2002 Statewide Nonresidential Audit Program Evaluation

Summary of Final Evaluation Report

Prepared by:

Rafael Friedmann, PG&E

Kris Bradley & Christie Torok, Quantum Consulting

QUANTUM CONSULTING

PG&E Pacific Gas and Electric Company

Evaluation Objectives

Impact Assessment

- Measure the program's effects on participant energy efficiency uptake using a variety of indicators

Process Assessment

- Explore customer perceptions of the participation experience and usefulness of the audit

Long-Term Assessment

- Characterize the longer-term benefits of the Audit program---assess longevity of the audit, examine the timing of customer responses to Audit participation, measure participant use of the Audit report, etc.

Follow-up Evaluation

- Measure customer response to "follow-up" program elements designed to encourage Audit participants to implement recommendations

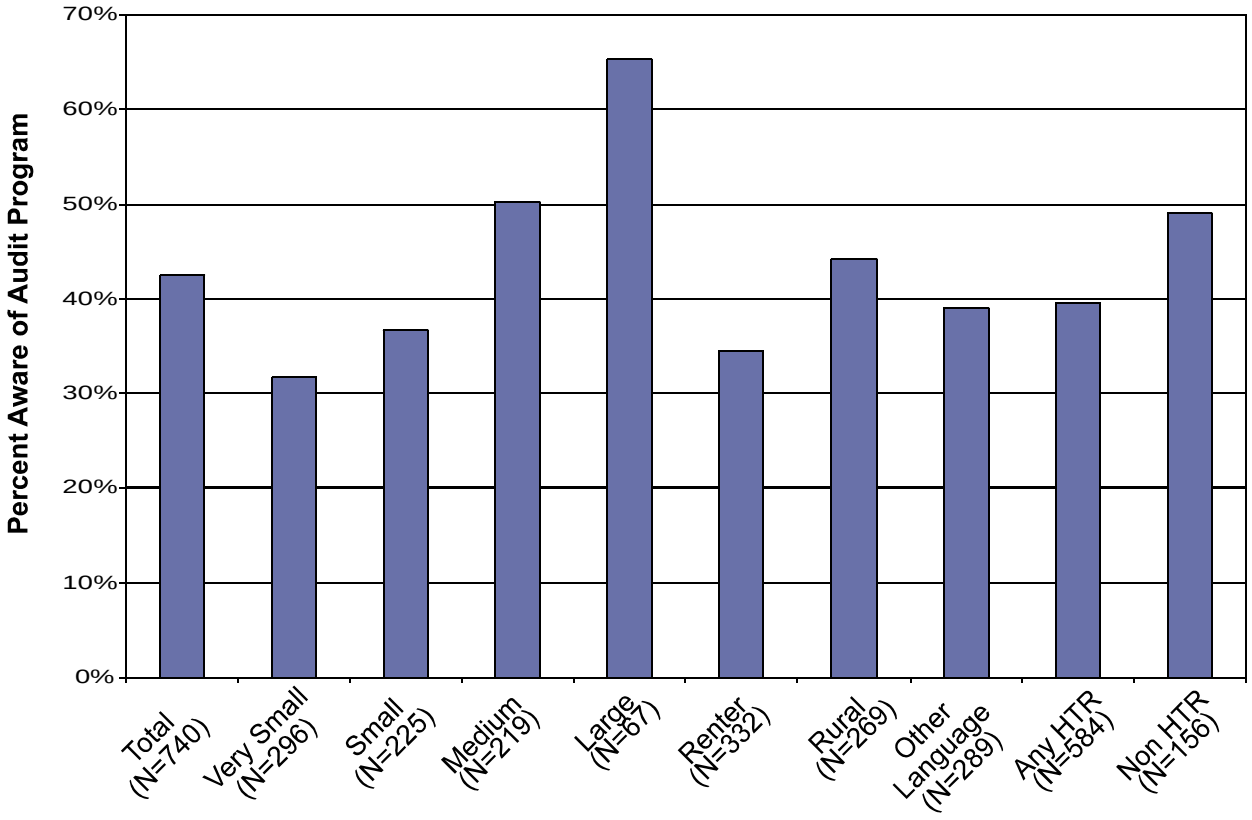
Program Targets and Accomplishments

- Statewide the Audit program delivered audit services to over 26,000 utility customers, with nearly ½ of the completed audits provided to customers defined as hard-to-reach (HTR)

Utility	Total Participation		Hard-to-Reach Participation	
	Q4 Report	Goals	Q4 Report	Goals
PG&E	6,487	3,000	5,493	1,600
SCE	8,844	4,500	5,314	1,800
SDG&E	3,977	3,950	845	750
SoCalGas	7,051	3,024	741	300
Total	26,359	14,474	12,393	4,450

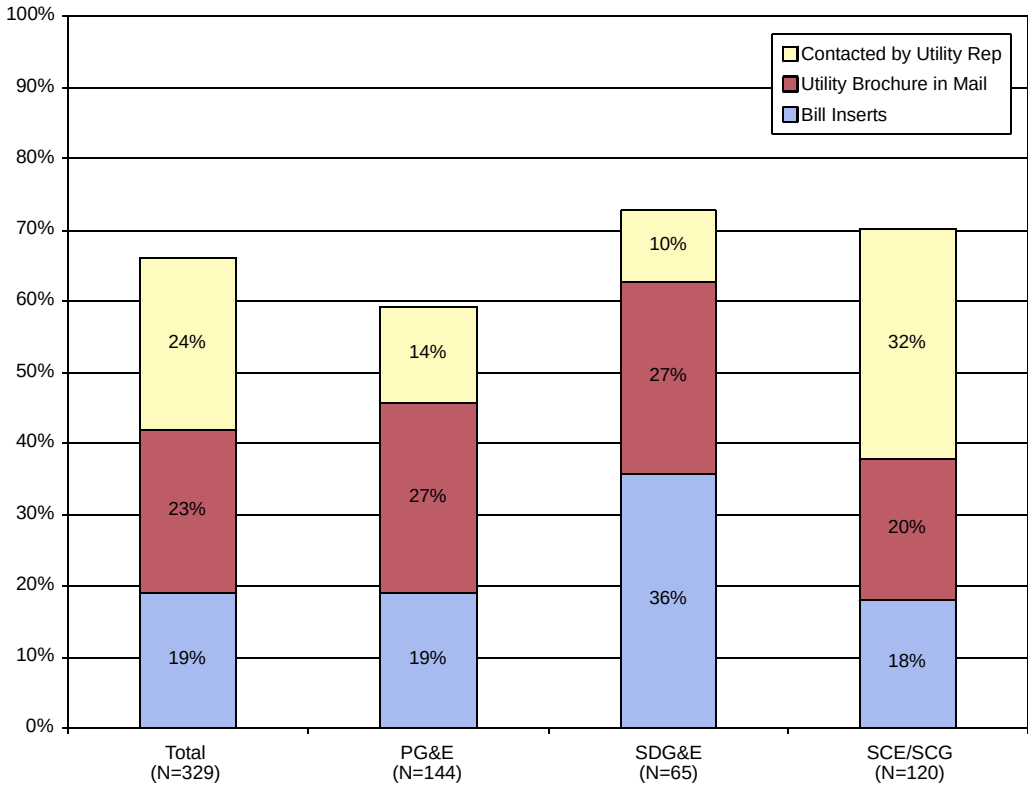
Rates of Audit Program Awareness in the General Population

- The rate of awareness of the Audit program in the general population is very high, at 42 percent, and the differences in awareness by customer size are quite large



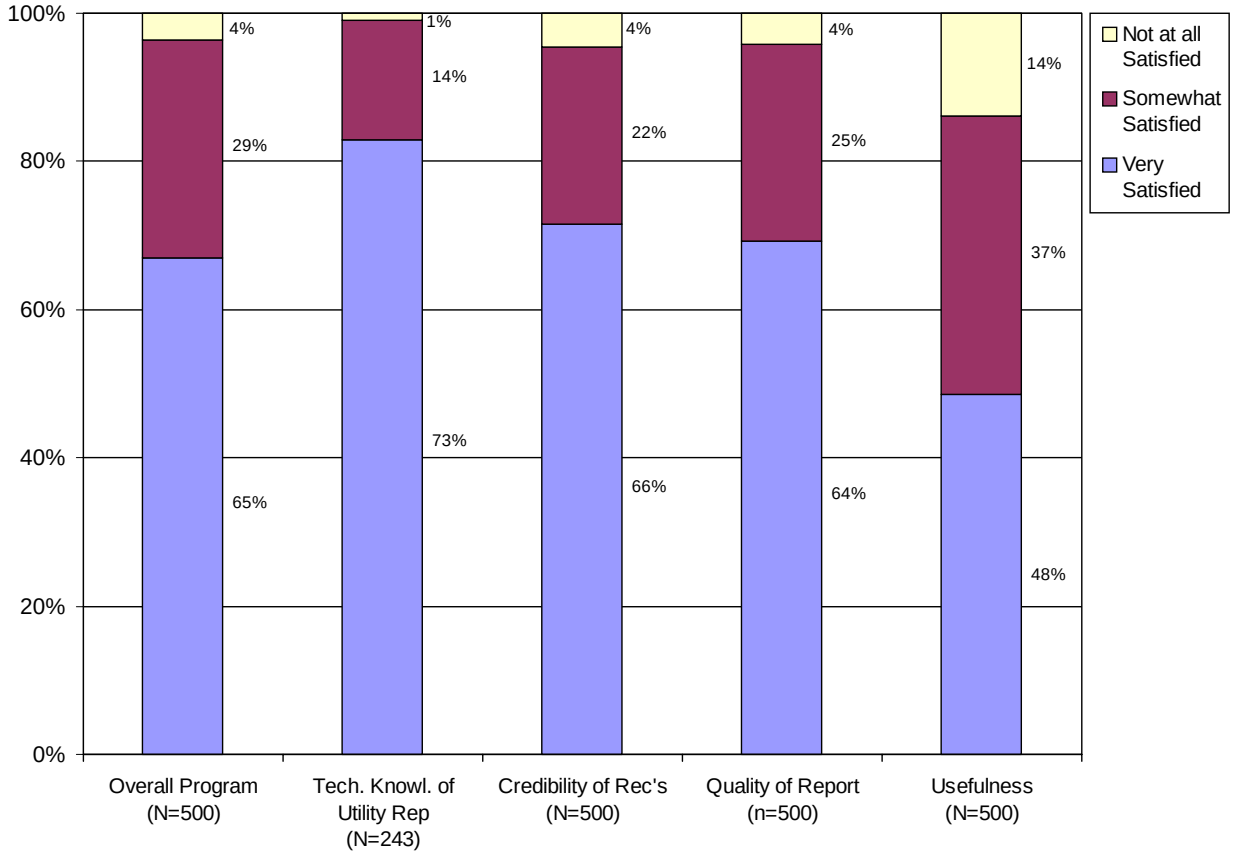
Utility Marketing Sources of Program Awareness in the General Population

- Awareness of the Audit Program in the general population is driven by the IOUs, who account for two-thirds of overall awareness



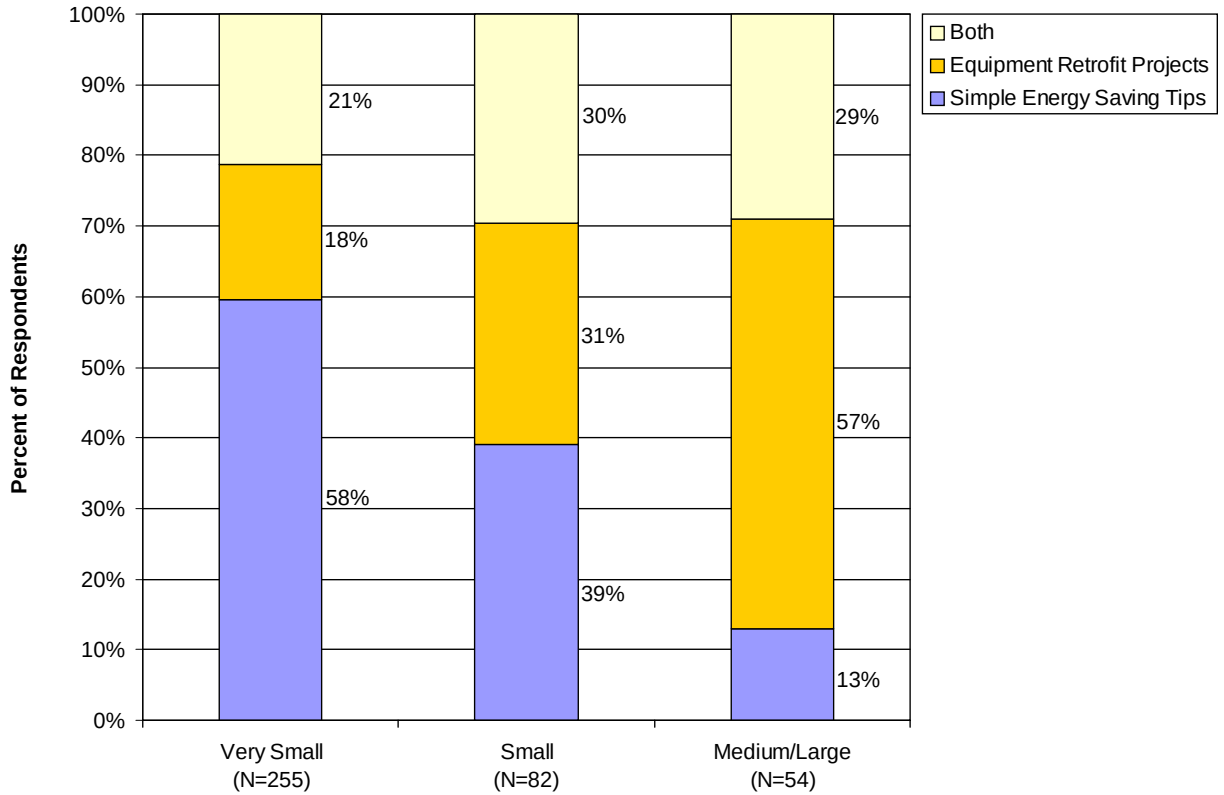
Satisfaction with Audit Program Elements

- Satisfaction levels with the Audit program are reasonably high, but participants desire a more useful audit product (report)



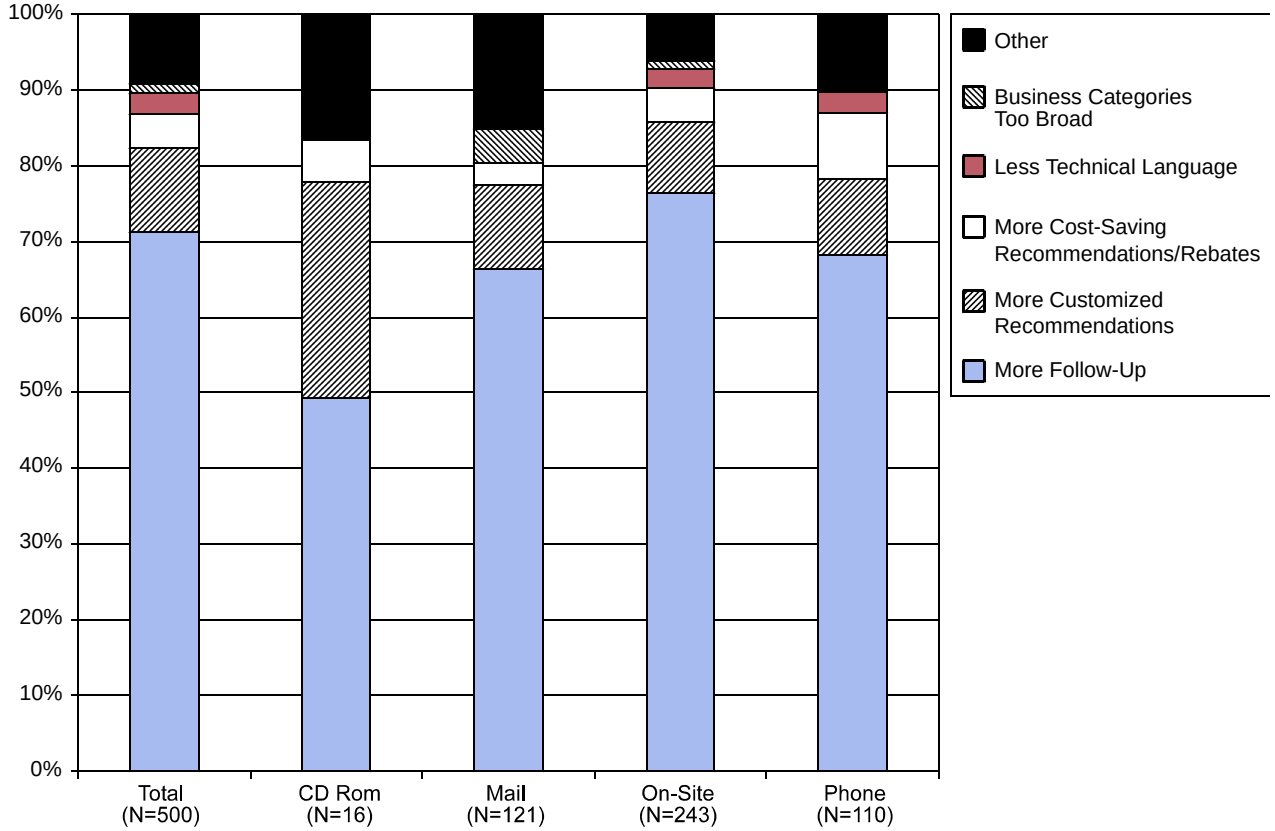
Participant Preferences for Recommendations by Size

- Larger customers prefer audit recommendations for equipment retrofit projects, while smaller customers prefer simple low cost/no cost energy saving tips



Participant Suggestions for Program Improvement

- Over 70% of participants want more utility follow-up, and some participants prefer more customized energy efficiency



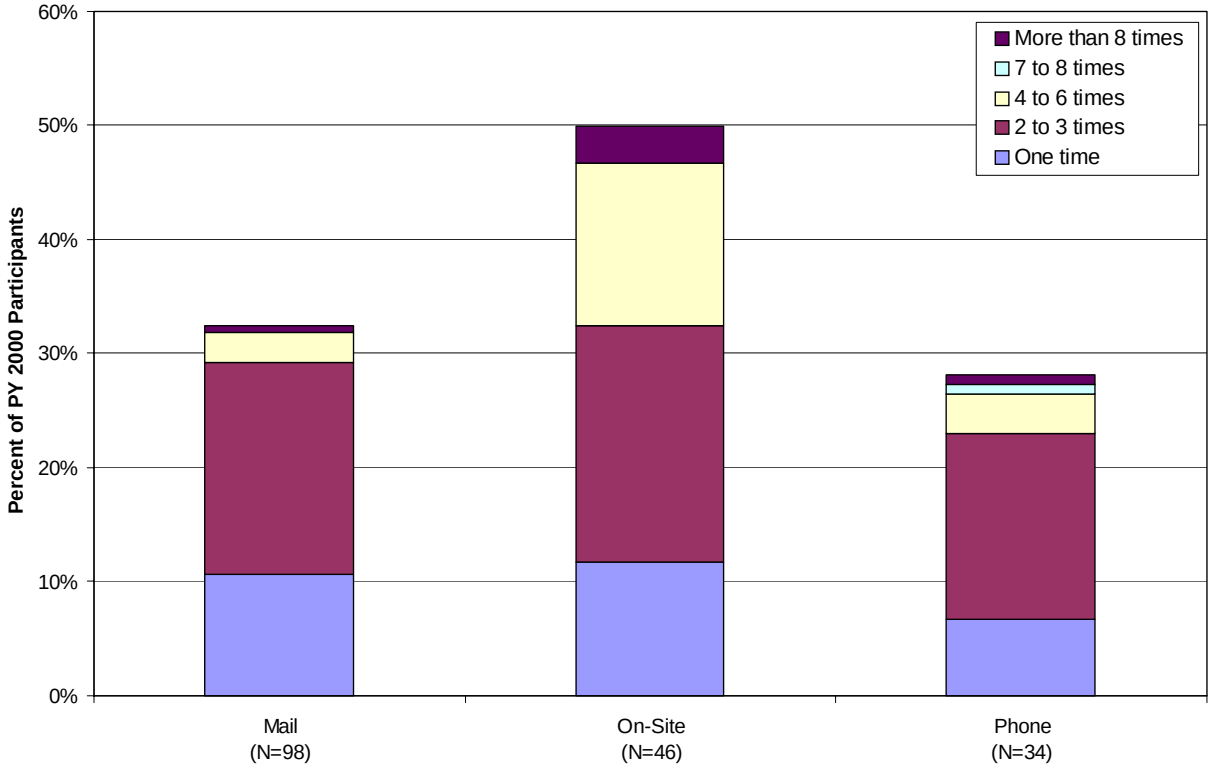
Reasons Why Recommended Measures are Not Implemented

- The most common reason that participants choose not to implement Audit recommended measures is lack of money

Participant Reported Reasons	Lighting	Cooling	Gas Appliances	Other Technologies
Do not have enough money	39%	46%	66%	45%
Product was not available	1%	0%	0%	0%
Could not find a service provider	1%	0%	0%	4%
Savings did not justify added investment cost	15%	6%	7%	4%
Other priorities for capital spending	15%	11%	14%	6%
No approval (corporate or landlord)	12%			10%
Owner responsible for changes		12%	7%	
No current perceived need	8%		40%	17%
Product unsatisfactory	2%			2%
No Time	3%	7%		0%
Other	3%	9%	0%	13%
No Answer	3%	14%	0%	4%
N	108	37	14	21

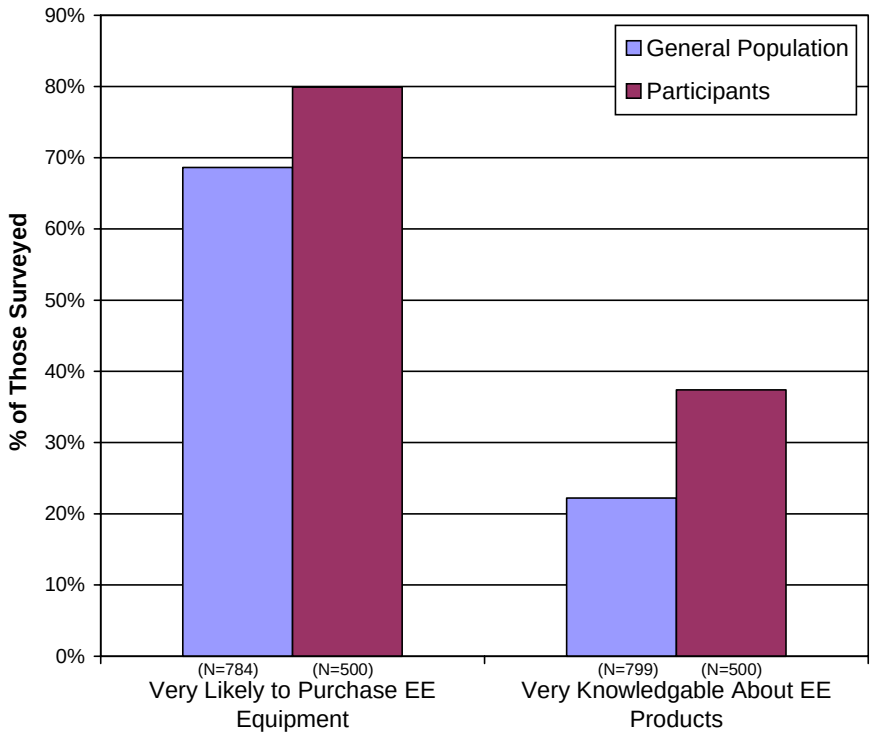
Participant Re-Use of Their Audit Reports

- While 50% of on-site participants review their audit report more than once, mail and phone audit participants revisit their reports about 30% of the time



