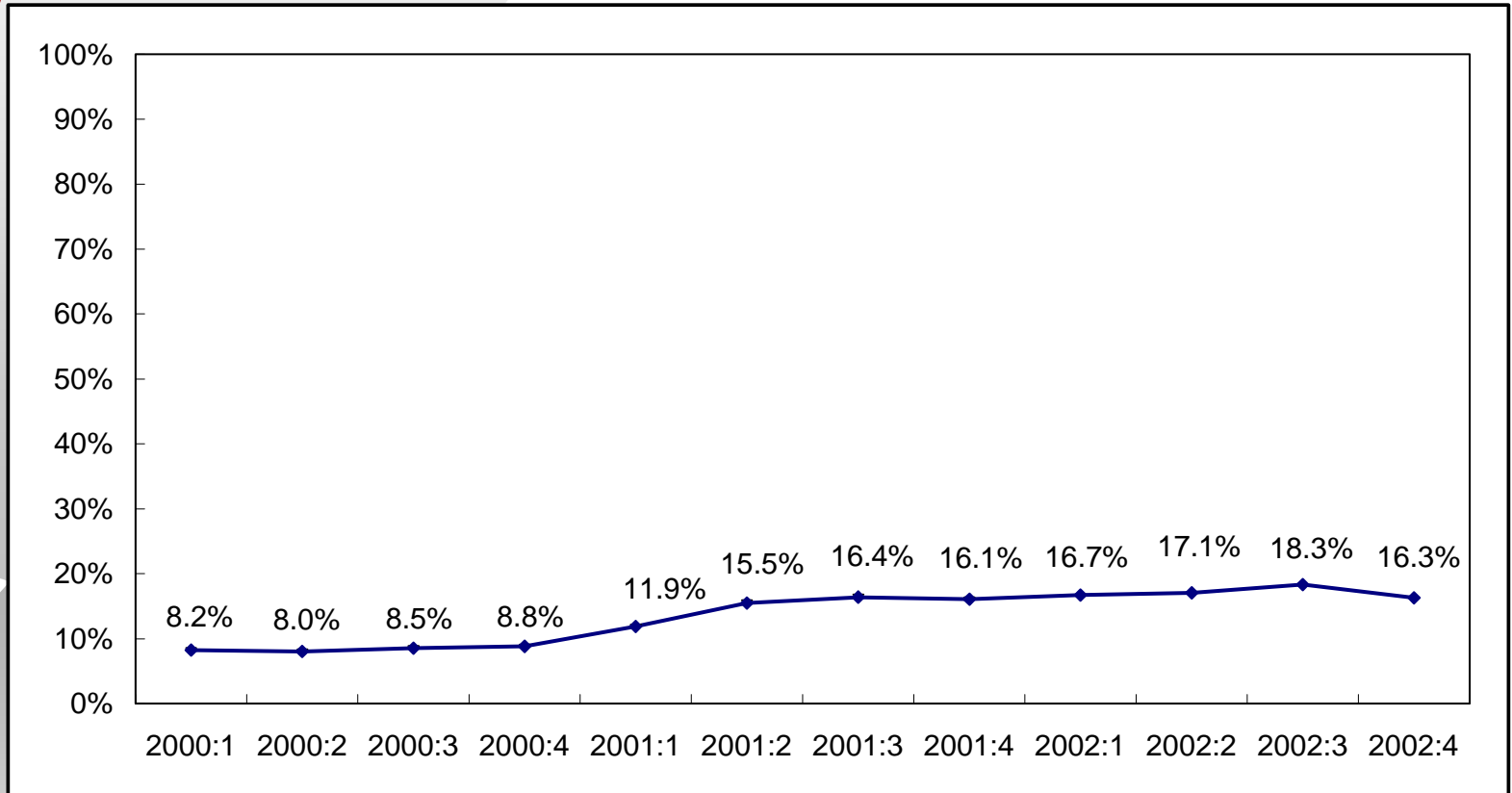
Gas Furnaces

Average AFUE



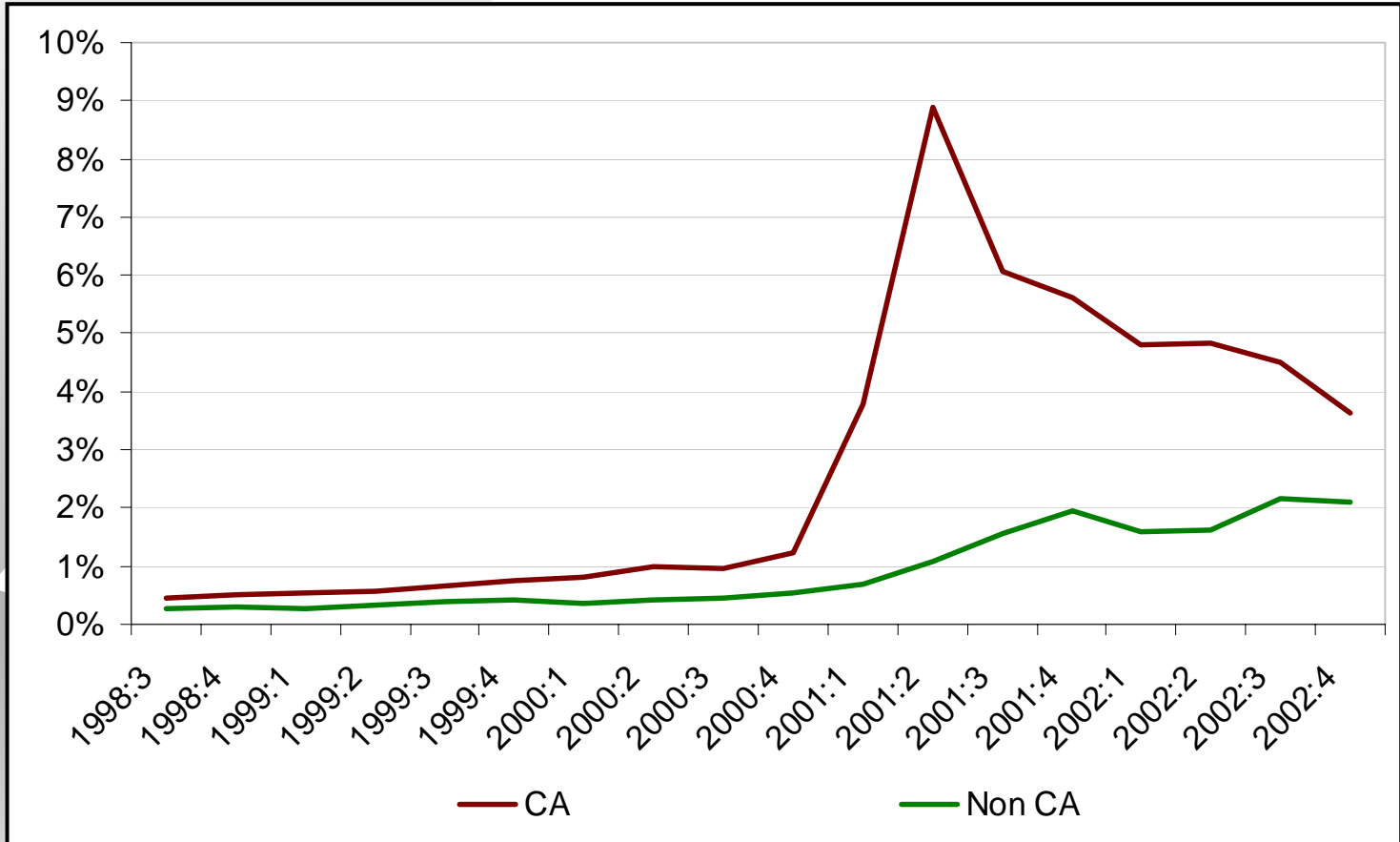
Gas Furnaces

Percent of ENERGY STAR Qualified Units



CFLs

CFL Sales as a Percent of Total MSBL Sales



Availability of Results

- **Reports & summaries covering data through 2001**
 - See CALMAC's publications database
- **Most recent reports & summaries covering 2002 data**
 - Lighting 2002: Summaries (Vol 1 & Vol 2)
 - HVAC 2002: Full report and summaries (Vol 1 & Vol 2)
 - Appliances 2002: Full report and summaries (Vol 1 & Vol 2)

Next Steps

- **HVAC & Appliances**
 - Increase retailer and distributor panels
 - Explore D&R data availability
- **Lamps**
 - National Lighting Tracking Scoping Study
 - Include national ENERGY STAR retailer data when available
- **Continue to support other statewide studies and requests from other regions**

EM&V of the 2002 Statewide ENERGY STAR New Homes Program

Presented by:

Mary Kay Gobris, PG&E Contract Manager

Study Conducted by:



Study Conducted for California's Investor Owned Utilities



Agenda

- Brief Background
- Study Objectives
- Summary of High Level Findings
- Building Characteristics Summary
- Process Findings
- Impact Findings
- Recommendations
- Questions

Project Personnel

- RLW Analytics: EM&V Contractor
- Itron Conducted surveys of single family builders and Title 24 consultants
- Mary Kay Gobris: Contract Manager, PG&E
- Evaluation Project Advisory Team includes: Shahana Samiulla, SCE; Henry De Jesus, SDG&E; Eli Kollman and Jay Luboff (CPUC)

Program Background

- Program Being Evaluated: California ENERGY STAR New Homes Program for PY 2002
- Statewide Program: Offered by all four Investor Owned Utilities
- Target Market: Builders of single family and multifamily new housing
- Benefits: Cash incentives, training, marketing support
- REQUIREMENTS: Build HOMES THAT EXCEED CODE by at least 15% and verify program requirements through a CHEERS inspection

Phase I EM&V Objectives

- **Provide a market assessment of building characteristics for participant buildings**
- **Measure the effectiveness of the program by analyzing the survey results of:**
 - ◆ **Builders**
 - ◆ **Title 24 consultants**
 - ◆ **CHEERS raters**
- **Provide a preliminary estimate of ex post energy savings**
- **Assess the overall program performance and provide specific recommendations to enhance the program effectiveness.**

High Level Findings

- The utilities did an excellent job of collaboration
- Program penetration was good
 - ◆ 20,000 dwellings participated out of 168,000 new home starts in 2002
 - ◆ With more money, more builders/dwellings could (and would) have participated
- Builders participating indicate that the Program has fostered a change in the way they construct new homes in California.

SF Building Characteristics

- **Building characteristic data obtained from builder's Title 24 files**
- **Builder's best estimate of actual construction**
- **Performance compliance approach most common**
 - ◆ **Allows builders to make “trade-offs”**

Energy Efficiency Measure	Minimum Efficiency Standard	Average Efficiency for Single Family Homes
Water Heater	At least 0.53	0.61
Furnace	Minimum 0.80 AFUE	0.82 AFUE
Air Conditioning	Minimum 10 SEER	10.8 SEER
Window U Value	Maximum 0.65 to 0.75	0.39
Window SHGC Value	Maximum 0.40	0.35
Window to Wall Ratio	Maximum 16 to 20%	17%

MF Building Characteristics

- Low rise multifamily housing characteristics from builder's Title 24 files
- Only a few high rise MF, not included in table

Energy Efficiency Measure	Minimum Efficiency Standard	Average Efficiency for Multi-family Low-Rise Homes
Water Heater	At least 0.53	0.61
Air Conditioning	Minimum 10 SEER	10.3 SEER
Window U Value	Maximum 0.65 to 0.75	0.51
Window SHGC Value	Maximum 0.40	0.49
Window to Wall Ratio	Maximum 16 to 20%	12%

Program Awareness

- 94% of non-participant single family builders reported they were aware of the program
 - ◆ Most common reasons for not participating were because of funding uncertainty, lack of time, and lack of interest
- 40% of non-participant multifamily builders reported they were aware of the program
 - ◆ Multi-family new construction market is a relatively new market for energy efficiency programs and is a more diverse market than single family homes.
 - ◆ Although less awareness, MF program showed greater market penetration

Program Effectiveness

- Overall program satisfaction ratings
 - ◆ 3.6 out of 5 points for single family builders
 - ◆ 4.33 out of 5 points for multi-family builders
- Reasons SF builders participated
 - ◆ Financial incentives (61%)
 - ◆ Differentiation in the market place (51%)
 - ◆ Advertising partnership (46%)

80% of single family builders think the ENERGY STAR label has had a positive impact on the marketability of their homes

- Reasons MF builders participated
 - ◆ Financial incentives (79%)
 - ◆ Lower energy costs for tenants (10%)

Program Satisfaction for Single Family Participant Builders

- All areas of satisfaction score above average.
- Communication with utility scores the highest, 4.1 out of 5
- Advertising partnership needs most improvement, 2.7 out of 5

Program Satisfaction	Average Rating*	Standard Error	n
Amount of Incentives	3.08	(0.40)	43
Advertising Partnership	2.71	(0.24)	38
Third Party Inspections	3.44	(0.62)	41
Certification Process	3.64	(0.57)	41
Application Documentation	3.38	(0.30)	43
Required Margin of Compliance	4.02	(0.41)	42
Incentive Processing and Payment	3.19	(0.28)	38
Communication with Utility	4.07	(0.16)	42
Overall Program	3.62	(0.33)	43

* Responses provided on a scale of 1 to 5 with a 1 meaning “not very satisfied” and a 5 meaning “very satisfied.” Values are weighted means, with weighted standard errors in parentheses.