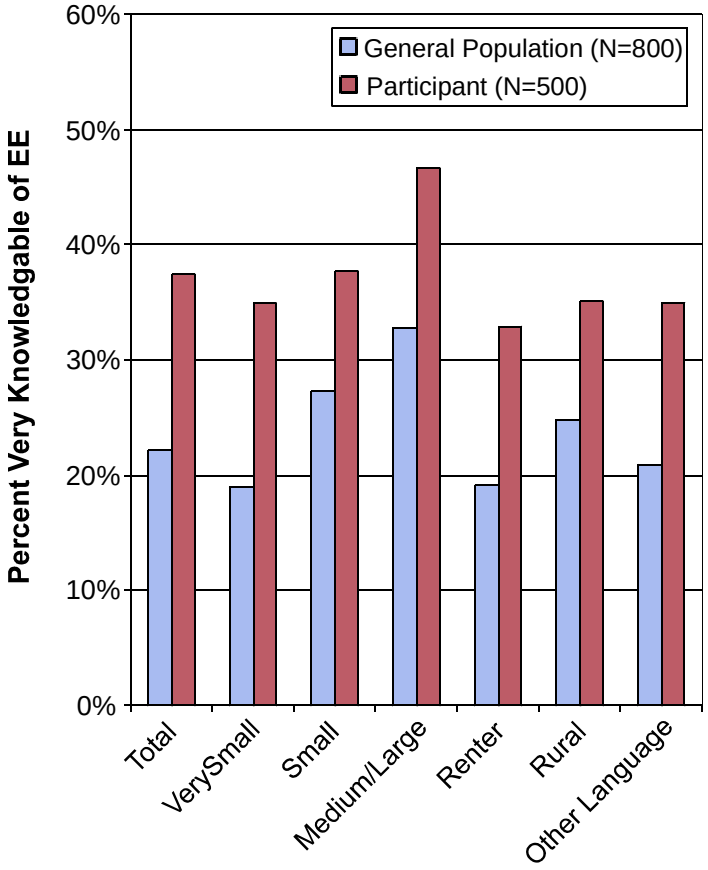
Purchase Intentions and Knowledge of Participants and the General Population

- The 2002 Audit program was successful in moving participants towards greater energy efficiency knowledge, awareness of opportunities and intentions to invest



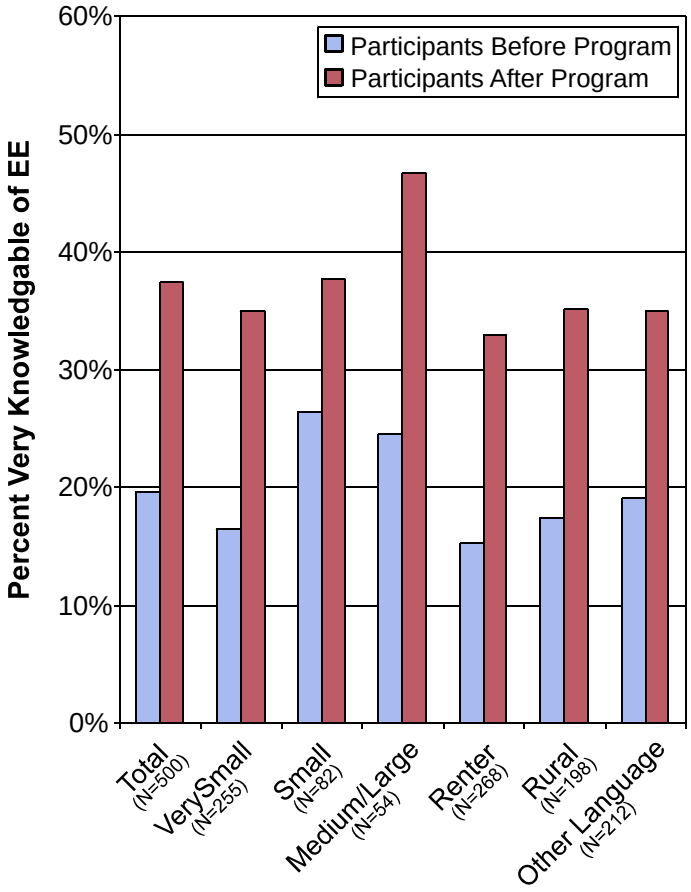
Self-Reported Knowledge of Energy Efficiency

- Participants are much more likely to report that they are very knowledgeable of energy efficiency



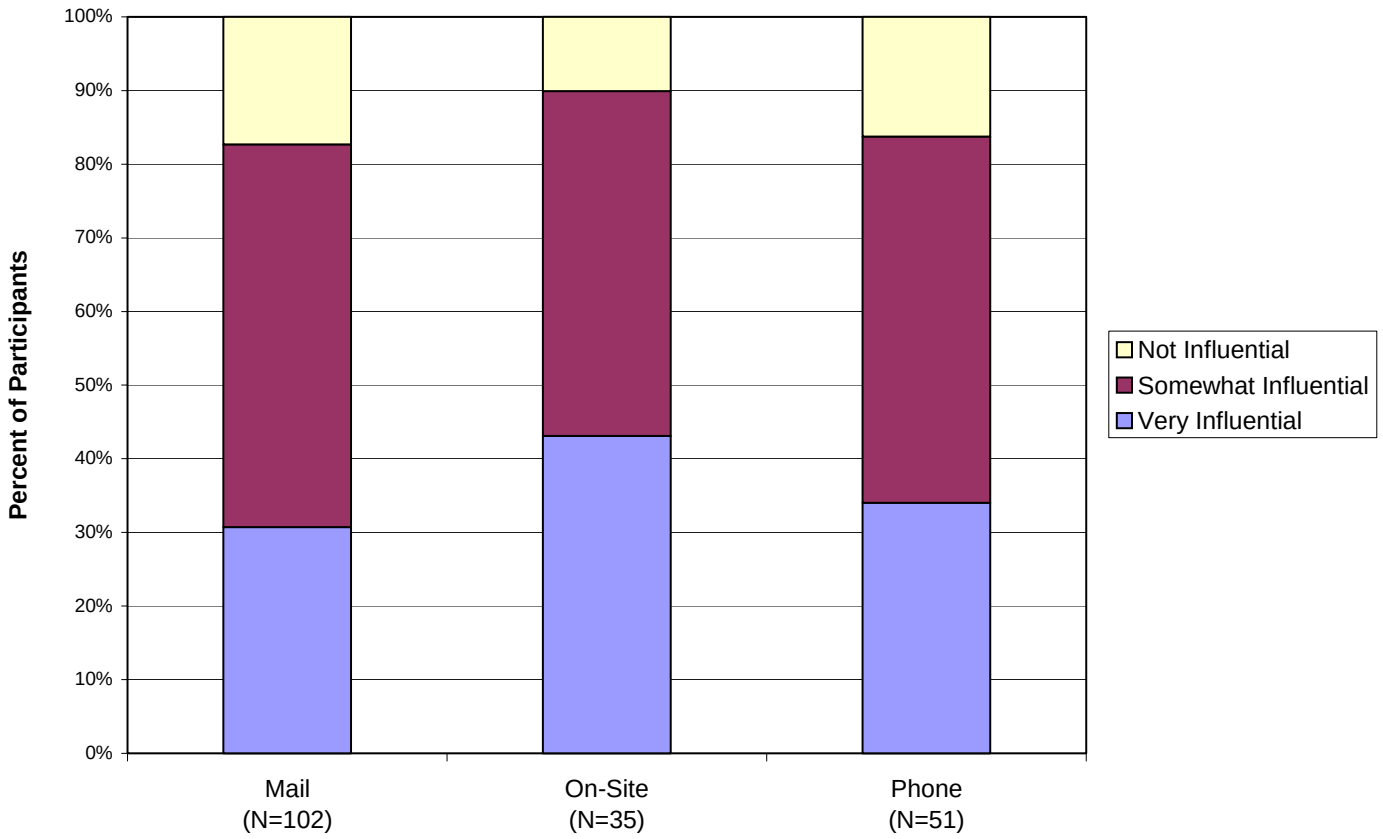
Participant Self-Reported Change in Energy Efficiency Knowledge

- Participants report that they are considerably more knowledgeable after participating in the program



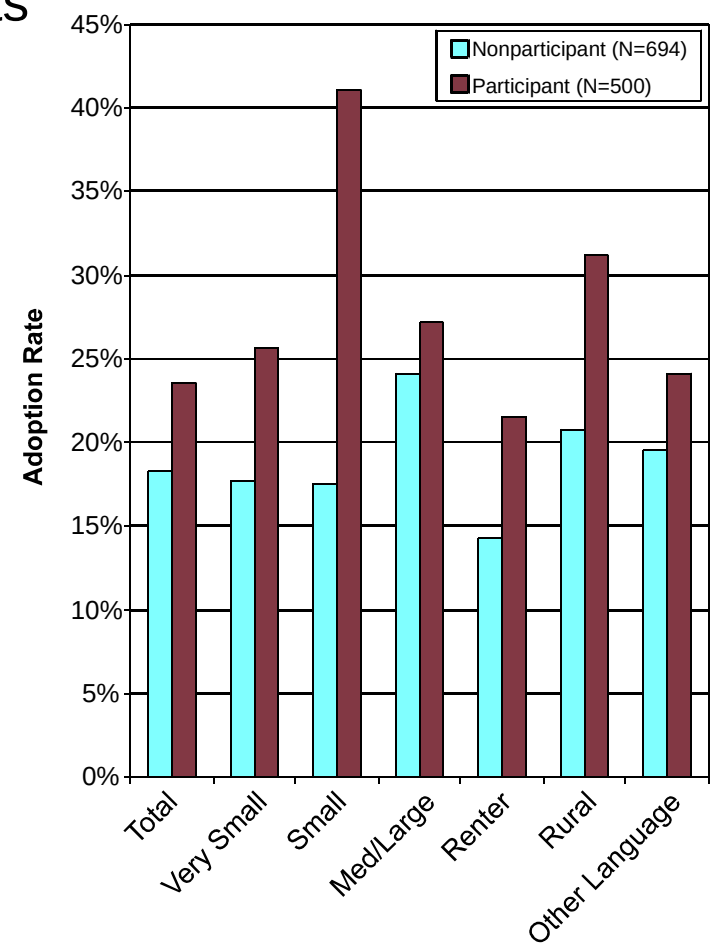
Influence of the Audit During the Energy Crisis

- Participants report a high level of influence from the audit program on their conservation actions taken during the crisis



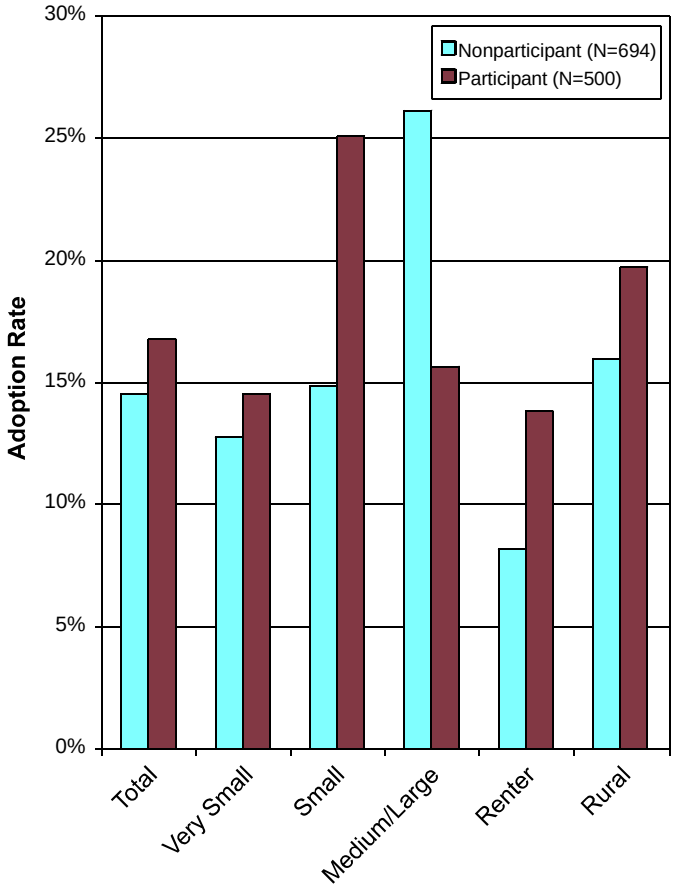
Lighting Equipment Adoption Rates

- Lighting is the only end use with consistent evidence of program effects



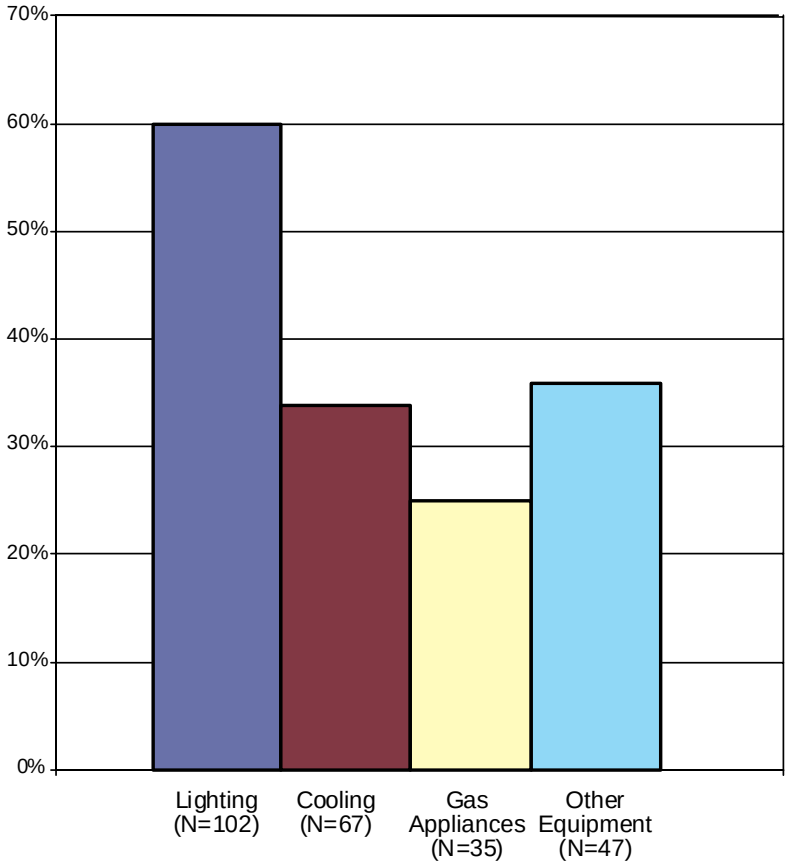
Cooling Equipment Adoptions

- Participants have a marginally higher adoption rate of cooling equipment than nonparticipants, and medium/large customers show the opposite effect



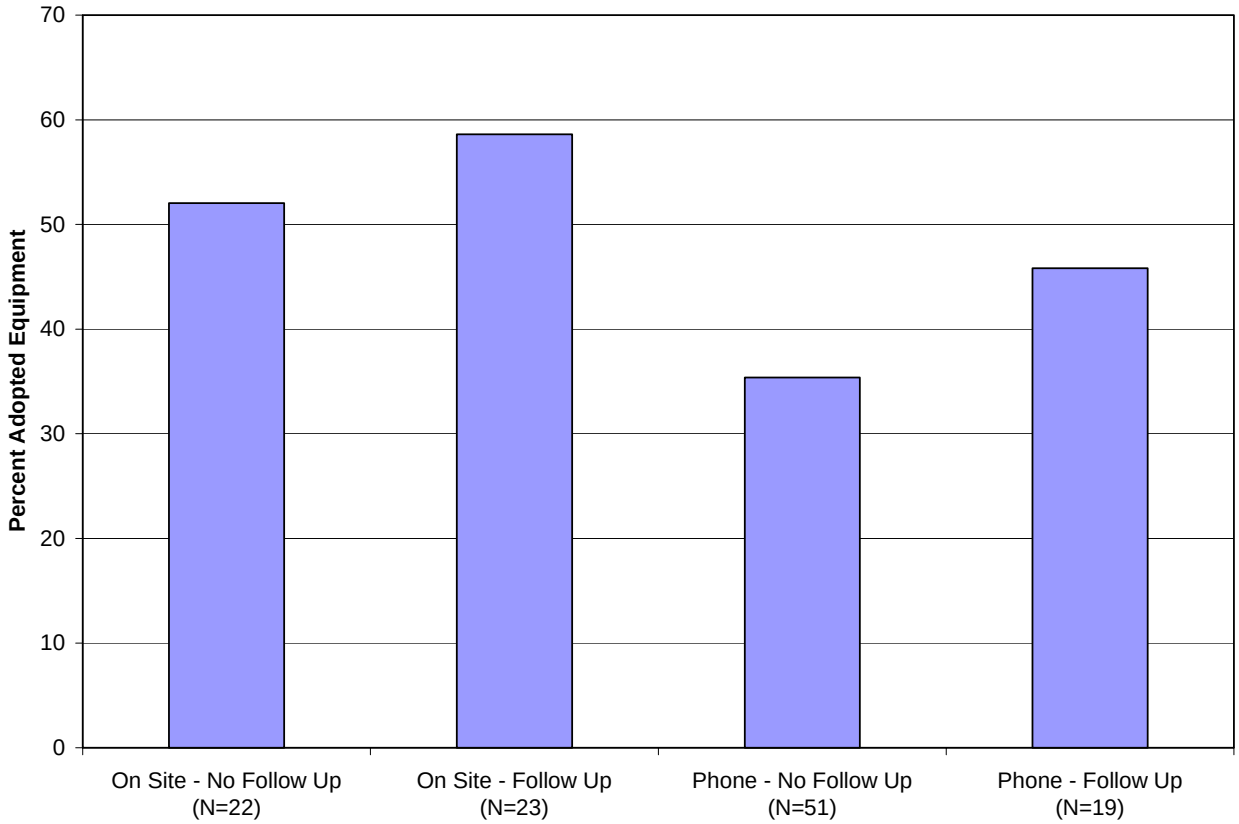
Percent of Equipment Adoptions Recommended in the Audit Report

- Recommendations in the audit reports clearly leads to equipment adoptions, especially for lighting measures



Effect of Follow-up on Percent of Participants that Adopt at Least One Recommended Measure

- The follow-up calls have a positive effect on participant likelihood of adopting high efficiency equipment



Other Findings

- Audits with greater customization and credibility also have a longer useful life and a more interested audience
- The greater customization, credibility and additional perceived value of the on-site audit also leads to greater impacts
- Relatively simple recommendations are implemented first
- Participant uptake of measures for more complex end uses requires years of consideration

Key Program Recommendations

- Make use of best practices in Audit delivery and reports
- Improve usefulness of the Audit reports
- Strengthen links to incentive programs
- Provide greater follow-up with customers following audits
- Evaluate the cost-effectiveness of the CD-ROM Audit
- Continue to direct on-site audits to larger customers
- Consider tracking goals based on downstream energy efficiency uptake
- Assess marketing strategy effectiveness and emphasize best practices

2002 Statewide Express Efficiency Program Evaluation

Summary of Final Evaluation Report

Prepared by:

Beatrice Mayo, PG&E

John Cavalli & Marissa Myers, Quantum Consulting

QUANTUM CONSULTING

PG&E Pacific Gas and Electric Company

Evaluation Objectives

Participation Assessment

- Assess participation trends over time (2000-02), in particular HTR participation
- Assess the effects of the 500kW Aggregation Rule
- Identify measures in need of ex-ante impact estimate revisions

Program Verification

- Assess IOU inspection process and analyze inspection databases
- Verify that measures were installed and program-qualifying

Process Assessment

- Examine program awareness, delivery channels, factors that influenced participation, program effects and customer satisfaction.
- A lighting vendor assessment to obtain feedback on promotional sales, rebate levels, the reservation system, eligibility requirements, and ideas for program improvements.

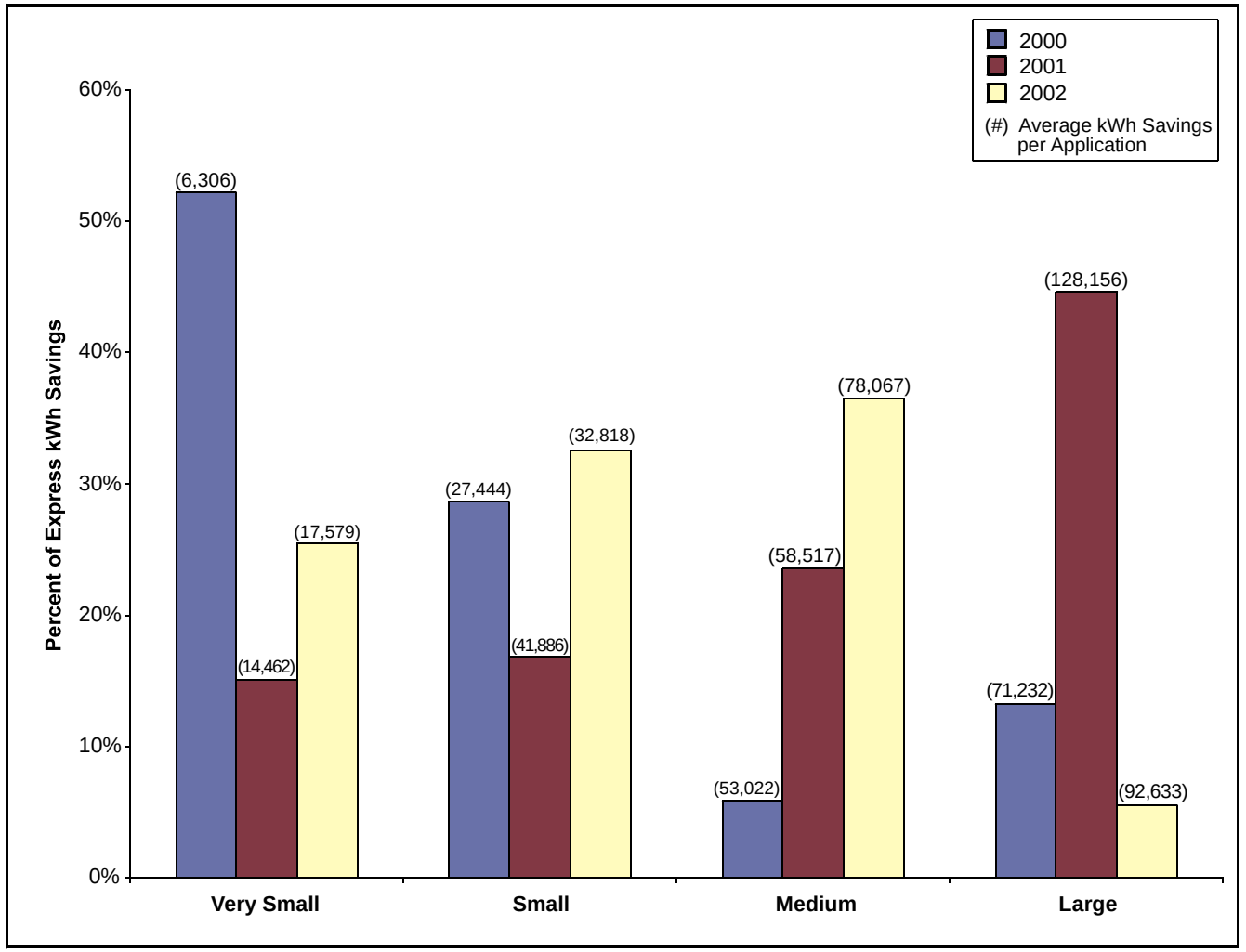
Program Targets and Accomplishments

- Overall, the program met the majority of its goals.

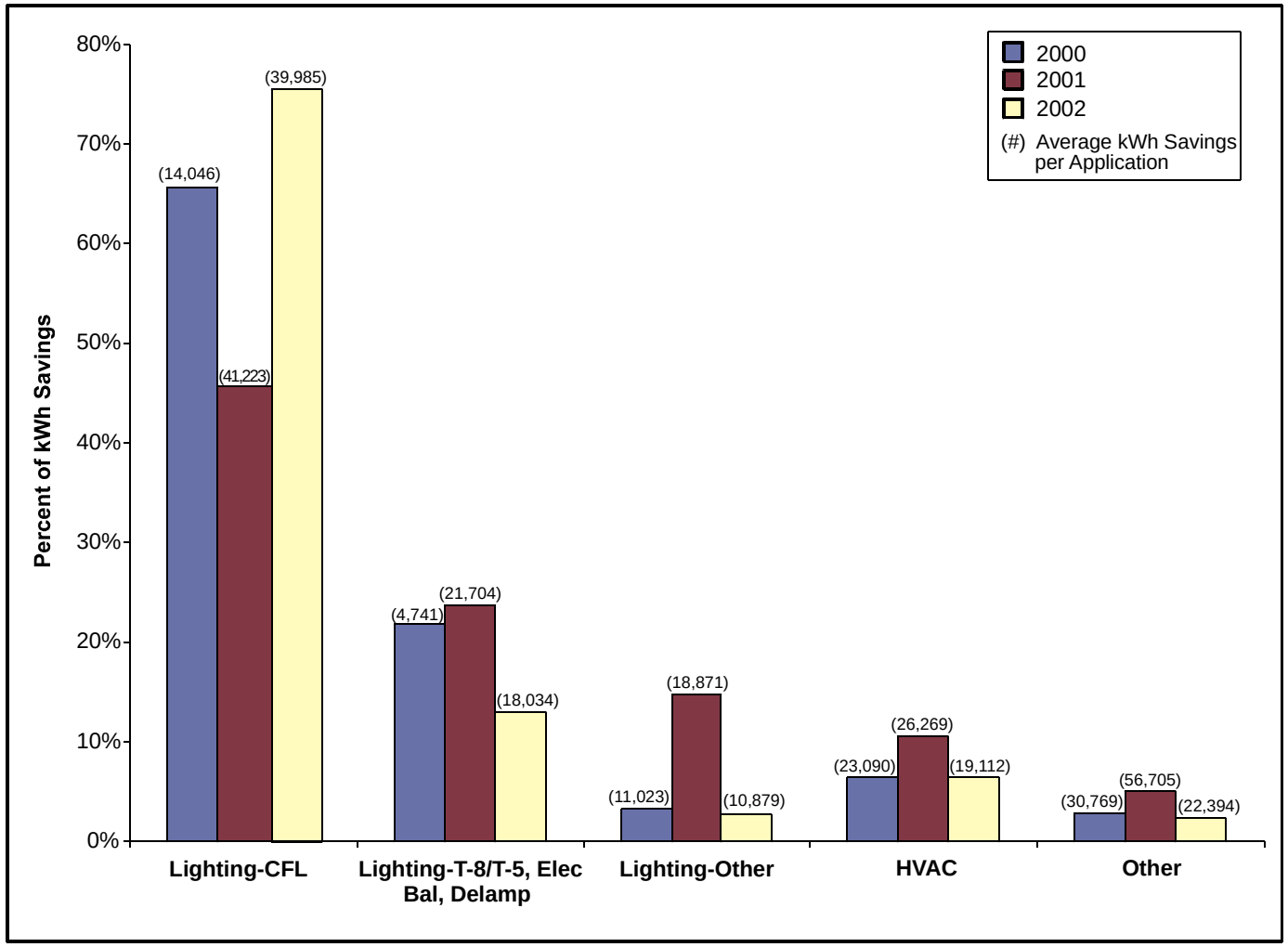
Statewide Program Savings	CPUC Target	Result	% Target Reached
Energy Savings, kWh	267,154,003	305,358,637	114%
Demand Reduction, kW	52,258	49,668	95%
Therms Reduction	3,993,959	4,105,257	103%

Utility	HTR Segment	CPUC Target % of Applications	Result % of Applications
PG&E	Business Size	41%	41%
	Geography	40%	34%
SCE	Size and Geography	47%	57%
SDG&E	Any	59%	66%
SCG	Any	42%	42%

Program Accomplishments: PY2000-02 kWh Savings By Customer Size



Program Accomplishments: PY2000-02 kWh Savings By Technology



Implications of Program Policy and Program Design

PY2000

- Policy issue – Emphasis on equity/serving HTR
- Program Design - provide high rebates and incentive to vendors
- Result – huge HTR participation, and large average rebate per kWh saved.

PY2001

- Policy issue – Energy Crisis created need for energy savings
- Program Design – allow >500kW customers to participate
- Result – Large job size and rebate, more diversified mix of measures.

PY2002

- Policy issue – Emphasis on equity/serving HTR, but more cost-effectively
- Program Design – Large customers and Large Chains ineligible
- Result – the program focused on CFLs to maintain cost-effectiveness and meet goals, smaller job size and lower rebate per kWh saved.

Effects of 500 kW Aggregation Rule

- Large Chain Accounts that Aggregated to over 500kW were ineligible in PY2002.
- Rule affected about 19% of the under 500 kW accounts and about 44% of annual consumption,
- The rule adversely affected cost-effectiveness and created inequites:
  - More application and incentive check processing, site inspections, and marketing to meet goals.
  - 23% of the total nonresidential market (in terms of annual kWh consumption) was displaced with no clear energy efficiency program option.

Program Verification Results

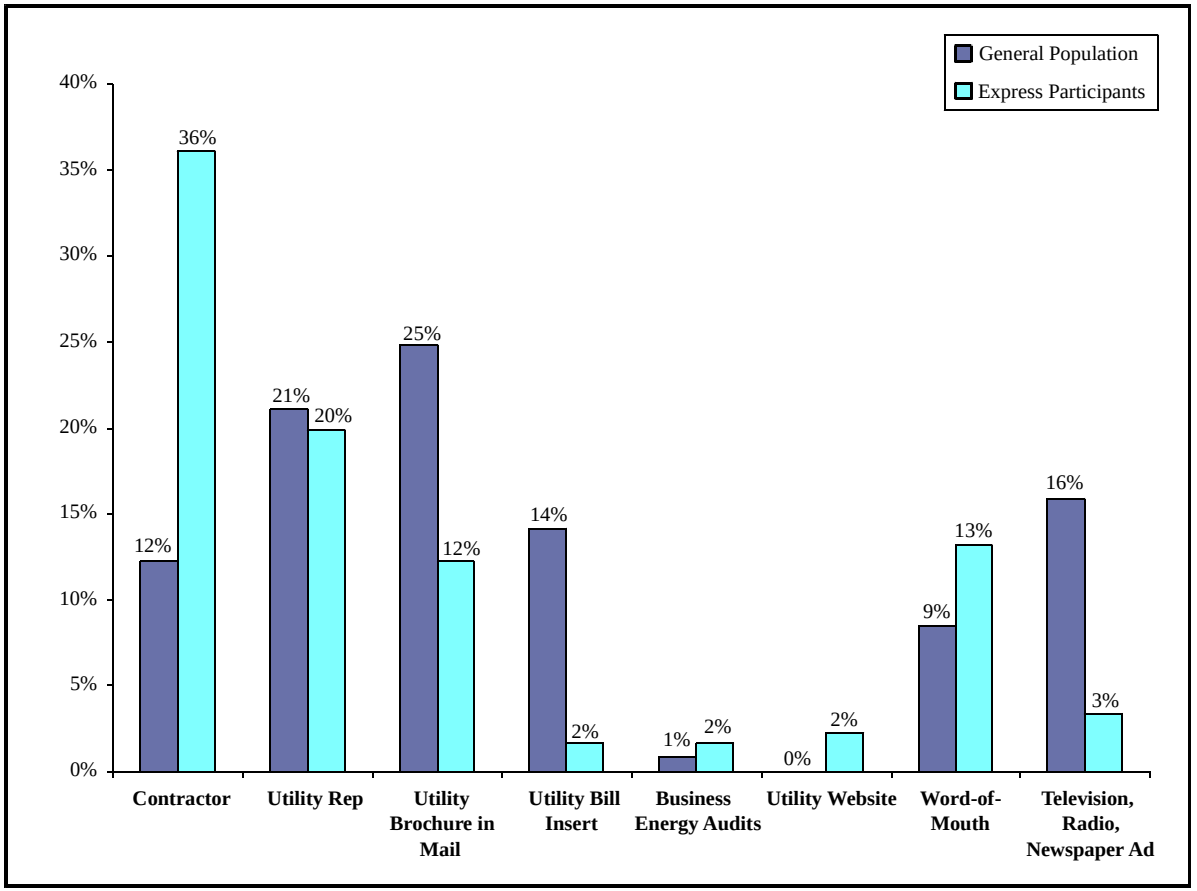
- Review of inspection databases confirmed IOU inspection procedures and illustrated representative sample of measures.
- Measure Installations were verified through 665 telephone surveys, and were determined to be program qualifying through 125 on-sites.

Process Assessment

- Interviews with 584 Participants and 741 General Population customers
- Interviews with 44 lighting vendors
- Interviews with seven Community Based Organizations (CBOs)

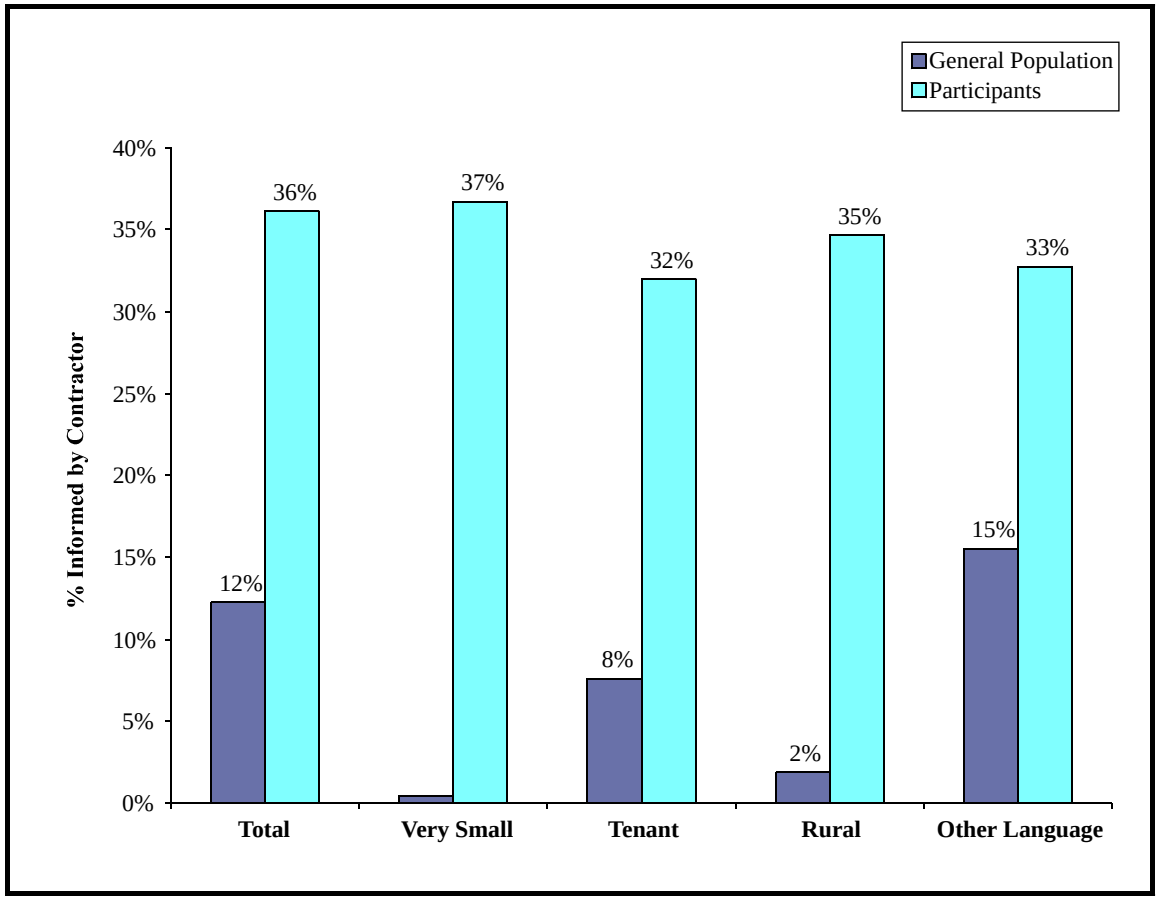
Sources of Program Awareness

- Contractors are the most effective delivery mechanism.



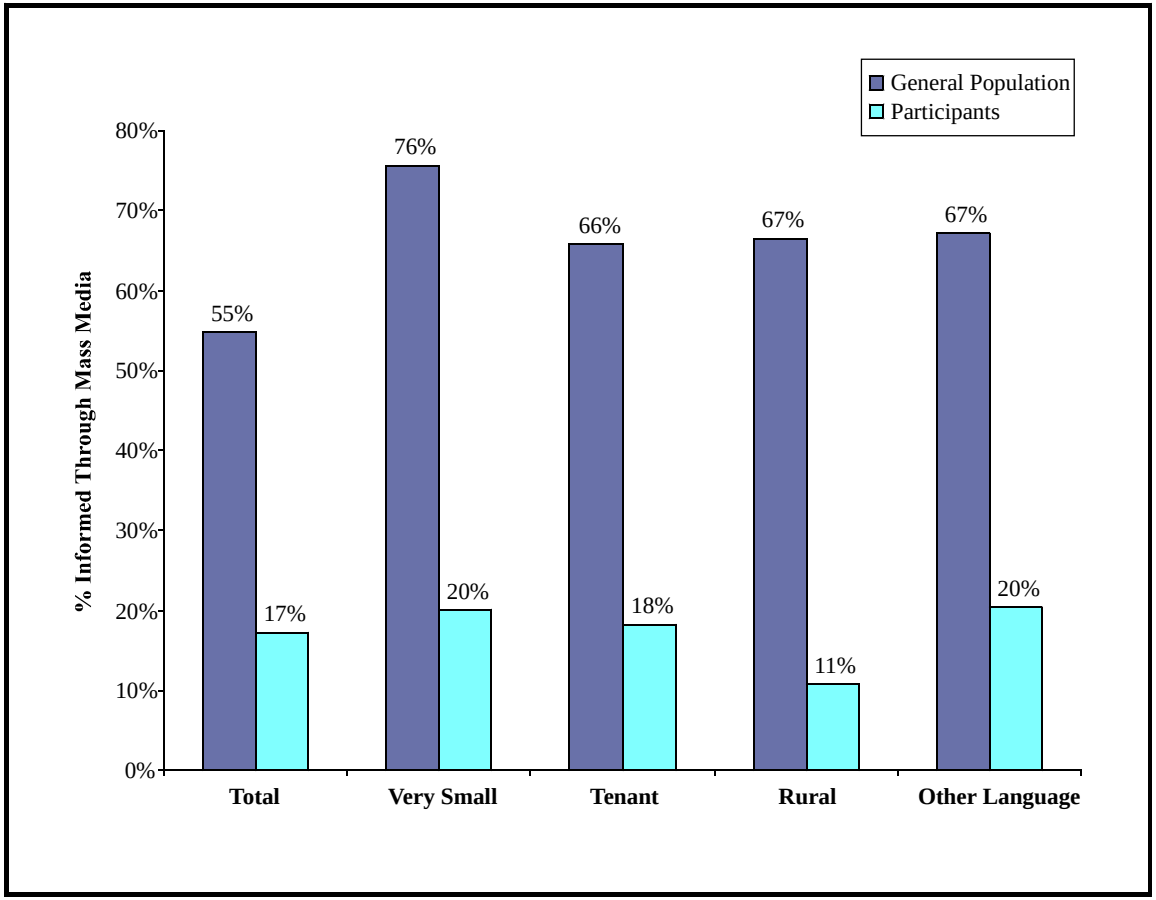
Program Awareness: Percent of HTR Customer Aware from Contractor

- Contractors do not market to HTR segments, but are effective.



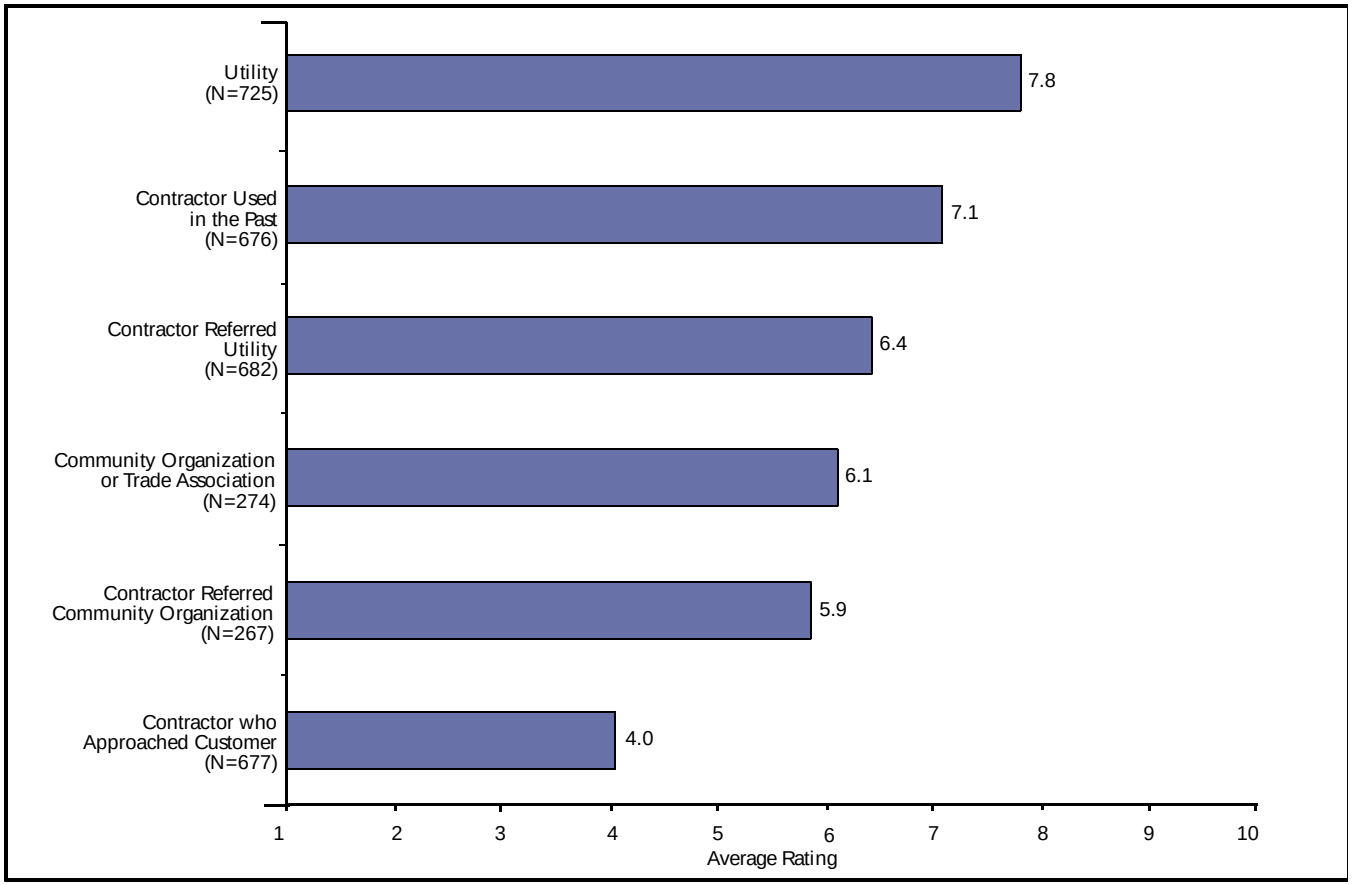
Program Awareness: Percent of HTR Customer Aware from Mass Media

- Most HTR customers become aware through bill inserts and mailers, which are not as effective.



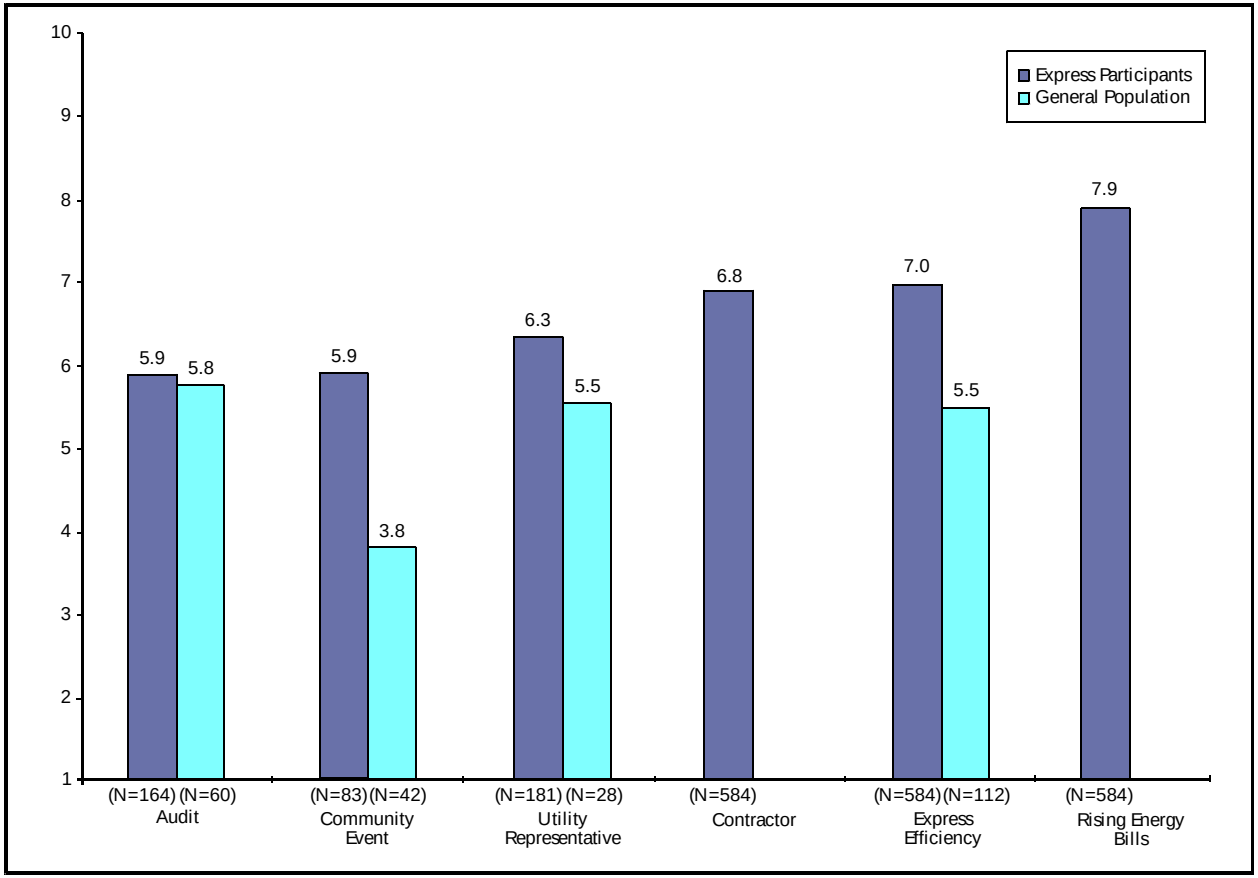
Credibility Ratings of Sources for EE Information

- Participants do not find contractors to be credible, unless they have used them in the past or were referred by a credible source.