Program Satisfaction for Multifamily Participant Builders

- Satisfaction with program very high
- Not surprisingly, required margin of compliance scored the highest (4.43) and 3rd Party Inspections scored the lowest (3.59)

Program Satisfaction	Average Rating*	Standard Error	n
Amount of Incentives	3.98	(0.32)	37
Design Assistance Incentives	4.24	(0.29)	27
Third Party Inspections	3.59	(0.42)	25
Certification Process	4.07	(0.35)	21
Application Documentation	4.16	(0.23)	36
Required Margin of Compliance	4.43	(0.19)	37
Incentive Processing and Payment	4.34	(0.29)	18
Communication with Utility	4.36	(0.21)	37
Overall Program	4.33	(0.20)	37

* Responses provided on a scale of 1 to 5 with a 1 meaning “not very satisfied” and a 5 meaning “very satisfied.” Values are weighted means, with weighted standard errors in parentheses.

Program Barriers

● What is a barrier?

- ◆ Single Family Builders
 - Funding uncertainty/lack of program funding
 - Third party inspections
- ◆ Multifamily Builders
 - Less awareness than single family builders
 - Application Documentation
 - Third party inspections

● What is not a barrier?

- ◆ Required margin of compliance
- ◆ Amount of incentives
- ◆ Product availability
- ◆ Contractor availability
- ◆ Communication with utility

Builders generally agree that building to ENERGY STAR costs more, but that the added cost does not outweigh the other benefits of participation

Phase I: Ex Post Savings

- Program exceeded filed Btu savings
 - ◆ Single Family: 134 MMBtu savings
 - ◆ Multifamily: 55 MMBtu savings
- 20% statewide SF compliance margin
- 23% statewide MF compliance margin
- 89 statewide HERS score
 - ◆ 87 is California minimum for ENERGY STAR

Phase II: Ex Post Savings

- More ex post savings analysis required in 2003
- Finalize Btu Savings Analysis
 - ◆ Once majority of homes are built and paid
- Determine kWh and Therm savings
 - ◆ Billing analysis
 - ◆ Engineering analysis
 - Informed by ESH on-site survey data
 - Informed by baseline study findings

Recommendations

- RLW Analytics urges CPUC to authorize programs on time to maintain program continuity.
- Required savings for multi-family should be at least 20% better than baseline
 - ◆ More than 50% of both participants and non-participants find it “very easy” to meet code
 - ◆ The majority of non-participant multifamily builders claimed that most of their most recent projects were 15% or more better than code
- On-site inspections may be prudent due to issues of the CHEERS database and quality assurance procedures



Evaluation of the 2002 Statewide Education, Training and Services Program

MAESTRO Evaluation Results Presentation
March 31, 2004

Prepared for:
Southern California Edison,
Pacific Gas and Electric Company,
San Diego Gas and Electric Company and
Southern California Gas Company

Overview of Presentation

■ Program

- ❖ Overview
- ❖ Program theory
- ❖ 2002 accomplishments

■ Evaluation

- ❖ Objectives
- ❖ Approach
- ❖ Research activities
- ❖ Findings
- ❖ Recommendations

Program Overview

- Education and training services offered to businesses, manufacturers, researchers, educational institutions, and the general public
- Five physical and virtual centers
 - ❖ **PG&E:** Energy Training Center¹ (Stockton)
 - ❖ **SCE:** Customer Technology Application Center (Irwindale) and Agricultural Technology Application Center (Tulare)
 - ❖ **SCG:** Energy Resource Center (Downey)
 - ❖ **SDG&E:** energy efficiency classes (throughout)

¹PG&E's Pacific Energy Center is funded separately and was evaluated separately

Program Theory

- Reduce information-related market barriers through cumulative exposure to measure-specific information

Barrier	Program Intervention
Information Costs	<ul style="list-style-type: none"> • Credible advocacy and information on a range of energy-efficiency products • A convenient, centralized location and flexible schedule of seminars
Performance Uncertainty	<ul style="list-style-type: none"> • Objective information, on-site demonstrations, and technical support
Information Asymmetry	<ul style="list-style-type: none"> • Unbiased, cutting-edge information on new technologies
Bounded Rationality	<ul style="list-style-type: none"> • Individualized information provided by knowledgeable instructors in an interactive environment to give customers the impetus to depart from the status quo • Objective information and on-the-spot technical support