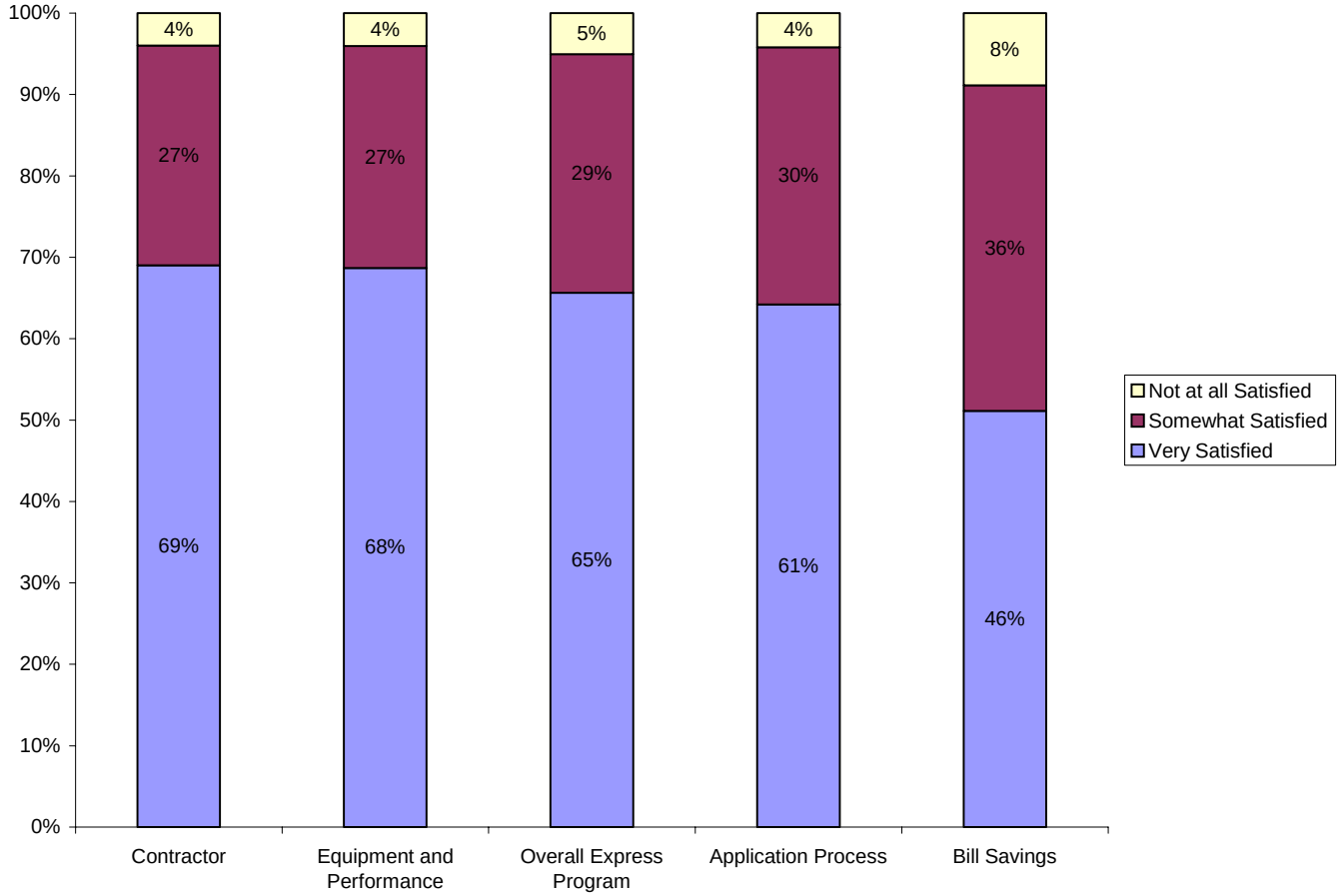
Influential Factors on Decision to Purchase EE Equipment

- Energy bills, rebates and contractors are the most influential sources.



Program Satisfaction

- Participants are Satisfied with all aspects of the Program, especially with Contractor performance.



Potential Designs to Serve Small Customers

- Vendors are the most influential delivery mechanism for the program, but have credibility and profitability issues with serving small Customers.

- Three program concepts designed to reduce the cost and trust barriers involved in marketing to small customers are explored:
  - Provide utility-approved lists of contractors to interested customers,
  - Allow vendors access to IOU customers' energy audits
  - Leverage vendor marketing through partnerships with community-based organizations (CBOs).

Vendor Opinion on Program Design Concepts

Program Idea	Usefulness to Vendor			
	Very	Somewhat	Not at all	N
Access to customers' energy audit data	66%	13%	22%	32
Meeting with community-based organizations to promote program to small businesses	44%	41%	13%	31
List of utility-approved contractors for customers	38%	34%	25%	31

- Furthermore, nearly half of participants that used contractors believed that a list of qualified contractors from their utility would be very important in selecting a contractor.

SCE's Success with Partnering with CBOs

Community events were most effective when:

- Contractors were present so that customers can sign up for the program on the spot.
  - Otherwise, the program application sits on the customer's desk and no follow-through occurs)
- Products are displayed, such as a booth at an Expo, or a demonstration site.
- Previous participants or product adopters attended to boost credibility.

Lighting Vendor Surveys Program Satisfaction

- Vendors were satisfied with most components of the program.
  - Appreciated the reservation system because it gave them a "sense of security that we're going to get paid."
  - Liked the program being consistent statewide.
  - Felt the application process was straightforward, and generally filled out the application on behalf of their customers.
- Aspects of dissatisfactions included:
  - Hassle to determine whether customers qualify for the program.
  - A quarter of all vendors were not at all satisfied with the time taken to process rebate checks.

Lighting Vendor Surveys
Rebates vs. Sales and Program Delays

- Most vendors prefer consistently higher rebates instead of periodic sales.
  - Difficult to accommodate customer demand
  - Delays with reservations
  - Rebates turnaround is slower
- Vendors also prefer higher base rebate levels over vendor bonuses.

- Three-quarters of vendors felt that delays in starting the program negatively affected their business.
  - Compress timeline for doing rebated jobs.
  - Lose customers
  - Cannnot retain staff
  - Unable to plan for their business

Recommendations for Future Research

- Impact evaluation should focus on CFLs.

Measure	Percent of Program's Energy Savings			Priority of Impact Analysis Needs					
				Gross Impacts					
	2000	2001	2002	Algorithm Review	Hours of Operation	Change in kW	SAE Bill Analysis	NTG	EUL
CFLs	66%	45%	69%	-	4	2	4	4	4
T-8s	22%	23%	12%	-	2	1	2	2	-
Other Lighting	3%	15%	2%	-	2	-	2	2	1
HVAC - Other	4%	8%	8%	1	1	-	2	1	2
HVAC - A/C	3%	3%	1%	-	1	-	2	1	-
Refrigeration	2%	3%	1%	2	1	-	1	1	1
Water Heating	0%	0%	5%	1	-	-	2	1	1
Agriculture	0%	3%	2%	-	-	-	-	-	-
Motors	1%	0%	0%	-	-	-	-	-	-

-	Not Recommended
1	Low Priority
2	Moderate Priority
4	High Priority

Key Recommendations

- Eliminate 500 kW Aggregation Rule
- Implement consistent rebate levels instead of periodic sales.
- Leverage effectiveness of contractors as a delivery mechanism
  - Utilize CBO relationships to reach HTR populations.
  - Strengthen linkage between audits and Express Efficiency
- Avoid interruptions between program years, and/or delays in starting a new program cycle.
  - Implement at least a two year funding cycle for the program.
- Revise operating hour and EUL estimates for CFLs.

2002 Nonresidential SPC Program: Process and Market Evaluation

Summary of Final Report

Prepared by:

Michael Rufo, Quantum Consulting

MAESTRO Project Manager:

Pierre Landry, Southern California Edison Company

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Presentation Overview

- Evaluation Scope and Objectives
- Evaluation Components
- 2002 Program Features/Changes
- Summary of Key Findings
- Summary of Recommendations

Evaluation Objectives

Market Assessment

- Re-measure market indicators developed in 1998 and 1999 to assess changes in market conditions due to effects of energy crisis, restructuring, programs

Process Assessment

- Investigate and assess participants' and program administrators' experiences with the 2002 program; integrate tracking data; assess program effectiveness

Impact Assessment

- Review program impact calculations, perform verifications, savings estimation, and limited measured for a representative sample of participants
  - This task is still in progress and is not included in this presentation

Data Collection

- Customer Participants – 36 phone in-depths
- Customer Baseline – 350 CATI surveys
- EESP Participants – 24 phone in-depths
- EESP Non-participants – 24 phone in-depths
- Customer Dropouts – 24 phone in-depths
- Utility Project Managers – phone in-depths

Activities Timeline

Spring/Summer 2003	Fall 2003	Winter 2003/2004	Summer 2004
Analysis of Program Tracking Data			Analysis of Program Tracking
	End User Market Survey		
EESP Participant / Non-participant Interviews			
	Customer Participant Process Interviews		
	Customer Impact On-Sites		
	Analysis of EESP Interviews	Analysis of Customer Interviews	
		Impact Analysis	
	Work-in-Progress Feedback to Program Managers	Process and Market Report	Impact Report

2002 Program Changes

- 2002 incentive rates are the same for all customers
  - No peak demand or small customer bonuses
  - Lighting $0.05/kWh - HVACR $0.14/kWh - Other $0.08
  - Gas $0.45/therm
- All projects use the calculated savings approach except when the utility determines a need for M&V
  - Supplemental payment provided for measured projects
- Calculated projects receive full incentive after approval of installation report - No Operating Report required
- Lighting measures accounted for no more than 30% of a utility's total incentive budget
  - Lighting measures eligible only as part of a comprehensive retrofit

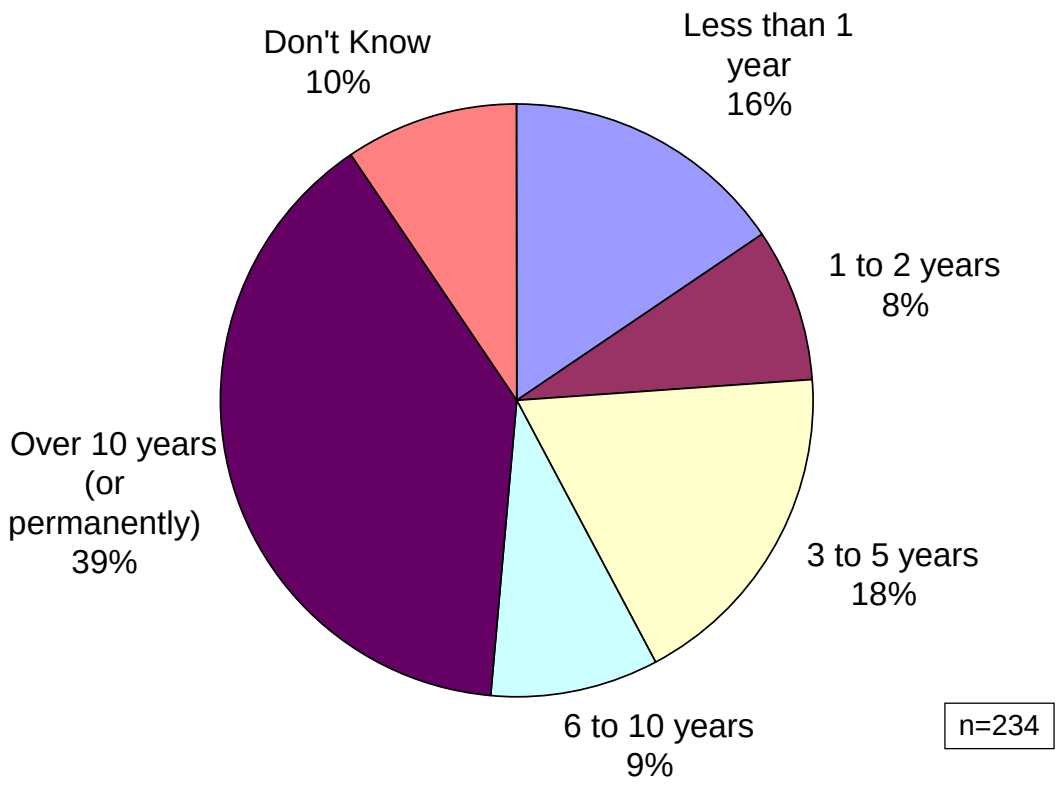
Key Findings – Market Related

- Many large non-residential customers believe the energy crisis-induced rate increases will last over ten years
- 60% report that the energy crisis spawned increased interest in energy efficiency in their organizations
- 80% reported taking conservation and EE actions in the past year, resulting in a reported 7% average reduction in usage
- % of customers with formal policies requiring purchase of EE equipment increased from 30% in 1999 to 43% in 2003
- 74% of the market, as compared with 55 % in 1999, said they had been approached by firms offering services to improve their facility's energy efficiency in the past year
- Customers' credibility ratings decreased across the board for all types of EE service providers; however, IOUs remained the highest rated private sector source of EE information

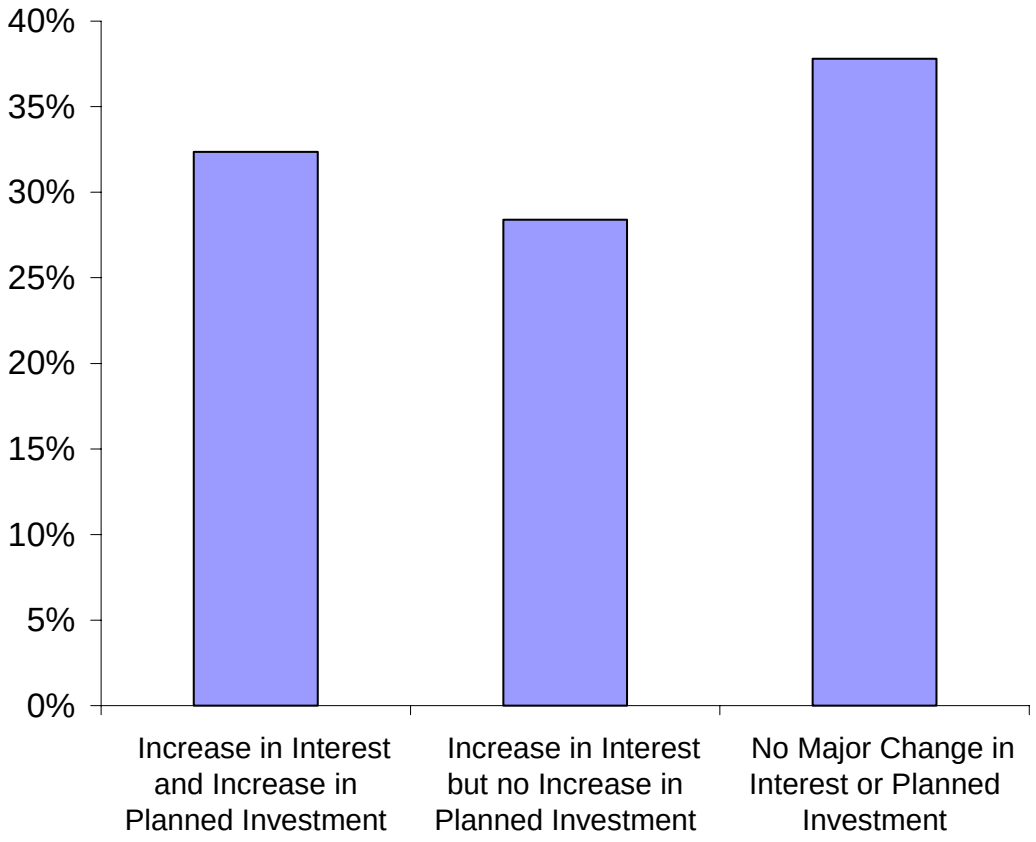
Key Findings – Market Related (cont.)

- The market for performance contracting remains extremely stable, showing virtually no change in customer familiarity, contracts offered, and contracts per year since 1999
- Half of the market reported being aware of the SPC program
  - SPC awareness levels were very similar across service territories
  - Impressions of the SPC program were generally favorable
- Customers, though positive about existing EE programs, provided a number of general recommendations including:
  - Improving the customer focus of programs, more information and better showcasing of successful efficiency projects, more flexibility, and increased incentive levels
- Roughly half of large customers say they still take or are willing to take demand reduction actions to reduce peak demand on power alert days if supplies are short

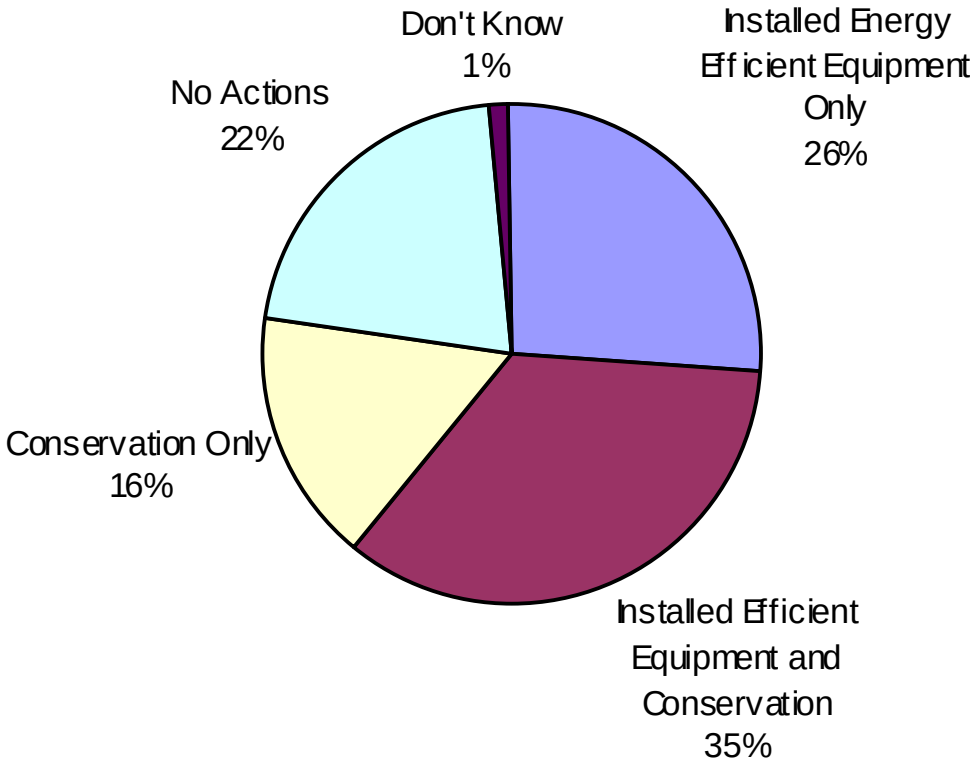
Expected Length of Price Increases



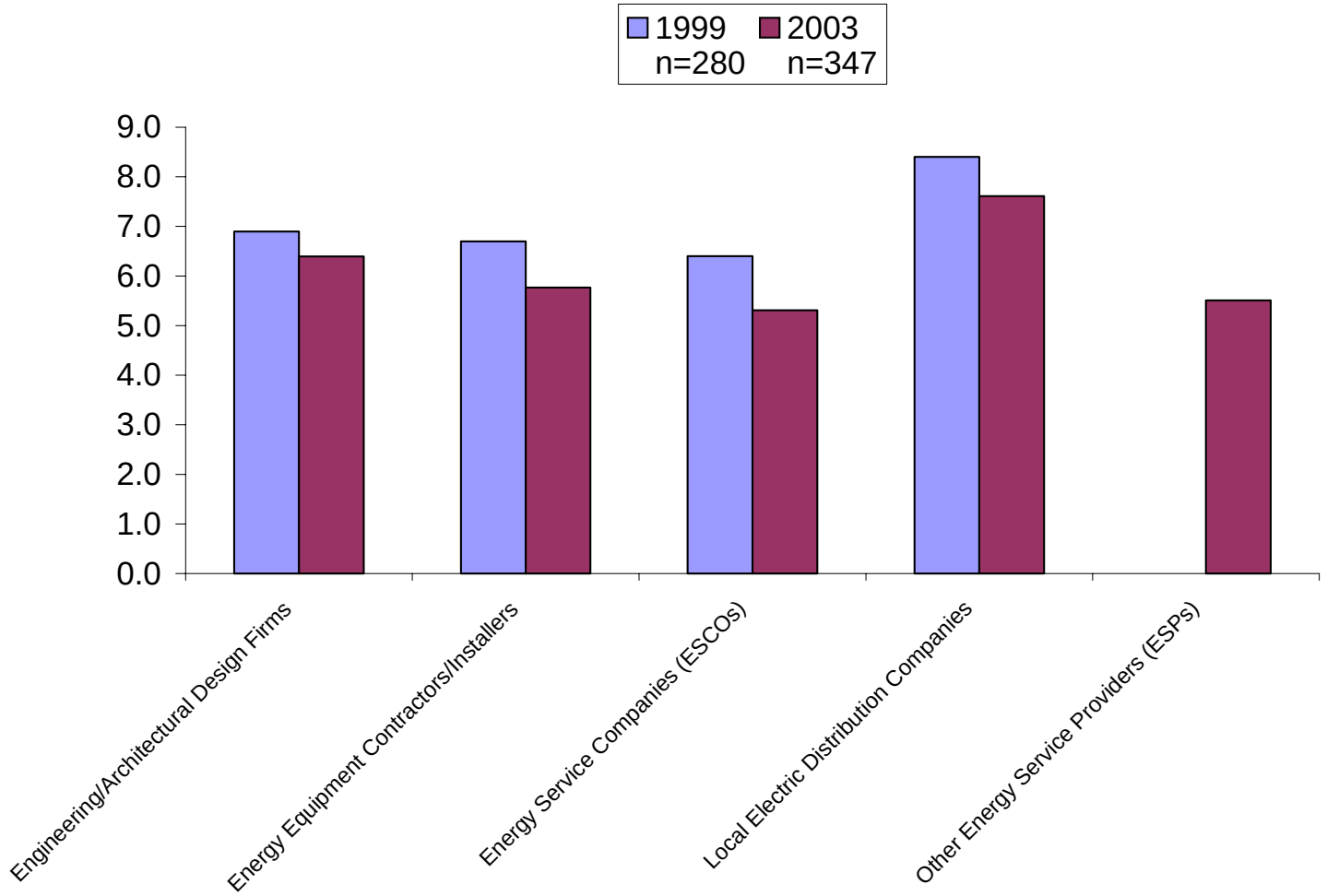
Effect of Energy Crisis on EE Interest and Investment



Type of Action Taken in Past Year



Credibility as Source of EE Information (10 = Extremely Credible)



Performance Contracting

Familiarity

Response	Size in Peak kW >500	>1000	>2000	Total	1999 Total
Very familiar	23%	21%	20%	21%	23%
Somewhat Familiar	26%	30%	29%	29%	32%
Unfamiliar	45%	45%	49%	47%	39%
Don't Know/Refused	6%	4%	3%	4%	5%
# Respondents	*154*	*106*	*90*	*350*	*349*

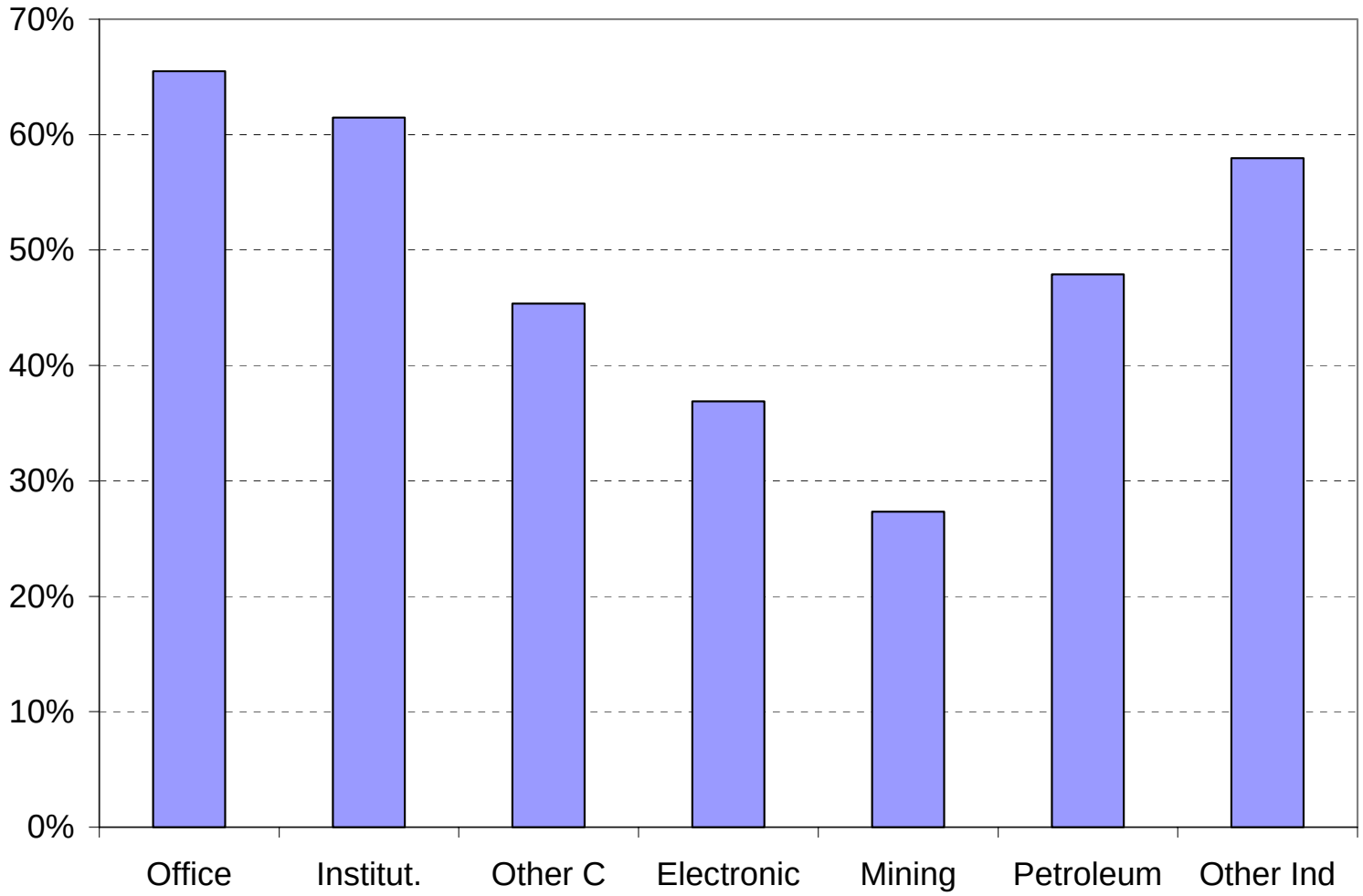
Solicited with Offer

Response	Size in Peak kW >500	>1000	>2000	Total	1999 Total
Yes	19%	29%	26%	25%	28%
No	68%	61%	68%	66%	65%
Don't Know/Refused	13%	10%	6%	8%	7%
# Respondents	*154*	*106*	*90*	*350*	*349*

Disposition of Offers

Response	Size in Peak kW >500	>1000	>2000	Total	1999 Total
Heard Presentation - No Proposal Requested	57%	40%	51%	49%	38%
Asked for and Received Formal Proposal	13%	21%	39%	30%	35%
Tried, but Failed to Negotiate Contract	10%	0%	6%	5%	6%
Negotiated and Signed Contract	9%	32%	4%	11%	13%
Don't Know/Refused	11%	7%	0%	3%	8%
# Respondents	*32*	*28*	*30*	*90*	*98*

SPC Program Awareness



Key Findings – Program Related

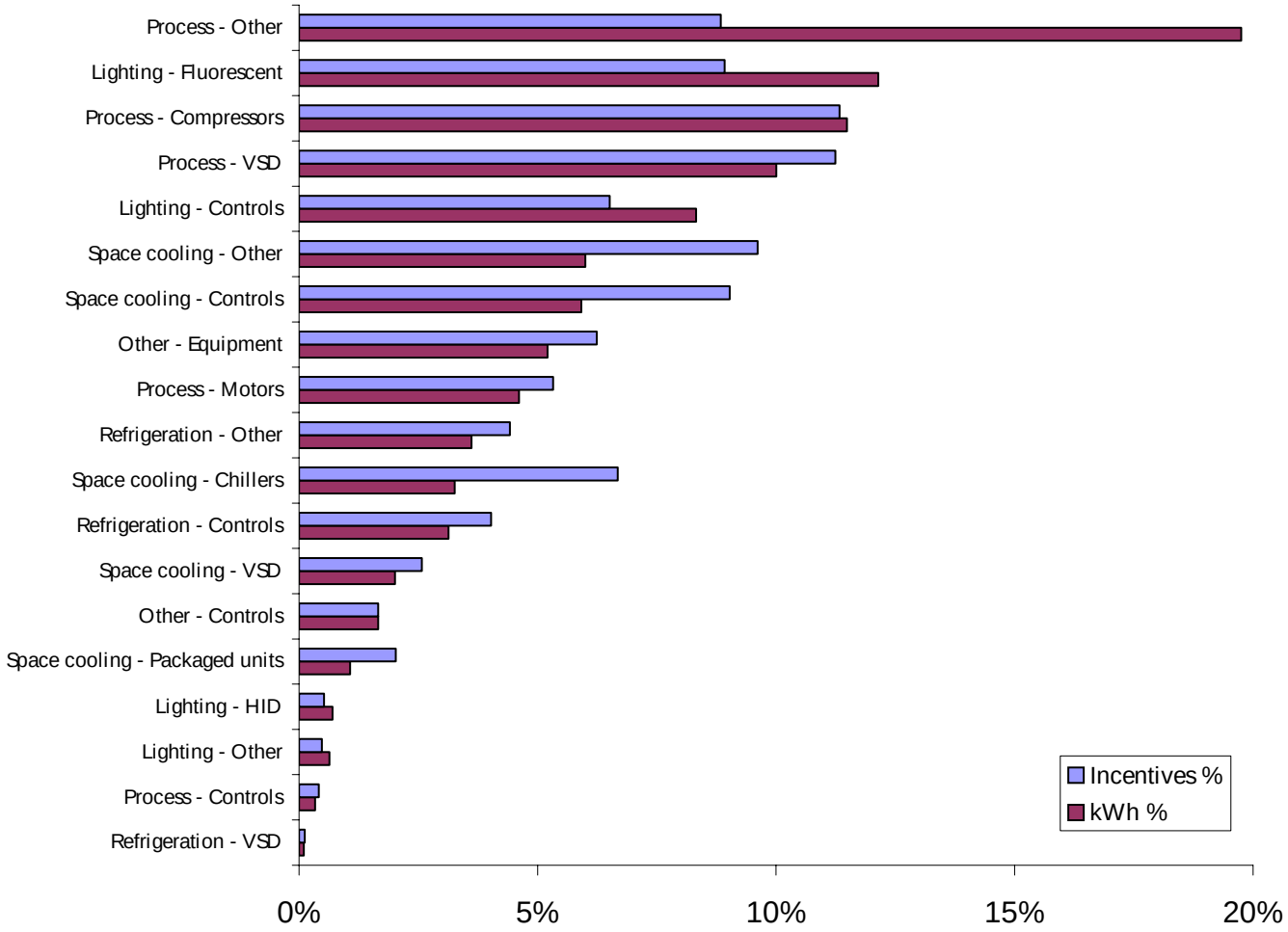
- Demand for the 2002 NSPC extremely strong
  - program funds subscribed quickly after program opening
- Projected savings are significant at 240 GWh, 5 million therms
  - final savings may be somewhat lower due to dropouts
- Industrial customers and process type measures continue to account for a majority of impacts
- Customer and EESP satisfaction with program features and administration are very high, continuing the positive trend of the 2000 and 2001 program years
- Most applications are now paid based on calculated not measured savings
- EESPs generally reported positive effects on their businesses
  - noted funding shortages limit program's ability to move the market
- Preliminary evidence of slightly lower net-to-gross as compared with previous years – final estimate in impact eval

2002 Tracking Data (as of 5/03)

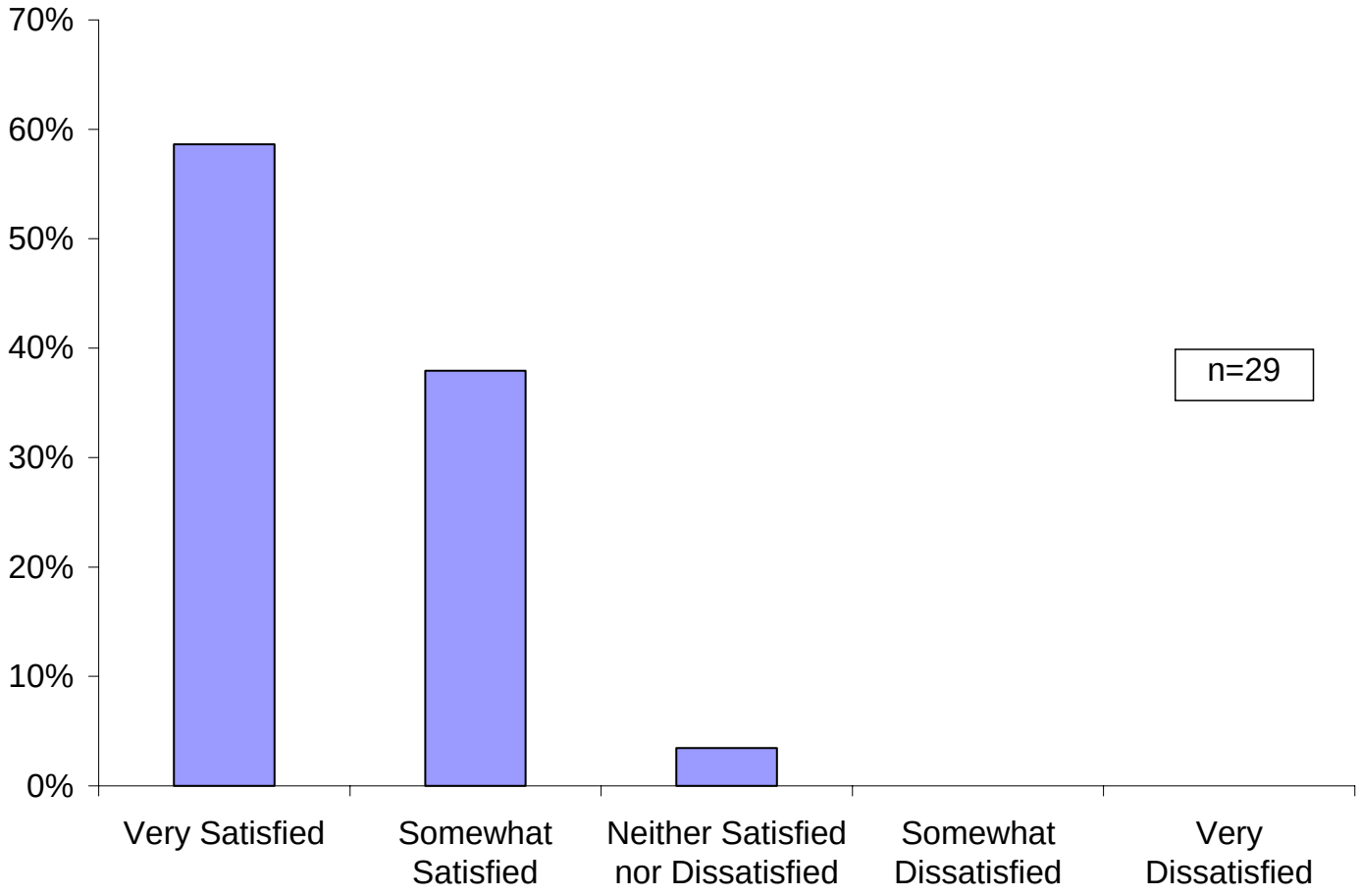
Activity Level	Statewide	PG&E	SCE	SDG&E
Total unique customers	299	118	144	39
Total number of applications	355	146	165	44
Total unique third-party sponsors	48	14	25	16
Total incentive funds committed ($ million)	17.87	6.84	8.72	2.31
Incentive funds committed to electric measures ($ million)	15.85	5.01	8.72	2.12
Incentive funds committed to gas measures ($ million)	2.01	1.83	0.00	0.19
Total savings from active applications (Btu, trillions)*	2.94	1.06	1.56	0.32
Electric savings from active applications (GWh)	238.53	58.54	152.24	27.76
Gas savings from active applications (therms, millions)	4.94	4.56	0.00	0.38
Average incentives per kWh	$0.066	$0.086	$0.057	$0.076
Average incentives per therm	$0.408	$0.401	-	$0.495

* Conversion rates obtained from *2001 Energy Efficiency Standards for Residential and Non-residential Buildings*, California Energy Commission, June 2001:
1 kWh = 10,239 Btu source energy
1 therm = 100,000 Btu source energy

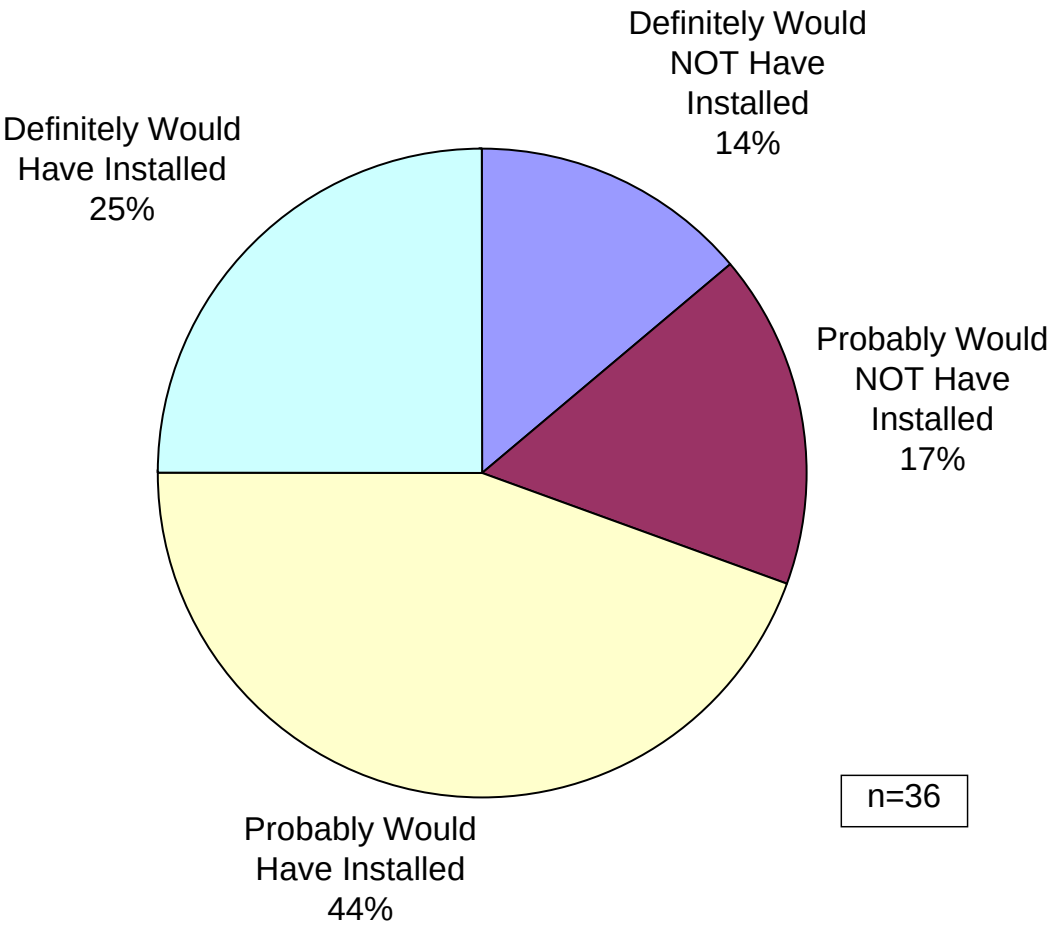
Distribution of Project Types



Customer Participant Program Satisfaction



Customer Participant Self Report of Program Effect on Implementation



Recommendations

- Continue successful program characteristics to:
  - Maintain high levels of customer and EESP satisfaction
  - Continue focus on industrial process and HVAC projects
- Consider increasing SPC funding level to attain year-round market impact
- Consider additional efforts to reduce free ridership:
  - Increased incentives for higher payback/emerging measures?
  - Set very low payback floor (e.g., 6 months)?
  - Allow PMs flexibility to exclude high probability free riders?
  - CPUC incentives to all implementers on *NTGR?*
- To increase certainty of program savings consider either:
  - Expanding and integrating the impact evaluation function or
  - Increasing the percentage of projects for which savings measurement is required in the program process
- Since most projects are no longer directly performance based, consider changing program name

Statewide Small Industrial Customer Wants and Needs Study

Summary of Final Report

Prepared by:
Rafael Friedmann, Pacific Gas & Electric
Kris Bradley and Marissa Myers, Quantum Consulting

QUANTUM CONSULTING

PG&E Pacific Gas and Electric Company

Summary of Key Findings

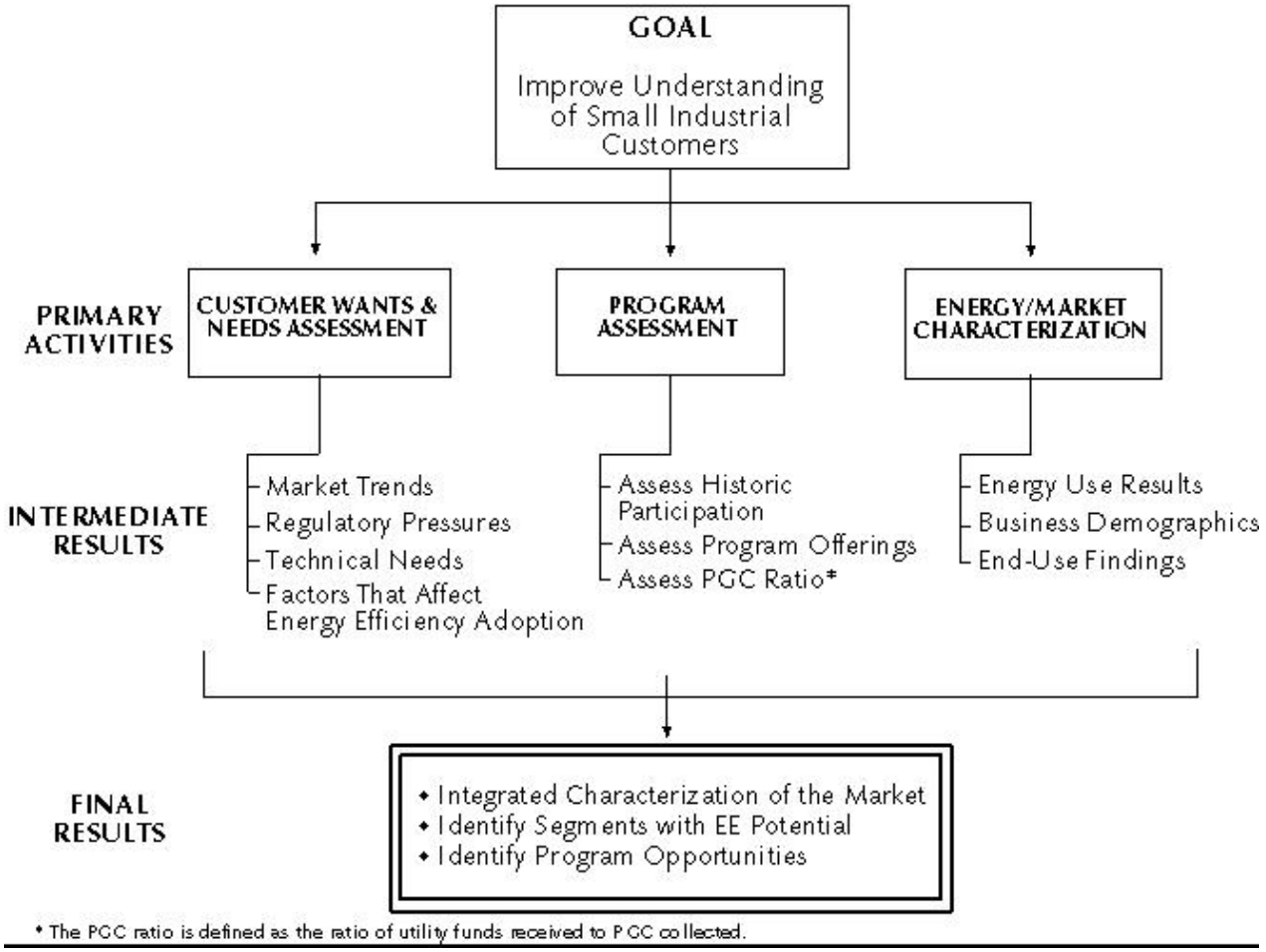
- **While small/medium industrial customers use just 5% of California's energy, efficiency opportunities are considerable**
  - **Decision making owners are receptive to energy efficiency**
  - **Industrial customers are willing to invest in cost-effective energy efficiency**
- **Challenges are that small/medium manufacturers are heterogeneous, and often require targeted solutions**
- **Also, different program elements are needed to deliver energy efficiency to small and medium industry**

Full study findings are available on CALMAC.org.

Overview & Objectives

- **Gain better understanding of small/medium customers**
  - **Needs and wants**
  - **Market characterization**
- **Develop program approach to small/medium customers**
  - **Program assessment**
  - **Separate small and medium program designs**

Study Activities

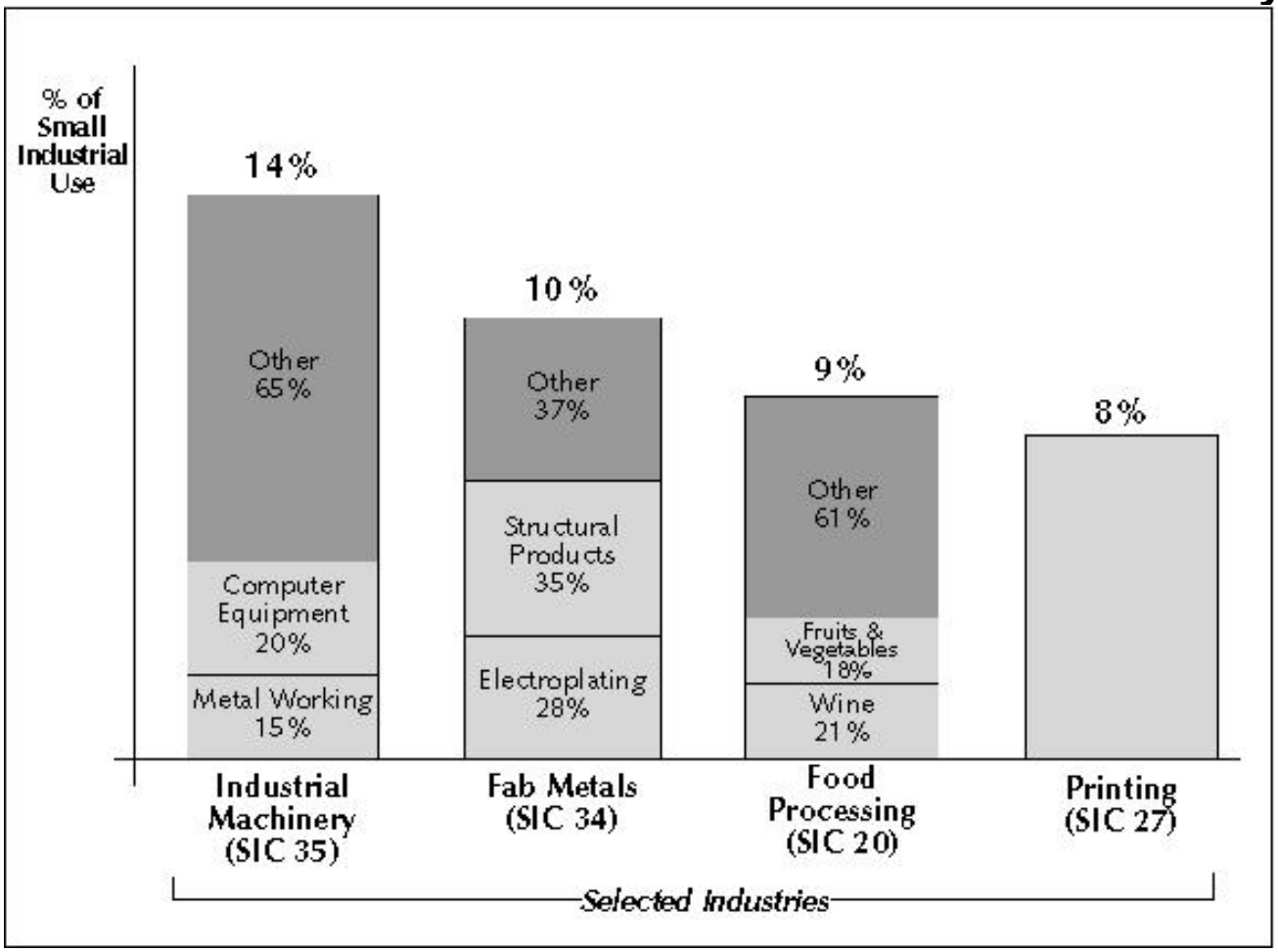


Methodology

- **Literature review**
- **Database analysis**
  - **Analysis of program participation and CIS-based population statistics**
  - **Industrial Assessment Center tracking system data mining**
- **Industry selection and assessment**
- **Data collection and analysis to verify study hypotheses**
  - **Customer survey**
  - **Interviews with Program Managers and Industry Observers**
  - **Supply side interviews**