2002 Program Accomplishments

- Core seminars and workshops
 - ❖ 444 energy-efficiency seminars
 - ❖ Over 7,000 non-residential customer attendees
- Physical center displays, demonstrations, technical consultants, facility presentations, fact sheets and brochures
- Program exceeded HTR goals
- Expansion of statewide collaborative efforts

Evaluation Objectives

- Measure program effectiveness and test program theory assumptions
- Provide ongoing feedback and corrective guidance regarding program design and implementation

Evaluation Approach

■ Program Effectiveness Assessment

- ❖ Changes in participant energy efficiency behaviors
- ❖ Reduction in relevant market barriers
- ❖ Program awareness among the target audience

■ Process Evaluation

- ❖ Program implementation and marketing
- ❖ Statewide coordination

Research Activities

- Participant survey
 - ❖ 346 telephone surveys
- Target market survey
 - ❖ 1,049 telephone surveys with nonresidential customers located within driving distance of the centers
- Program filings and materials review
- In-depth program staff interviews



Study Findings

- Program Effectiveness
- Program Target Market
- Process Evaluation

Program Effectiveness Findings

1. Is the program **effectively designed** to reduce market barriers?
2. Has the program **reduced market barriers** for its seminar attendees?
3. Have energy-efficiency **behaviors and adoptions increased** as a result of the program?

Program Effectiveness Findings, cont.

1. Attending the program's seminars reduces relevant market barriers
2. The program resulted in changes in awareness, behaviors, and attitudes for $\frac{3}{4}$ of participants
3. The program was effective in increasing energy-efficiency behaviors and adoptions for over $\frac{1}{2}$ of participants

Target Market Findings

1. What percentage of the target market is **aware** of the program?
2. What is the extent of **prior participation** among the target audience?
3. How much **interest** exists among the target market for using the program's services?

Target Market Findings, cont.

1. Awareness ranges from 14 to 57 percent, higher for rural areas
2. One-third of customers have used the program's services
 - ❖ <35k end-users and 10k upstream market actors
3. More than ½ of customers are interested in participating

Target Market Findings, cont.

■ **Barriers** to expanding participation:

- ❖ Lack of awareness (more than 50%)
- ❖ Concerned that seminars would not be relevant to their situation (25%)
- ❖ Do not have enough time to attend (13%)

Process Evaluation Findings

■ Administration and coordination are effective

- ❖ High rate of staff retention, effective local communication
- ❖ Statewide coordination: reduced seminar development costs, expanded seminar offerings
- ❖ Maintaining contact with corporate decision-making can prove challenging, but has improved

Process Evaluation Findings, cont.

- Prior participants form the foundation of the program's **marketing** database
 - ❖ Most participants learn about the program through a mailed brochure
 - Preferred source
 - ❖ Program tracking could be improved

Process Evaluation Findings, cont.

- **HTR goals** set for the first time in 2002
 - ❖ The program has always targeted a diverse group of attendees
 - ❖ HTR definitions are not consistent statewide
 - ❖ Tracking of HTR criteria besides geography is difficult
 - ❖ However, reliance on geographic HTR alone may not be appropriate given that the centers have fixed locations (with the exception of SDG&E)

Process Evaluation Findings, cont.

■ **Customer satisfaction** is very high

- ❖ Almost every participant from 2002 was very or extremely satisfied with the seminar(s) they attended and found them to be very or extremely useful
- ❖ The few who were not satisfied reported that the seminar was “average” or “not applicable to my situation” (each cited by 5 percent of participants)

Recommendations

- Continue and expand **statewide coordination**
- Ensure that the program is **adequately staffed** with the appropriate personnel
- Improve **tracking** of seminar participants
- Develop a consistent **HTR** definition that is not limited to geographic HTR criteria

Recommendations, cont.

- Emphasize in **program marketing** materials the program's attributes that participants respond to most favorably, i.e., its credibility and objectivity and use of hands-on demonstrations
- Continue and expand existing marketing efforts to **increase awareness** of the program among the target audience

Recommendations, cont.

- Ensure that marketing efforts address customers' concerns about the potential **relevance of the program's seminars**
- Address customers' **time constraints** through marketing and program design

Recommendations, cont.