Industry Selection

Annual IOU Electric Use of Industries Selected for Study



Business Demographics

Summary Statistics for Small and Medium Industrial Facilities

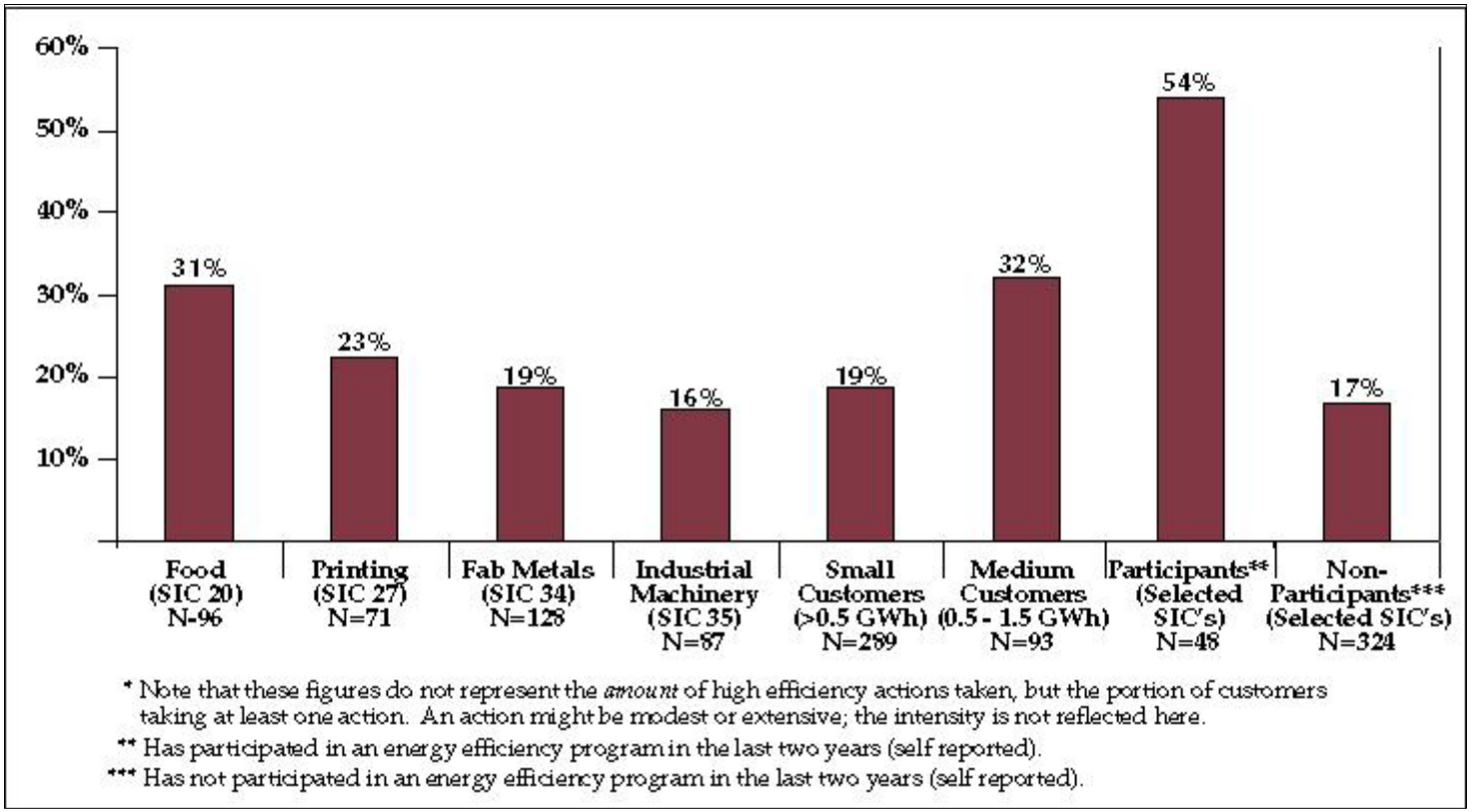
Customer Site Demographics	Small	Medium
Average facility size (thousands of sqft)	16	68
Percent that own facility outside of California	3%	18%
Percent with only one facility	84%	58%
Percent with less than 20 employees	83%	15%

Small/Medium Market Characterization

- **Owner is the most important player in equipment decisions**
- **Small customers depend on equipment vendors**
- **Small and medium customers often lack technical knowledge**
- **Small and medium customers are receptive to training**
- **Medium customers are willing to implement energy efficiency measures**

Efficient Equipment Installs

Customer Self-Reported High Efficiency Equipment Installations Over the Past Two Years



* Note that these figures do not represent the *amount* of high efficiency actions taken, but the portion of customers taking at least one action. An action might be modest or extensive; the intensity is not reflected here.

** Has participated in an energy efficiency program in the last two years (self reported).

*** Has not participated in an energy efficiency program in the last two years (self reported).

Medium-sized Customer Profile

Customer Survey-Based Characteristics

- **Medium-sized customers are more likely than small to:**
  - **Have multiple locations**
  - **Place high importance on:**
    - **cost saving measures**
    - **keeping up with new technology**
    - **Keeping up with changing market demands**
  - **Be aware of and install new technologies**
  - **Feel able to make energy efficiency decisions with internal resources**
  - **Have an energy policy**
  - **Be aware of energy efficiency programs**
  - **Rely on their utility to provide them with information**

Small Customer Profile

Customer Survey-Based Characteristics

- **Compared to medium customers, small customers are:**
  - **Less inclined to undertake energy conservation actions**
  - **Prevented from implementing cost cutting measures by:**
    - **lack of capital**
    - **limited time**
    - **uncertain business conditions**
  - **Rely more on suppliers (especially manufacturers and contractors) for information about EE and new technologies**
  - **Feel their success is determined by external economic conditions**

Program Approaches

- Most HTR customers become aware through bill inserts and mailers, which are not as effective.

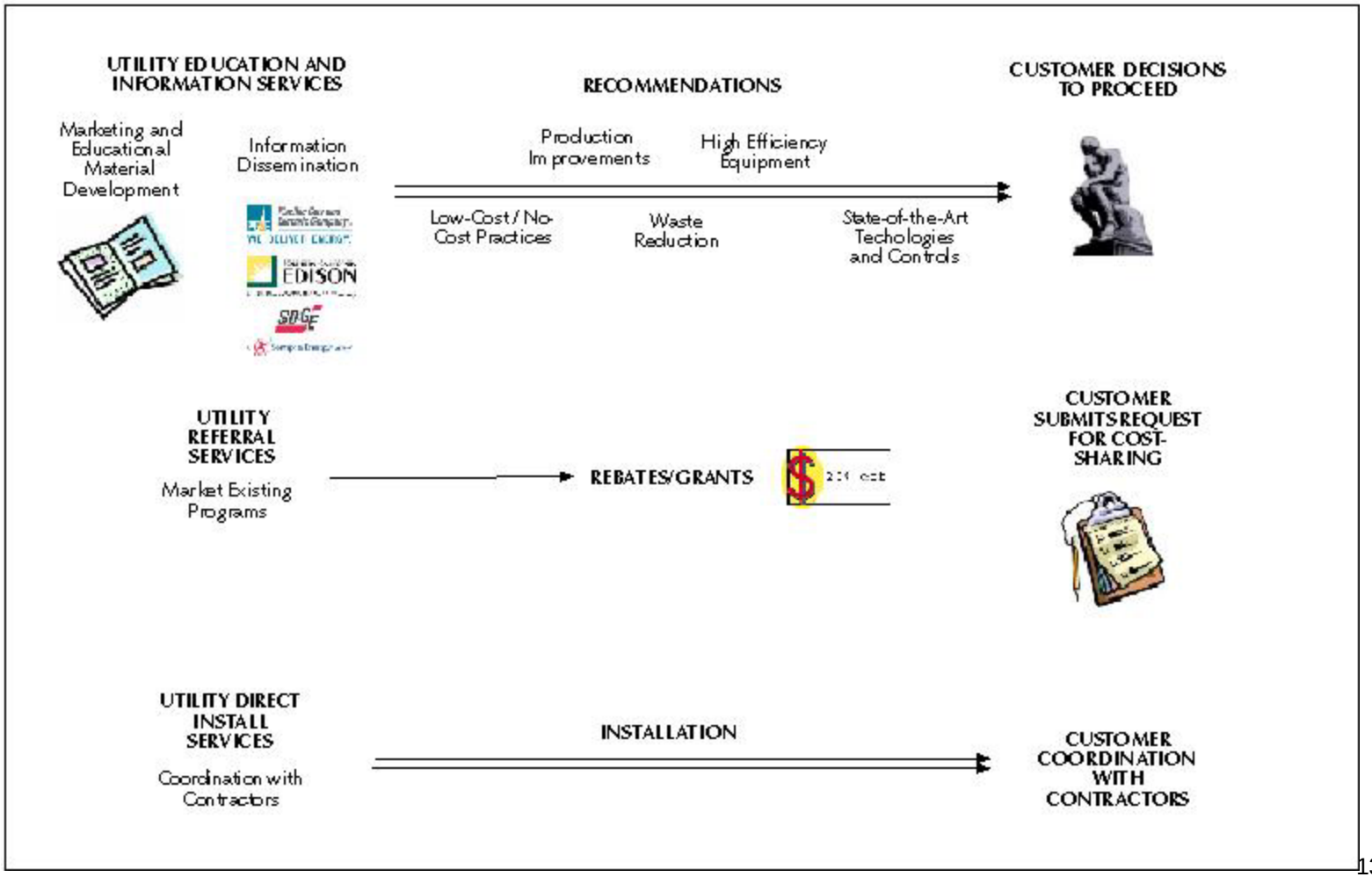
Small Customers

- **Information & Education**
- **Direct Installs**
- **Rebates**

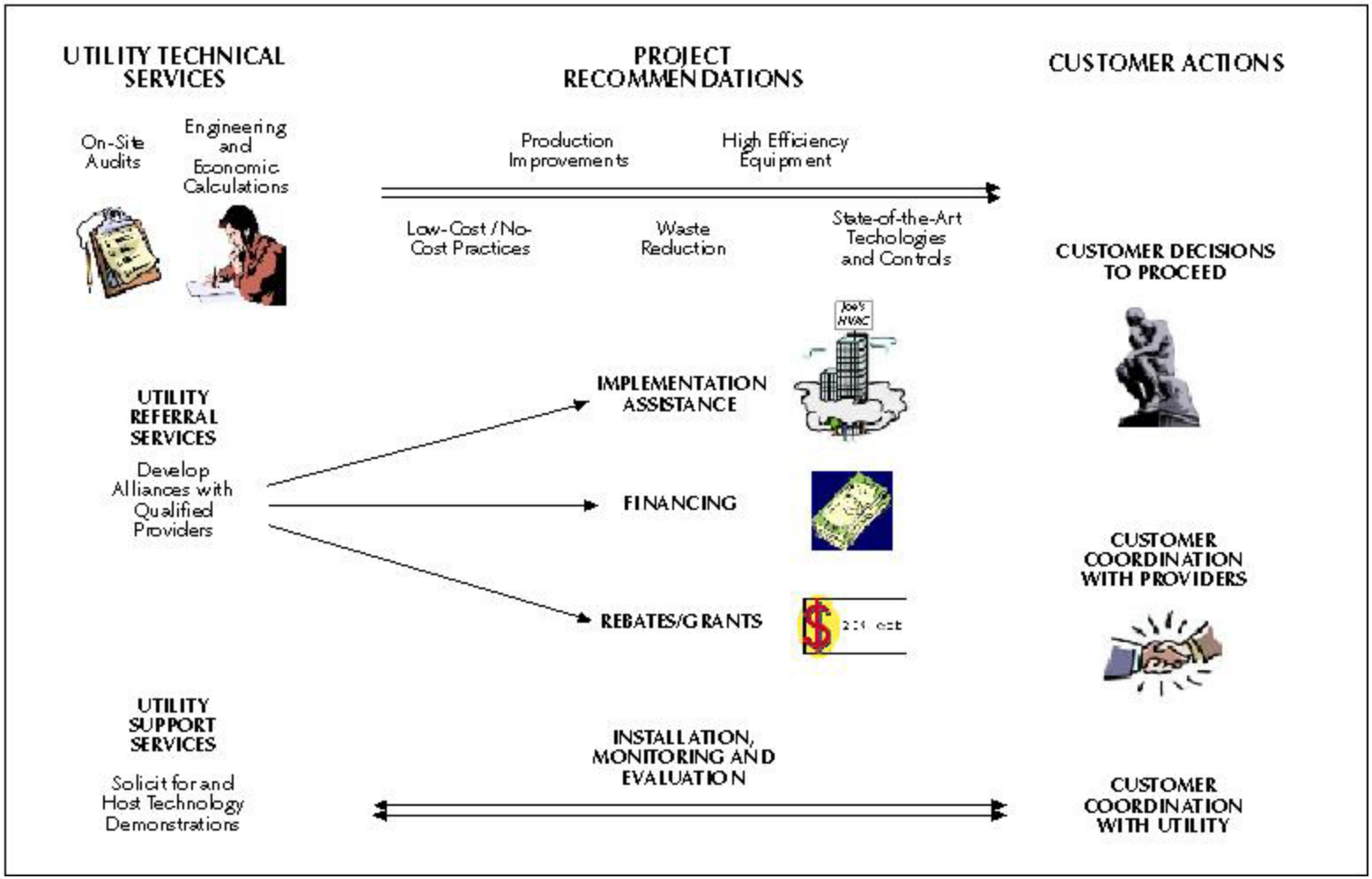
Medium Customers

- **Rebates**
- **Onsite Assessment**
- **Specific Recommendations**
- **Technology Demonstration**
- **Referrals**
- **Implementation Assistance**
- **Financing**
- **Rebates**

Small Customer Recommendations



Medium Customer Recommendations



Current Program Match-up

How California's program portfolio matches up with the recommended approach for Small/Medium Industry

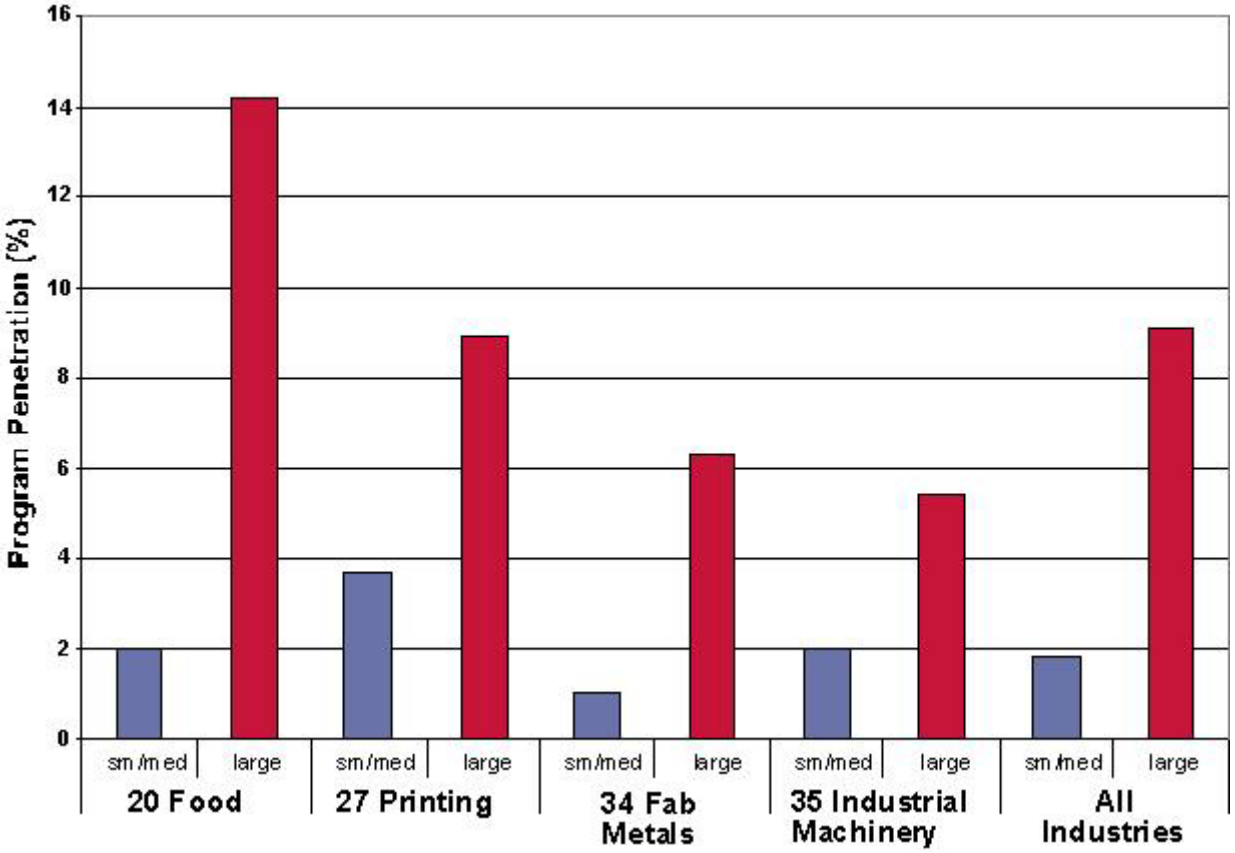
Existing Program Elements	Small	Medium
On-Site assessments		Nonresidential Audit Program
Energy efficiency recommendations		Nonresidential Audit Program
Information and education	Utility website and brochures, etc.	
Technology demonstration		Training and energy centers
Direct Installs	Third party direct install programs	
Referrals		Current program gap
Implementation assistance		
Financing		
Rebates and grants	Express Efficiency	SPC

Conclusions

- **Current programs provide the necessary elements to meet the needs of small/medium industrial customers**
  - **Small industrial customers are well covered**
  - **Program offerings for medium industrial customers could be strengthened by offering referral services for:**
    - **Implementation Assistance**
    - **Financing**

Program Participation Findings

Large Industrial Customers are More Likely to Participate in Express Efficiency (1999-2001)



Conclusions (con't)

- **Yet, evidence suggests that small/medium industrial customers remain under-served by California's programs**
  - **Targeted marketing to industrial customers would help to reduce this inequity**
  - **Enhanced linkages among the programs offered would help to streamline energy efficiency in California**

Statewide Study of The Effects on Program Cost-Effectiveness Due to Targeting the Small Nonresidential Sector

Summary of Final Report

Prepared by:

Chris Ann Dickerson, PG&E

John Cavalli & Marissa Myers, Quantum Consulting

QUANTUM CONSULTING

PG&E Pacific Gas and Electric Company™

Background

- **Small Nonresidential Customers**
  - **< 20kW peak demand**
  - **Comprise over 80% of all nonresidential accounts in California**
  - **Below average rate of participation in energy efficiency programs**
- **CPUC placed emphasis on equitably serving hard-to-reach (e.g., small) customers**
  - **IOUs set participation goals for HTR customers**
  - **In PY2002, half of Express Efficiency participation was among very small customers**

Implications of Emphasizing Small Nonresidential Customers

Targeting Small Nonresidential Customers can Adversely Affect a Program's Cost-Effectiveness

- **TRC is commonly used metric for cost-effectiveness**
  - **TRC = lifecycle benefit of program savings, divided by program and measure costs**
  - **Higher program or measure costs per lifecycle unit of savings reduces cost-effectiveness**
- **Contractors often charge small customers more than large customers on a per unit basis to cover fixed costs.**
  - **Larger measure costs per unit savings decreases cost-effectiveness**
- **Small customers provide less savings potential, but still have many of the same fixed costs associated with marketing and administering a program.**
  - **Higher program costs per unit savings decreases cost-effectiveness**

Study Goal

Determine the Extent to Which Program's Targeted at Small Nonresidential Customers are Less Cost-Effective.

- **Specifically, per unit of savings, how much more does it cost to:**
  - **Administer energy efficiency programs to small nonresidential customers**
    - **Program Costs: Administration, marketing, implementation**
  - **Implement/Install energy efficiency measures for small nonresidential customers**
    - **Measure Costs – What vendors charge customers**

Research Objectives

- **Conduct Literature Review**
  - **Are there existing studies that answer or research questions or provide program and measure cost data?**
- **Analyze Measure Cost Data**
  - **What is incremental measure cost per unit of lifecycle savings to install energy efficiency measures for small nonresidential customers?**
- **Analyze Energy Efficiency Program Cost Data**
  - **What is incremental program cost per unit of lifecycle savings to administer energy efficiency program's targeted at small nonresidential customers?**

Literature Review

- General consensus that small customers are more costly to serve.
- Little quantitative evidence published to support this assertion.
- Reviewed:
  - Conferences 1993-2003: IEPEC, ACEEE, AESP, …
  - Trade Publications: E-Source, Energy Journal, …
  - Industry Organizations: CEE, NEEA, NEEP, CEC, NYSERDA, …
- Identified very useful data sources for analysis.
  - 2001 California Database for Energy Efficient Resources (DEER)
  - IOU Program Tracking Data
  - 2002 CPUC Energy Efficiency Program filings

Measure Cost Analysis

- **Measure Cost = Equipment and labor costs charged by vendors to install EE equipment.**

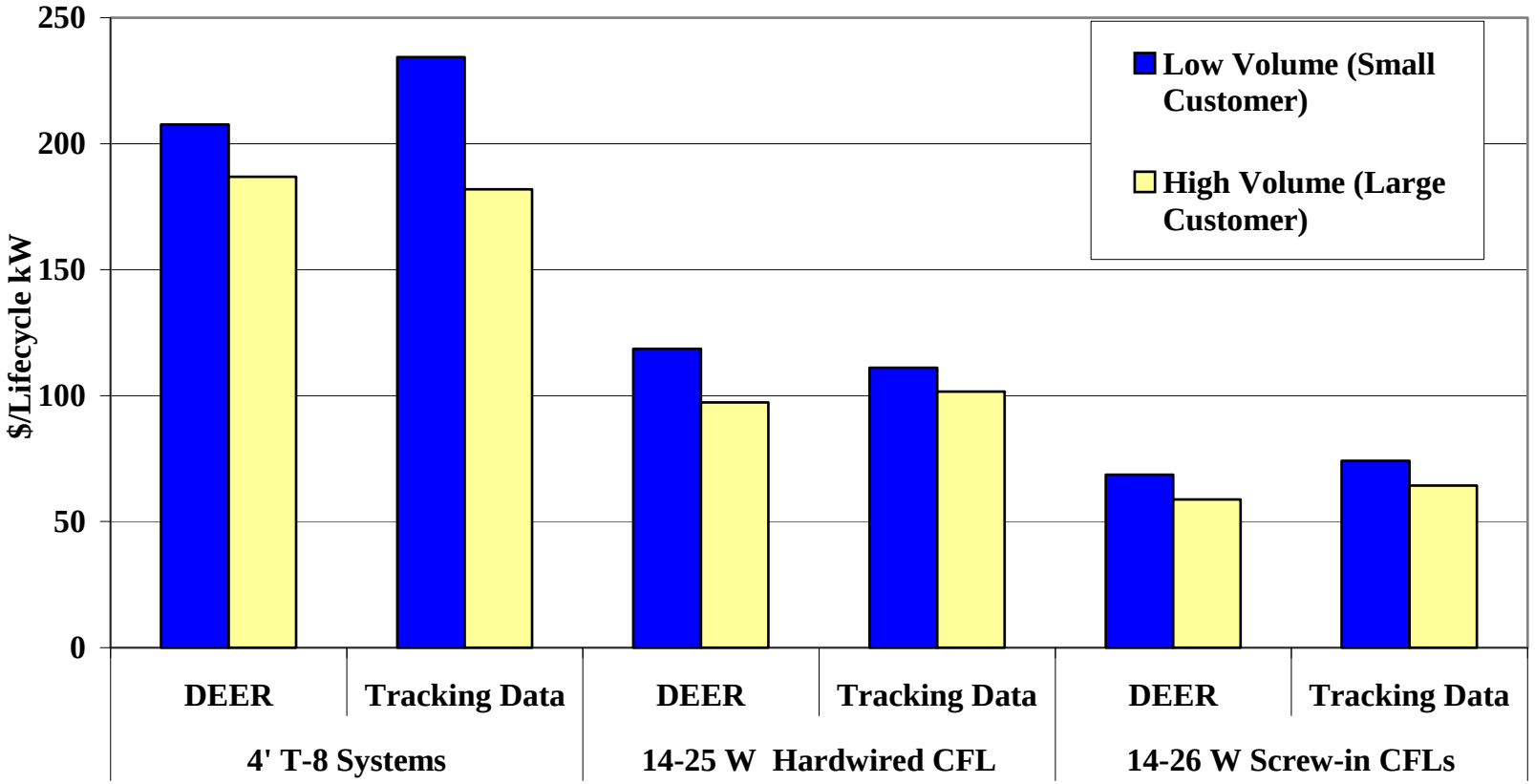
- **Data Sources Analyzed:**
  - **2001 California Database for Energy Efficient Resources (DEER)**
    - **Based on Vendor interviews**
  - **1994-2001 California IOU Energy Efficiency Program Tracking Data**
    - **PG&E documented over 10,000 actual project costs in 1997**

Measure Cost Analysis

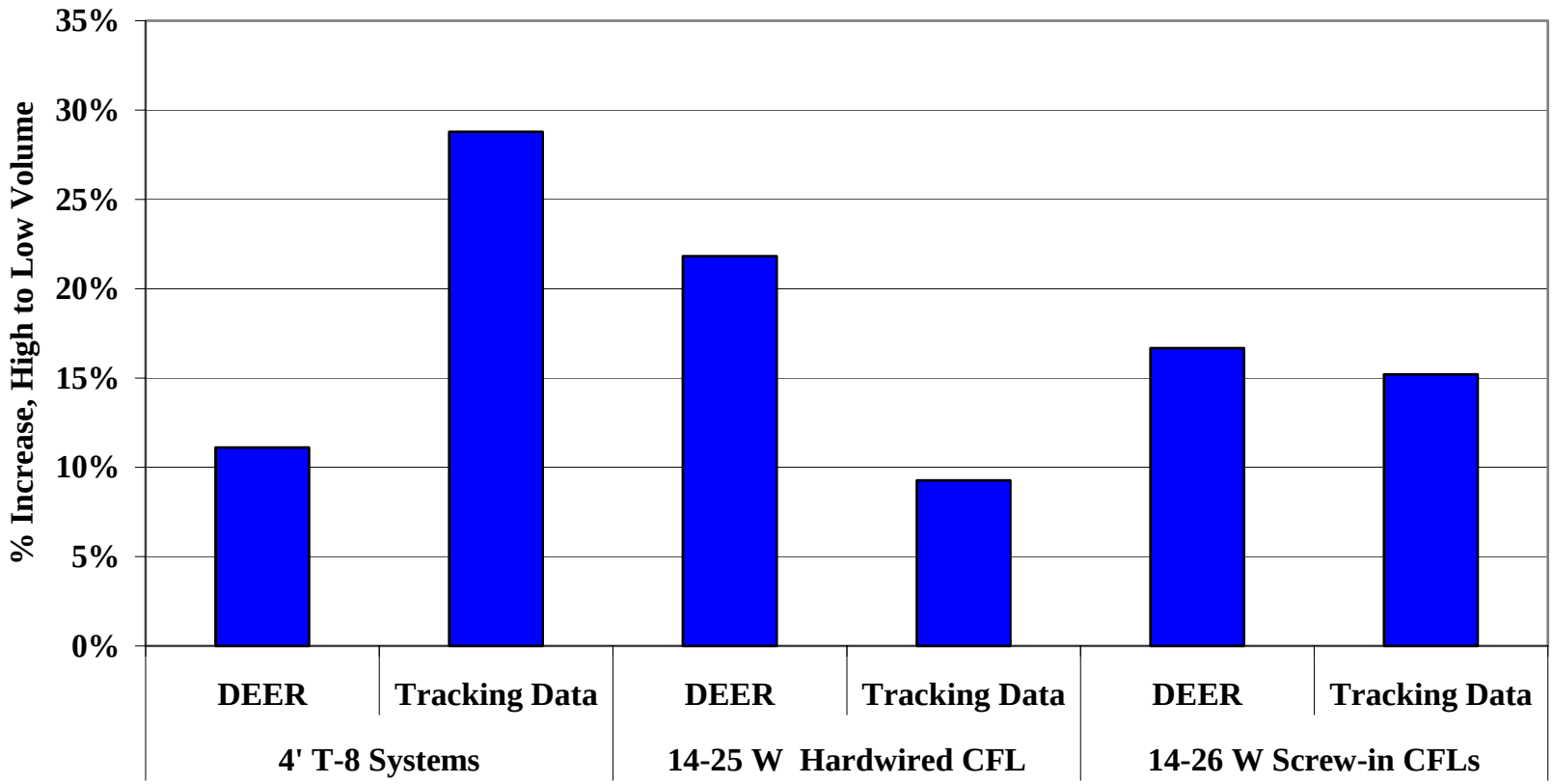
- **Used Job Size as a proxy for Customer Size**
- **Focused on lighting: T-8 systems and CFLs**

- **DEER reports 17% higher measure costs for small jobs**
- **PG&E tracking data revealed 18% higher measure costs for small jobs**

Normalized Measure Costs
- $ per Lifecycle kW Saved -



Percent Increase in Measure Cost for Low Volume Projects



Program Cost Analysis

- **Analyzed Budgets and Program Filings from Nine 2002 Programs Offered by IOUs & Third Parties**
  - **Administration Costs**
  - **Marketing and Outreach Costs**
  - **Audit Costs for Identifying Potential Measures**
  - **Application Processing and Inspection Costs**
  - **Incentives Paid**
  - **Expected Participant Co-payment**
  - **Lifecycle Demand (kW) Savings for the Program**

Programs Analyzed

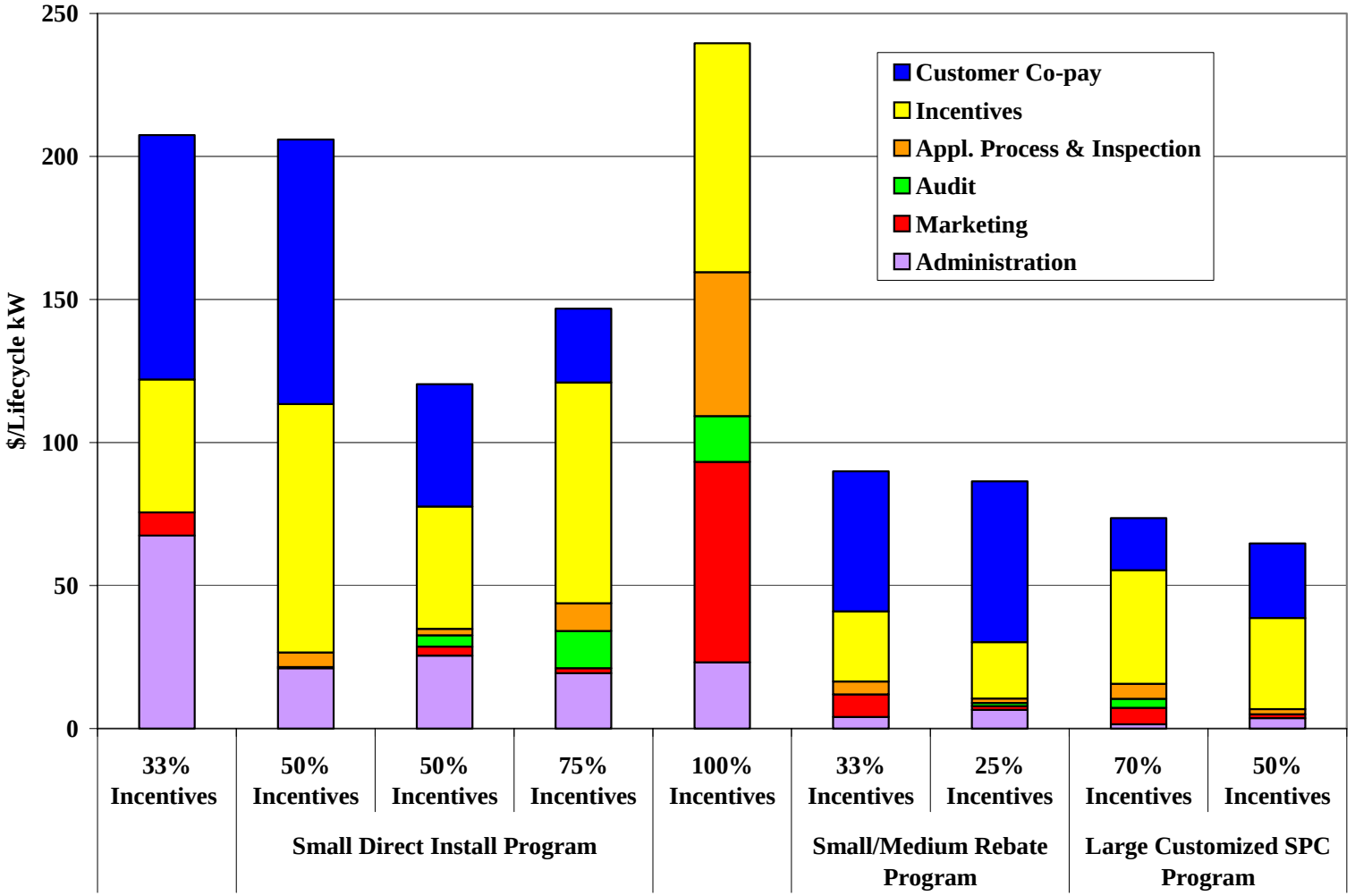
- **5 Third Party/Local Programs (#1-5) and 4 Statewide Programs (#6-9) were Analyzed:**

Program	Targeted Customer Size	Program Type	Average Incentive (% of Measure Cost)
1.	Small (<100 kW)	Direct Install	33%
2.	Small (<100 kW)	Direct Install	50%
3.	Small (<100 kW)	Direct Install	50%
4.	Small (<100 kW)	Direct Install	75%
5.	Small (<100 kW)	Direct Install	100%
6.	Small and Medium (<500 kW)	Perscriptive Rebate	25%
7.	Small and Medium (<500 kW)	Perscriptive Rebate	33%
8.	Large (>500 kW)	Standard Performance Contract	50%
9.	Large (>500 kW)	Standard Performance Contract	70%

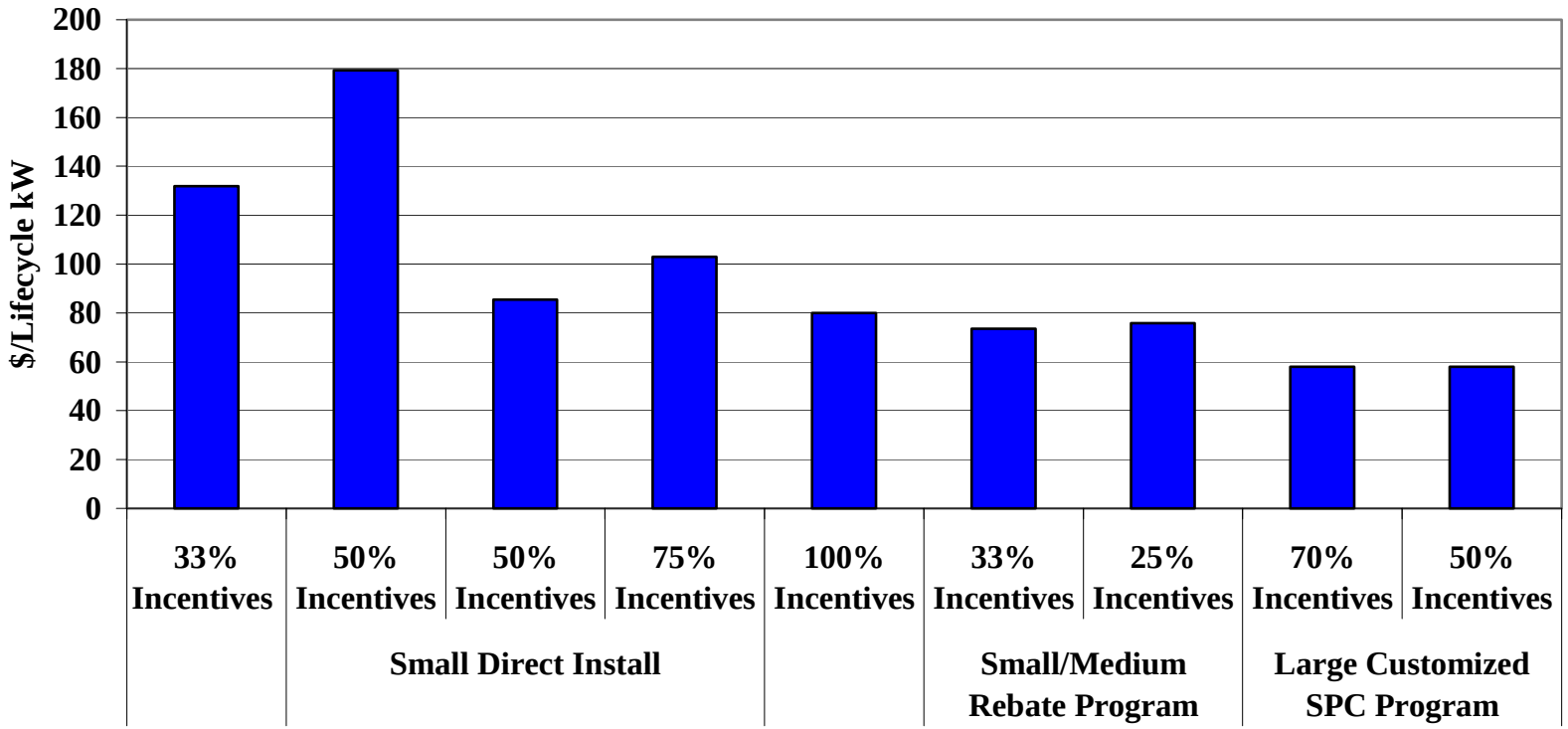
Program Cost Analysis Issues

- **Program Size Varied Significantly**
  - Compared Costs per Lifecycle kW Saved
- **Administrators Classified Costs Differently**
- **Programs Paid Different Levels of Incentives**
  - Focused on Societal Costs
- **Administrators Had Different Cost and Savings Assumptions**
- **Programs Had Different Measure Mix**
  - Normalized Measure Portfolio and Assumptions to $100 per Lifecycle kW

Total Societal Costs per Lifecycle kW - Breakout of Cost by Component -



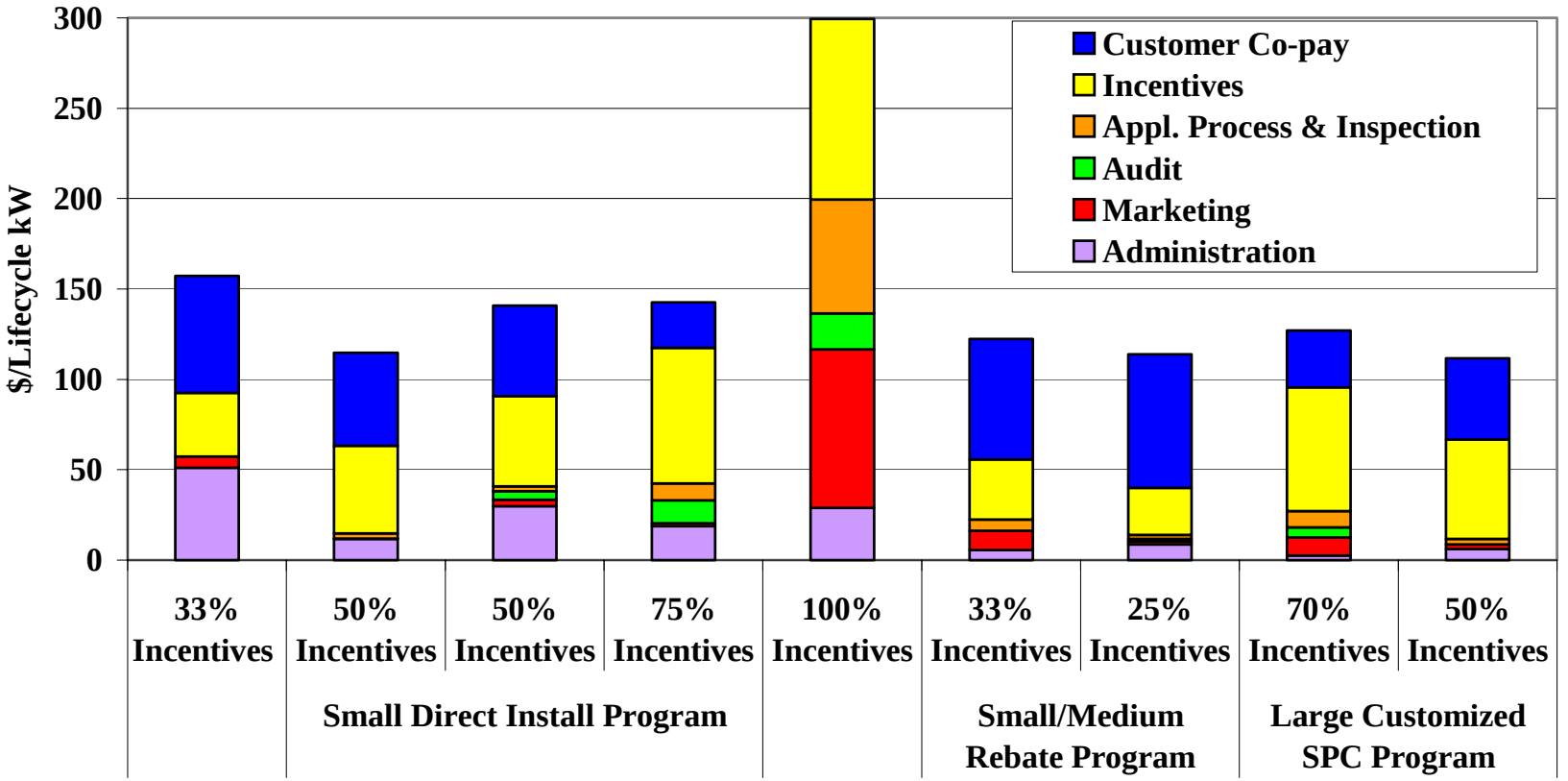
Measure Cost per Lifecycle kW



Measure Cost and Measure Mix

- **Measure Cost per lifecycle kW differs due to differences in assumptions and in measure mix**
- **Normalize by assuming each program has an average measure cost = $100/Lifecycle kW**

Total Societal Costs per Lifecycle kW
Normalized to $100/Lifecycle kW Measure Cost



Incremental Program Costs

- **Program Costs were Consistently Higher Among Programs Targeting Small Nonresidential Customers**
  - **Societal costs are 44% higher among the 5 direct install programs**
  - **Societal costs are still 17% higher after removing outlier (100% incentive direct install)**

Conclusions

Small Nonresidential Customers Cost More to Serve

- Higher Measure Costs
  - DEER and MDSS consistent at about 17% higher
- Higher Program Costs
  - Less certainty, based on budgets
  - In the 10-30% range

Program Implications on Equity Considerations for Hard-to-Reach Customers

- Don’t assess equity based on energy savings or number of applications
- Incorporate societal costs

California End Use Survey (CEUS) Project

Coordinated by the California Energy Commission

Contract Manager: Mark Ciminelli

Project Team:

Itron, Inc.
KEMA-XENERGY
ADM Associates
JJ Hirsch

Presenter: Dr. Frederick D. Sebold, Itron

Project Background

- Both CEC and Utilities needed data on commercial buildings
- Last comprehensive on-site surveys were conducted in mid 1990s or earlier
- Project funded out of PGC Funds
- Project began in 2001
- Project is ongoing

Project Objectives

- To characterize the way in which the commercial sector uses energy (EUIs, load profiles and saturations)
- To support the end-use forecasting process (baseline values)
- To support the assessment of energy efficiency opportunities in the commercial sector (measure saturations, applicability factors, impacts)
- To provide a tool that can be used by the CEC for tailored analysis of commercial energy usage as well as other purposes

Major Project Elements

- On-site surveys of 2800 commercial premises
- The development of a comprehensive database on these premises
- The development of a building simulation and analysis tool (DrCEUS)
- Preparation of building simulations for all 2800 sites
- The development of profiles of market segments, as defined by building categories, climate zones and planning areas (EUIs, saturations, hourly end-use profiles)

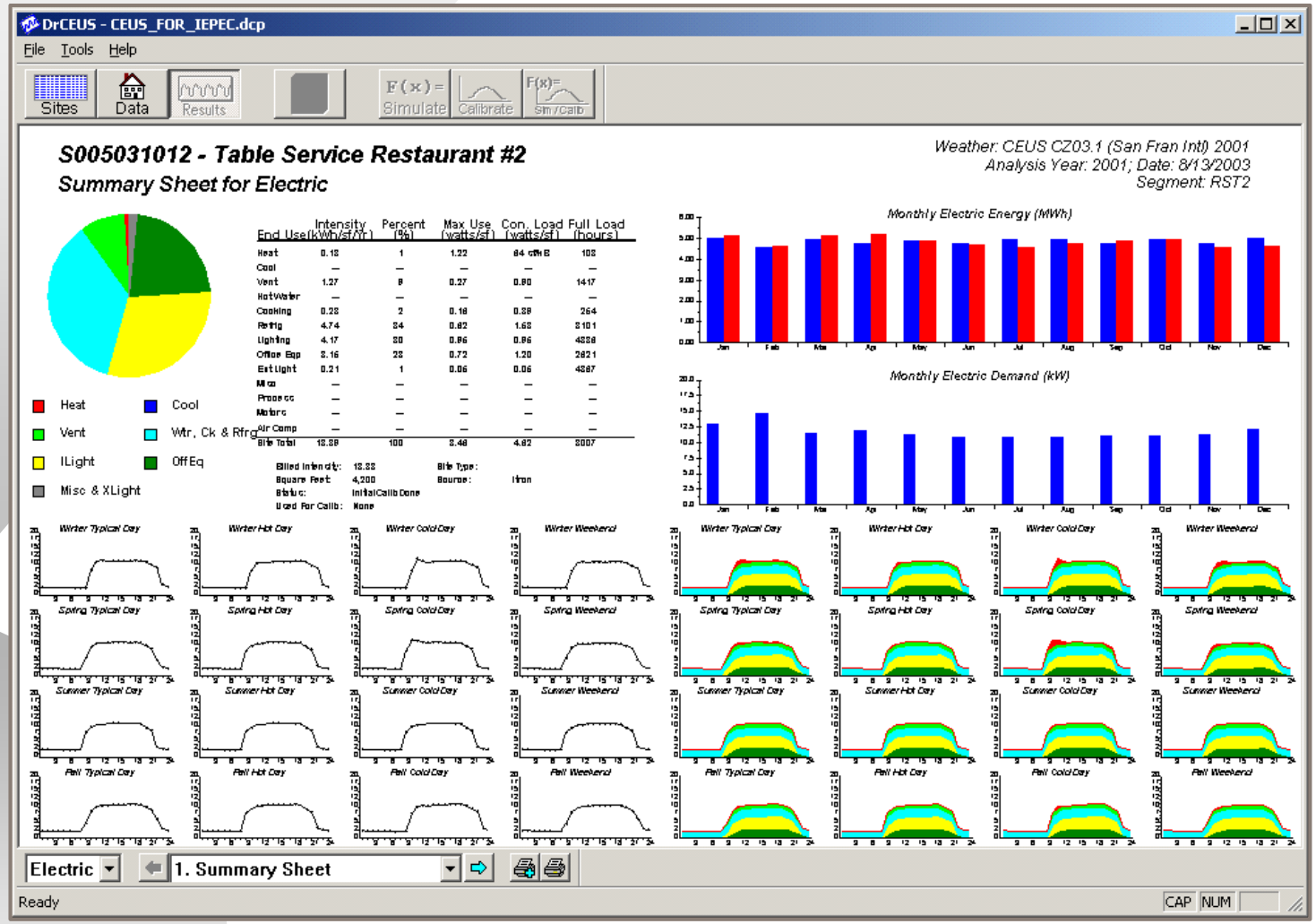
On-Site Surveys

- **Sample Distribution:**
  - PG&E: 1,005
  - SCE: 1,144
  - SDG&E: 351
  - SMUD 300
  - Total: 2,800
- **Survey Contractors:**
  - XENERGY/KEMA
  - ADM Associates
- **Survey Information:**
  - Site geometry and orientation
  - Site HVAC zoning
  - Shell features
  - Equipment inventories by component and HVAC zone (size, efficiency, units)
  - Operating schedules for all equipment
  - Recent site changes

Building Simulations

- Cover all 2,800 sites
- Cover all end uses
- Informed by logger data on lighting and HVAC fans
- Calibrated judgmentally and mechanically to:
  - 2002 billing information, including hourly data where available
  - 2002 load research data on individual sites, where available
  - 2002 segment load profiles
- Weather normalized