- Incorporate **PG&E's PEC** and the nonresidential seminars that the ETC offers into the Statewide program evaluation

2002 Statewide Building Operators Certification and Training Program Evaluation

Prepared for California's Investor-Owned Utilities:

Pacific Gas and Electric Company
San Diego Gas and Electric Company
Southern California Edison Company
Southern California Gas Company

MAESTRO Workshop
March 31, 2004

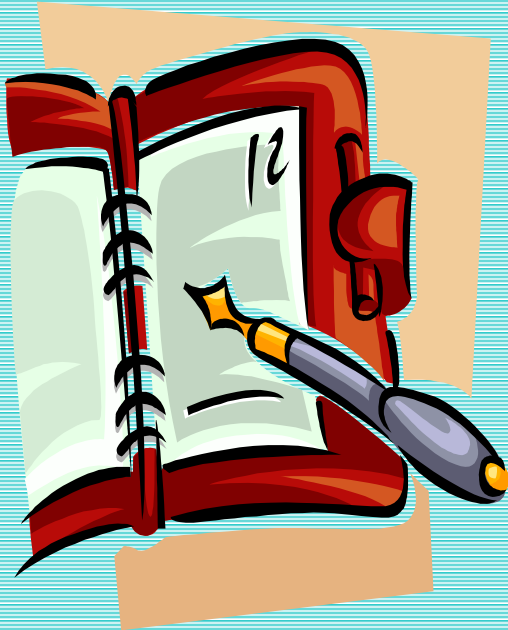
Presented By:

Marjorie R. McRae, Ph.D.
research / into / action inc

Advisory Committee

- **Program Advisory Committee Members for the Statewide Nonresidential Retrofit Building Operator Certification and Training Program:**
 - **Betsy Krieg, Statewide Lead
Pacific Gas and Electric Company**
 - **Henry De Jesus
San Diego Gas & Electric**
 - **Angela Jones
Southern California Edison**
 - **Eli Kollman, CPUC Energy Division**
 - **Jay Luboff, CPUC Energy Division**

What is the BOC?



- BOC = Building Operator Certification & Training Program
- 8 days of instruction on O&M techniques for
 - Optimal building performance
 - Energy efficiency
 - Occupant comfort
- Training provided by Northwest Energy Efficiency Council under contract to California utilities
- Level 1 and Level 2 training
- In California in 2002:
 - Level 1 training only
 - Training in 7 locations throughout the state

Evaluation Method

- **Analysis of Interview Data**
 - 67 Participating Students
 - 30 Supervisors of Students
 - 7 Utility and BOC Staff and Instructors

- **Five-Point Scales of Satisfaction, Agreement, Etc.**
 - Self-report method
 - Today, we report top positive responses ("4" and "5" on scales; e.g., "agree" and "strongly agree")

Preaching to the Choir?

➤ Who are the 2002 BOC students?

- 80% had 6+ years experience (average = 14 years)
- 82% had prior job-related training
- 70% supervise others (average = 7 staff)

➤ Their facilities

- 80% served 2+ buildings
- 90% served 100,000+ sq ft (36% served 1+ million sq ft)
- 30% offices, 30% institutions, 20% industry

Students & Supervisors Are Highly Satisfied

- 90% report satisfaction (“4” and “5” on a 5 point scale)
- “excellent,” “wonderful,” “great,” “useful,” “awesome”
- even the least satisfied--due to desire for more advanced course--still praised teachers, curricula, and availability of training

Can you please everyone?

- **73% say course is at appropriate level**
 - 15% say it's "too easy"
 - 12% say it's "too much, too fast"
- **85% say course is appropriate for facility**
 - least true for very small or very old facilities

Student Recommendations for Improvement

- 20% want greater access (more locations, greater frequency)
- 31% commented on process or procedures
- 19% offered substantive comments on course
 - Diverse comments, with little commonality

They Value Utility Involvement in BOC

- 30% would be less satisfied with less utility involvement
- 40-50% would be more satisfied with more utility involvement
 - more financial assistance
 - more information on utility programs
 - more series offered
 - more training on specific topics

They Value the Certification

- 85% believe certification increases employee's value
- 60% of students would be less satisfied without certification
- 40% of supervisors would be less likely to send students were certification not offered

Certification Implies a Continued Market Presence

- 55% of students would be less satisfied if BOC were discontinued
- 27% of supervisors would be less likely to send staff if program likely to be discontinued

Expected Demand for Program is High

- 75% of students plan to get Level 2 certification
- 55% of students and 43% of supervisors expect facility to send more students
- Program can expect about 1.75 additional students per participating facility (on average)

OK, OK, So They Like It



BUT DOES THE BOC DO ANYTHING?

Influence on the Job

- 93% used BOC concepts on the job
 - 72% did new things
 - 61% more frequently did things they already knew about
- 79% have saved energy using BOC
- 78% have saved money using BOC
 - 46% saved money on troubleshooting and use of contractors
- 75% report BOC has led to their improved job performance

More Influences

- 78% have advised in equipment operation or replacement decisions
- 78% have undertaken, recommended, or influenced energy-efficiency projects
 - Lighting: 42%
 - HVAC systems: 31%
- 67% have improved occupant comfort

They Said the BOC Increased:

- Likelihood of company making energy-efficient investments: 81%
- Likelihood of company's participation in utility efficiency programs: 73%
- Student's confidence in ability to respond appropriately to a request for a demand response: 34%

Is the BOC Good for Everyone?

- **Students reporting BOC had positive effect on their on-the-job behaviors**
 - **Under 10 years O&M experience: 100%**
 - **10+ years, but not a supervisor: 100%**
 - **10+ years, supervisor, but under 1 million SF of space: 87%**
 - **10+ years, supervisor, more than 1 million SF: 60%**
 - **All students: 88%**

Marketing and Implementation

- Program implementation is streamlined; BOC is simple for utility managers to operate
- Marketing and outreach went according to plan; courses filled easily
- Utility training facilities provide excellent locations for BOC classes
- Staggered course start times worked well and provided students accessible options for making up missed classes

2002 Statewide BOC Accomplishments

- 8 Level 1 series were taught in 7 locations.
- 219 students received training.
- Training began 6 months after CPUC directive authorizing program.

Conclusions

- BOC has high levels of satisfaction among participants and their supervisors
- BOC is reaching its targeted market
- There is demand for BOC Level 1 and Level 2 training
- Participant interest warrants continuing utility-sponsored BOC training and certification

Recommendations

- Market BOC as training for line staff, as designed.
- To complement BOC's clear presentation of energy efficiency actions, clearly identify BOC content related to demand response.
- Develop a long-term vision for the BOC in California.
- Evaluate the 2003 program, including Level 2 and Level 1 content changes.

The Evaluation Framework: What It Does and Doesn't Do

Marian Brown
Manager, Measurement & Evaluation
Southern California Edison

CALMAC Workshop
April 1, 2004

Project Team

- Consultant Team:
 - Nick Hall, TecMarket Works
 - Lori Megdal, Megdal & Associates
 - Pete Jacobs, Architectural Energy Group
 - Plus:

Roger Wright, RLW Analytics	Ken Keating
Paul Chernick, Resource Insight	Steve Nadel, ACEEE
Ralph Prah, Ralph Prah & Assoc.	Ed Vine, CIEE
Sharyn Barata, B&B Resources	

Project Advisory Group

- Marian Brown, SCE, project manager
- Jay Luboff, CPUC Energy Division
- Eli Kollman, CPUC Energy Division
- Christine Tam, CPUC ORA
- Mike Messenger, CEC
- Sylvia Bender, CEC
- Chris Ann Dickerson, PG&E
- Kenneth James, PG&E
- Athena Besa, SDG&E and SoCalGas
- Rob Rubin, SDG&E and SoCalGas
- And a host of volunteer reviewers

The Framework is a Systems Approach to Evaluation

- It's a decision guidance system at two levels:
- The program-specific level
 - What types of studies should be conducted
 - How each type of study should be done
- The policy level
 - Role of over-arching studies
 - Considerations for designing the timing and structure within which evaluation occurs

Focus of the Framework

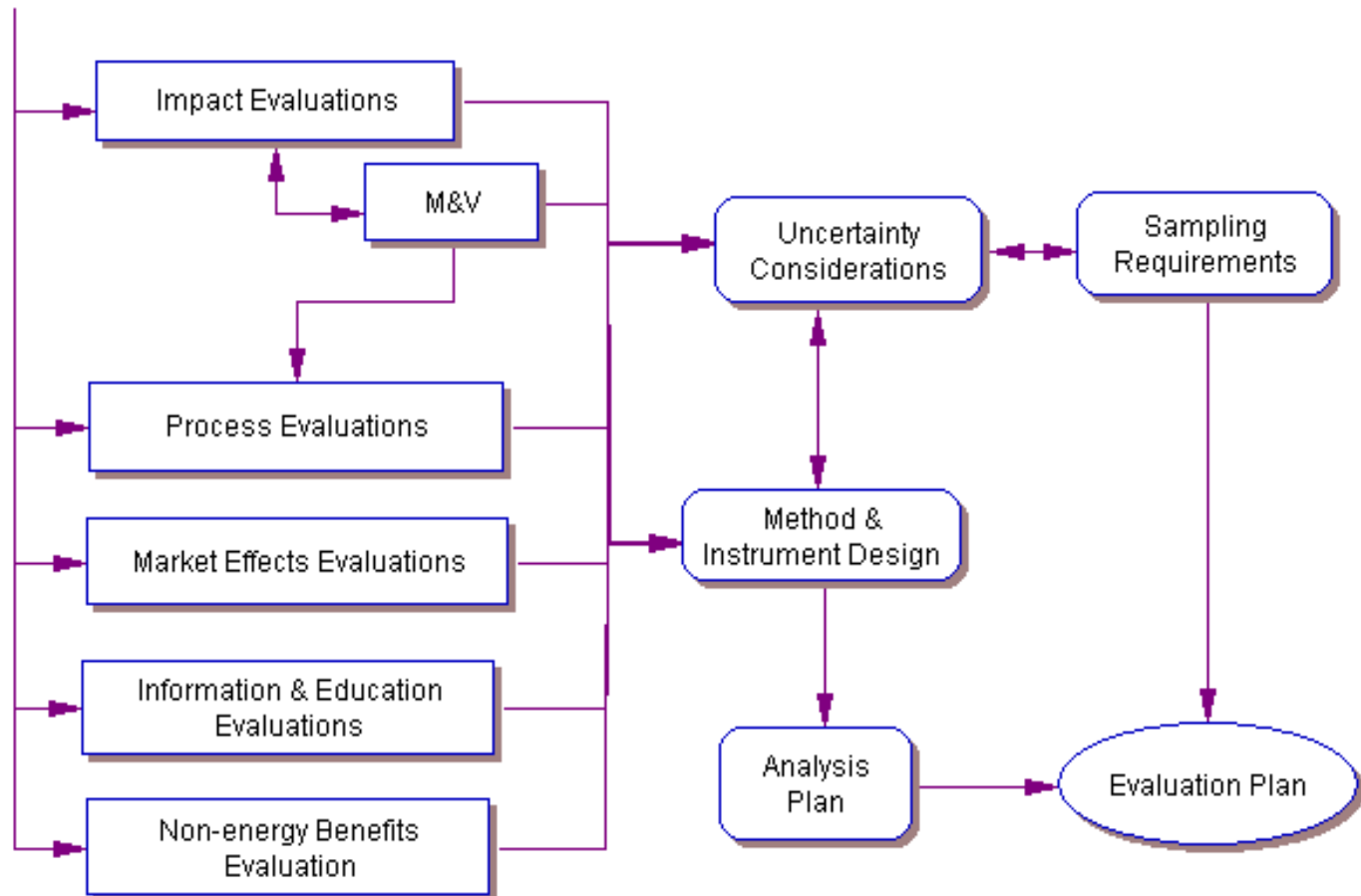
- What decisions need input?
 - Savings goals and portfolio development
 - Cost-effectiveness analysis
 - Individual program planning
- Quality and form of the information provided
 - Energy and demand savings estimates
 - Uncertainty issues
- Goals
 - More consistency and comparability of information provided
 - More reliable and usable evaluation results

Defining the Policy, Program, and Evaluation Cycle

1. Goal Setting – updating potential analysis and energy cost forecasts
2. Portfolio Analysis – sector and program priorities
3. Portfolio/Program Design, Selection, Review and Approval
4. Program Launch Preparation, Evaluation Planning and Regulatory Review
5. Program Implementation; Evaluation, M&V, Market Assessment; and Ongoing Regulatory Oversight

The Overall Roadmap

California Evaluation Framework



Key Features

- Portfolio Focus
- Covers Multiple Types of Evaluation
- Considers Non-Utility Implementers
- Evaluation Priorities and Resource Allocation
- Program Theory/Logic Models
- Ethics

What The Framework Doesn't Do: It's Not the New M&E Protocols

- It's not a set of protocols. It's currently structured as guidance for good evaluation rather than prescriptions.
- It doesn't define the regulatory structure and timetable within which evaluation will be designed, implemented and used.

Unresolved Issues

- Protocols vs. Guidelines
- Defining Appropriate Roles of Various Entities in Programs and Evaluation
- Relationship of Impact Evaluation Results to Program Performance Incentives