Site-Level Results



Itron

Knowledge to Shape Your Future

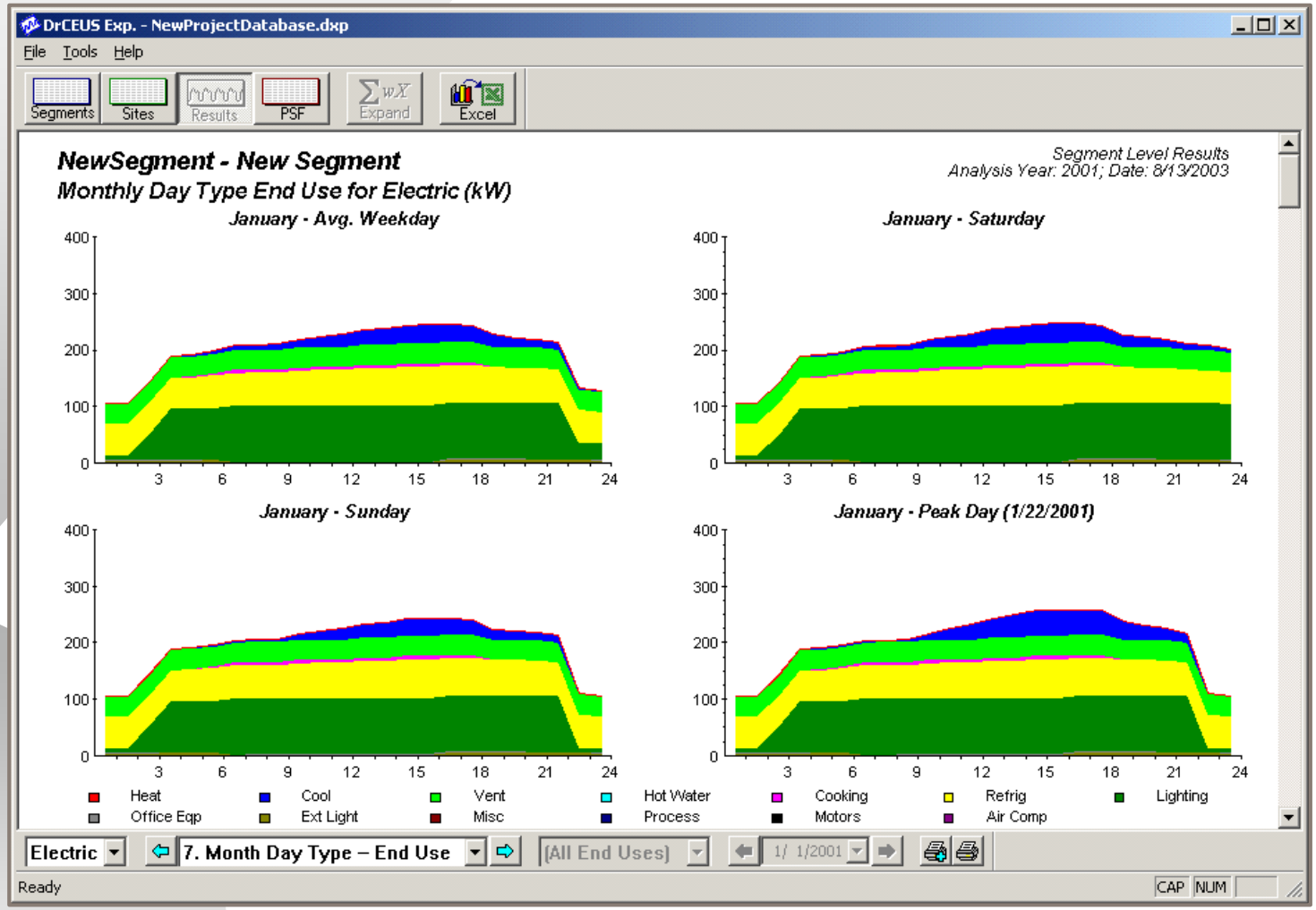
Electric / Gas / Water

Information collection, analysis and application

Segment Analysis

- Expands site level results to population (by segment) using expansion weights
- Available results:
  - Segment level day-type end-use profiles, EUIs
  - Segment-level saturations
  - Segment comparisons
  - 8760s by end use
  - Pick-a-day graphic
  - Monthly day-type profiles

Segment Analysis End-Use Graphics



Itron

Knowledge to Shape Your Future

Electric / Gas / Water

Information collection, analysis and application

Project Status

Element	Current Status	Expected Completion
On-Site Surveys	1,450 of 2,800 done	September 2004
Simulations	1,050 of 2,800 done	October 2004
Simulation Software	Main elements done	June 2004
Segment Analysis	Not yet started	December 2004

Nonresidential Market Share Tracking Study

Presented for:

MAESTRO at Pacific Energy Center, San Francisco

Presented by:

Patrick McCarthy

Dr. Jack Wang

Study Sponsors

California Energy Commission

California Public Benefits Program

Pacific Gas and Electric

San Diego Gas and Electric

Southern California Edison

April 1, 2004

Agenda

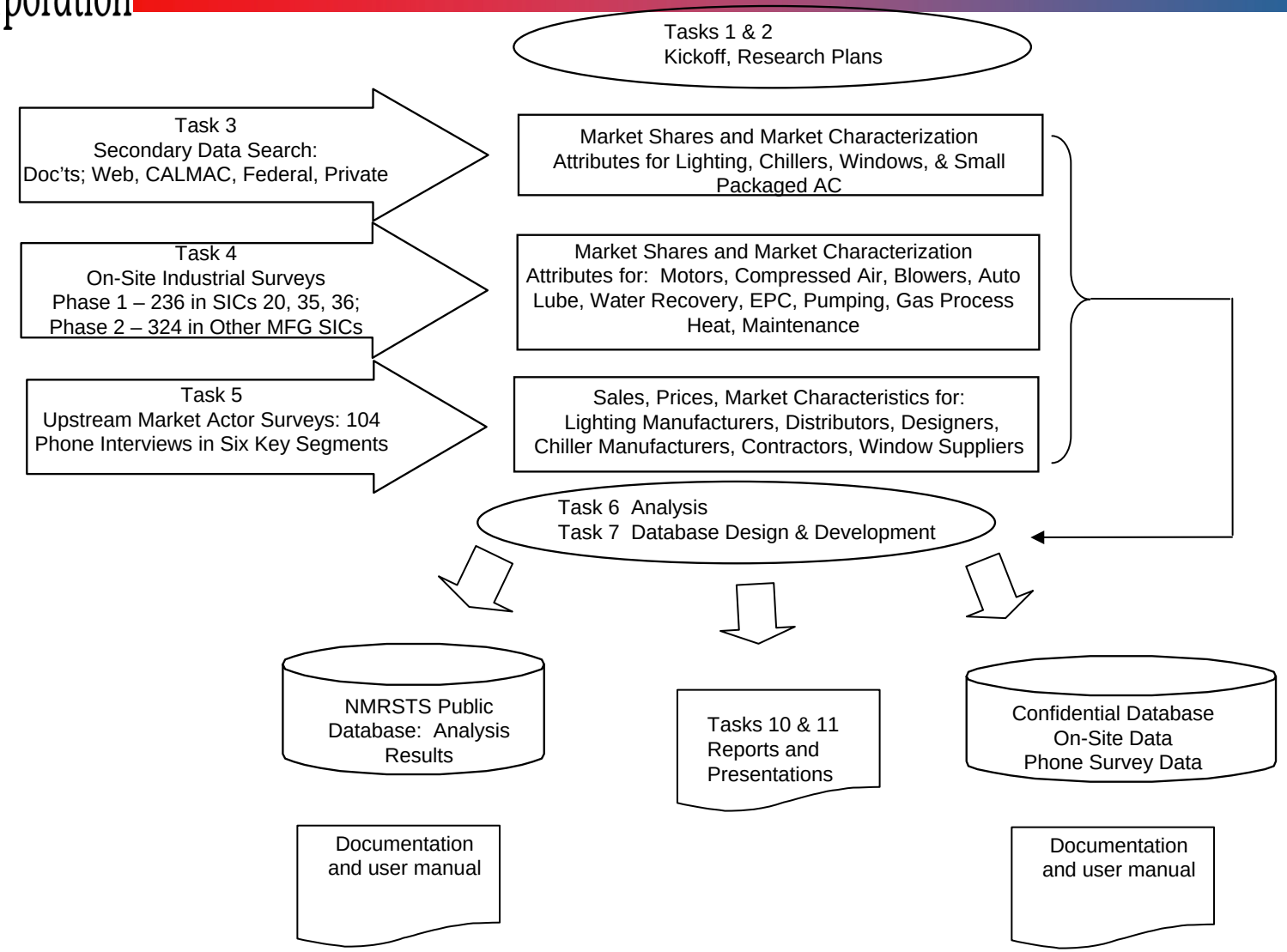
1. Project Overview
2. Data Sources and Sample Sizes
3. Selected Interesting Findings
4. Public Use Database Training

Project Objectives

Collect, process, and store data on nonresidential market shares, quantities, prices, market pathways, purchase / usage decision factors, and other market characterization attributes for energy-efficient vs. standard-efficiency technologies and practices, including:

Packaged air conditioning
Lighting
Windows
Chillers
Motors
Compressed air systems and optimization
Blowers
Automatic lubrication systems
Water recovery and reuse
Electronic process controls
Maintenance
Fluid process pumping, and
Gas process heating

Project Overview



Sample Sizes

Industrial Purchases and Practices Survey

- 28 Pre-Onsite-Survey Supplier / Expert Surveys
- 236 Onsite Surveys Over SICs 20, 35, and 36
- 324 Onsite Surveys Across All Manufacturing SICs Other than 20, 35, and 36

Upstream Market Actor Surveys

- 53 Lighting Manufacturers, Distributors, and Designers
- 27 Chiller Manufacturers and Distributors
- 24 Windows Suppliers

Secondary Sources

- Data included from 5 secondary sources of 40 sources reviewed

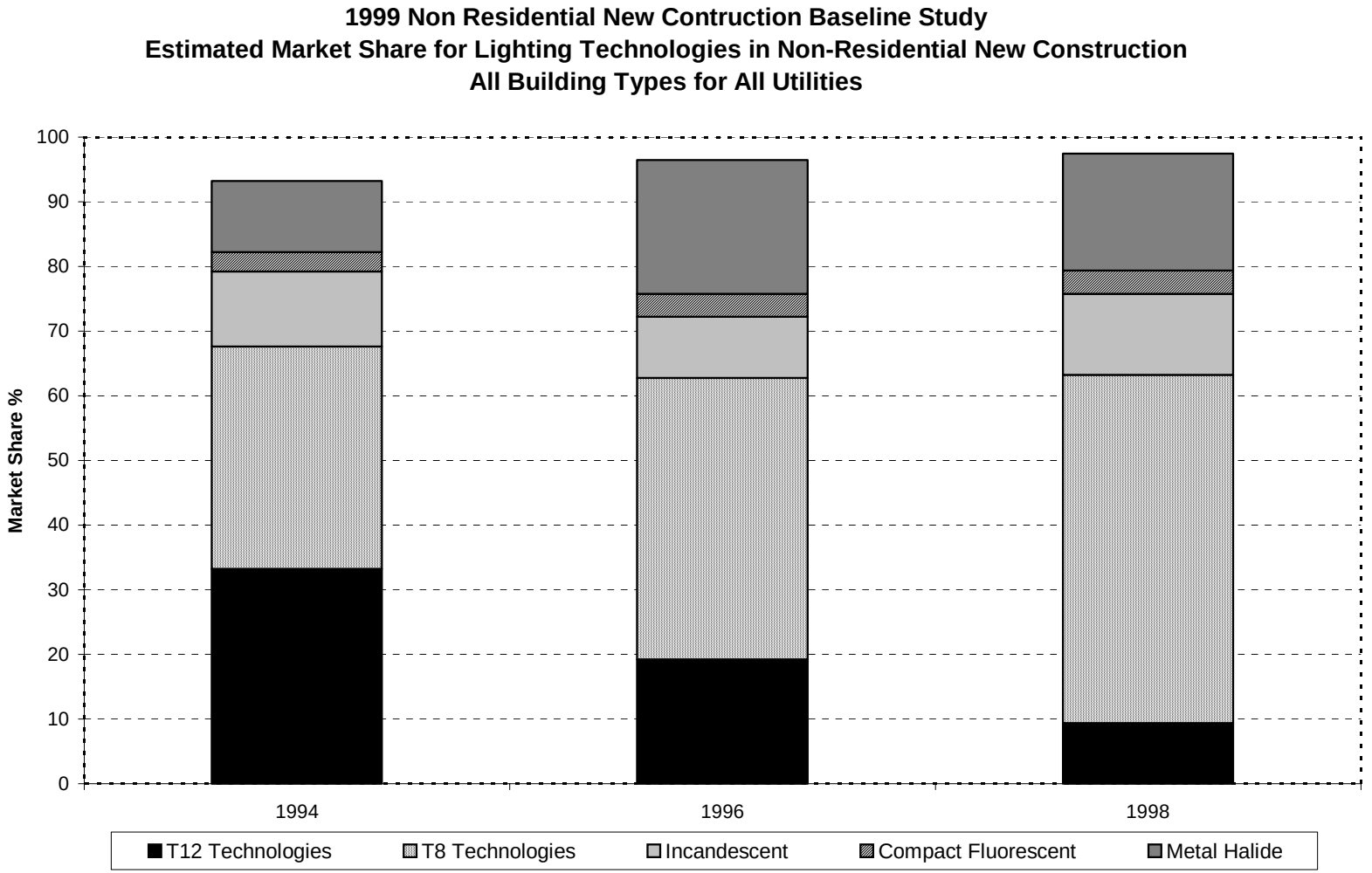
Secondary Data Sources Drawn from for Public Database

- 1998 Nonresidential New Construction Study (NRNC), 990 surveys over 4 survey years
- 1998 California Food Industry Energy Management Survey Study, 109 surveys
- 2000 C&I New Construction and Retrofit Lighting Design and Practices Study, 72 surveys
- 2000 California Residential Efficiency Market Share Tracking Study, 5 PAC distributors
- 2001 Database of Energy Efficiency Resources (DEER), 318 sources

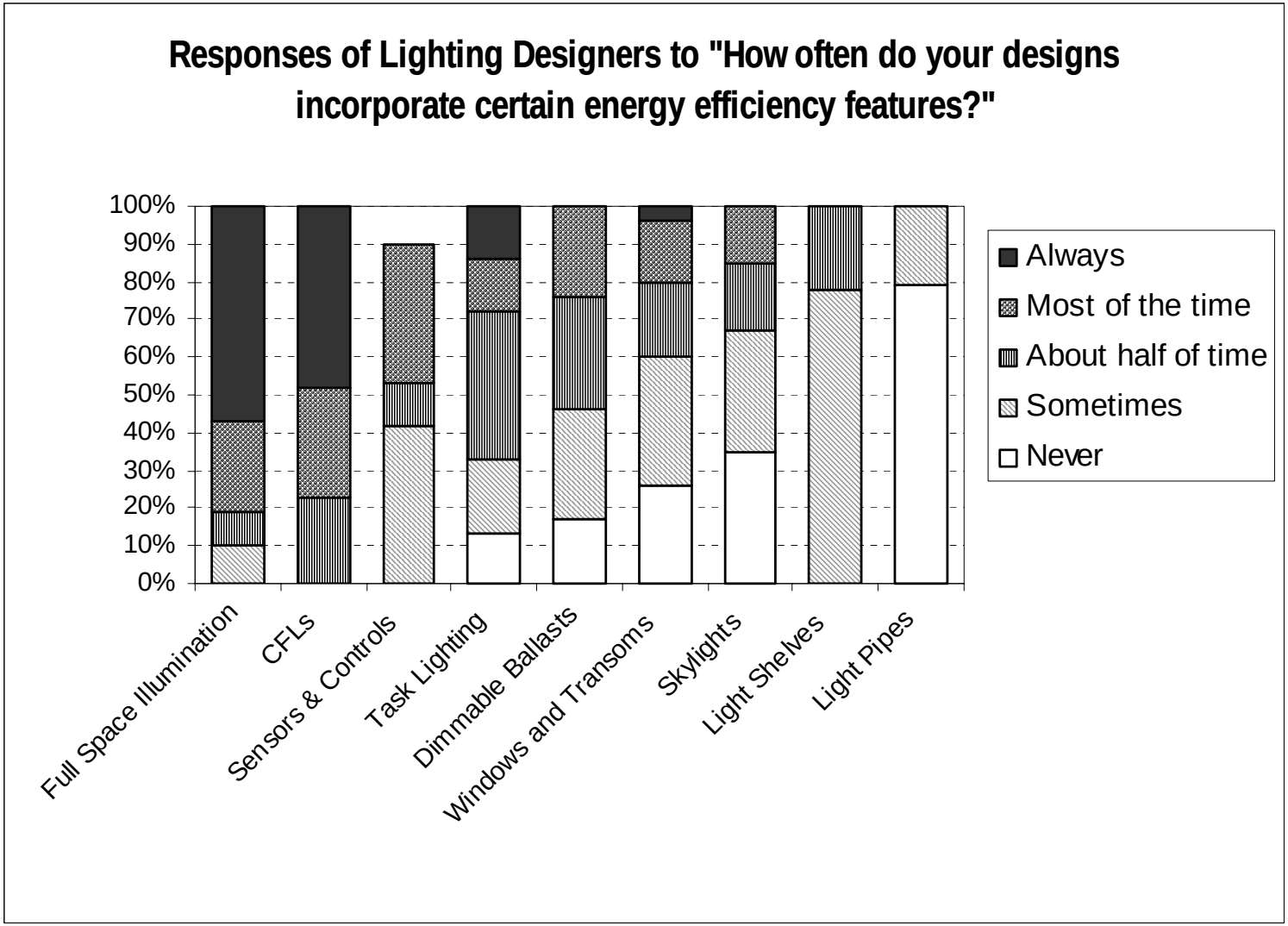
Major Technologies / Practices Covered in the Industrial Onsite Survey

Technology / Behavior	Phase 1: 2001- 2002	Phase 2: 2002-2003
Lighting (T8's vs. T12's)		•
Motors	•	•
Process Fluid Pumping		•
Variable Speed Drives (as parts of other sections)	•	•
Compressed Air	•	•
Maintenance	•	•
Gas Process Heating		•
Blowers (as part of Maintenance Section)	•	•
Electronic Process Controls	•	•
Water Reuse and Recycling	•	•
Refrigeration	•	•
Power Generation	•	•

Lighting: Selected Lighting Results Derived from NRNC Data



Lighting: Designers' Responses on Incidence of Selected Efficiency Features in Their Designs



Chillers: Key Water-Cooled Chillers Results

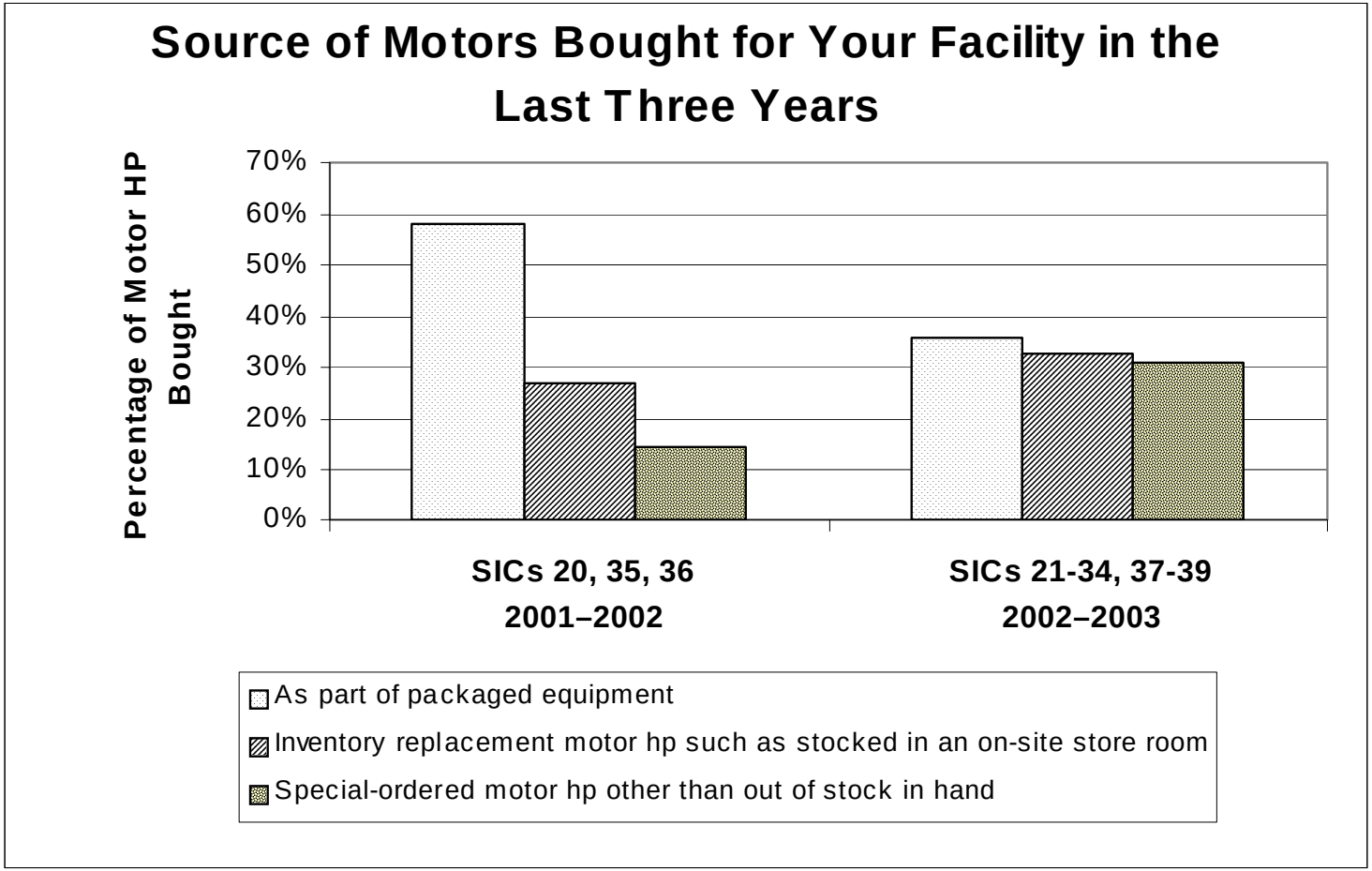
Market Share for Chiller Technologies (1994-1998)

Water Cooled					
Less Than 150 Tons	High	Less than 0.75	15.2%	4	8.2%
Less Than 150 Tons	Medium	0.75 thru 0.85	25.0%	4	16.4%
Less Than 150 Tons	Low	Greater Than 0.85	59.8%	17	16.0%
		Total:	**100.0%**	**25**	
150 thru 299 Tons	High	Less than 0.59	14.8%	7	9.0%
150 thru 299 Tons	Medium	0.59 thru 0.75	26.5%	11	13.4%
150 thru 299 Tons	Low	Greater Than 0.75	58.7%	10	16.4%
		Total:	**100.0%**	**28**	
Greater Than or Equal 300 Tons	High	Less than 0.56	7.6%	12	3.0%
Greater Than or Equal 300 Tons	Medium	0.56 thru 0.65	44.3%	23	12.0%
Greater Than or Equal 300 Tons	Low	Greater Than 0.65	48.1%	20	12.2%
		Total:	**100.0%**	**55**	

Motors: Premium-Efficiency Motor Market Share

Questions and Responses	2001–2002								2002–2003	
	SIC 20		SIC 35		SIC 36		SICs 20, 35, 36		SICs 21-34, 37-39	
	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error
Percentage of HP of motors bought in last 3 years meeting or exceeding NEMA Premium Efficiency Standards										
1 - 49 hp	12.40%	5.20%	28.70%	6.60%	3.90%	2.20%	**15.80%**	4.10%	**5.00%**	2.20%
50 - 200 hp	17.20%	4.50%	13.90%	12.60%	18.90%	3.30%	**17.50%**	3.40%	**16.20%**	6.20%
Total 1 - 200 hp	14.80%	3.60%	27.80%	6.40%	8.50%	3.90%	**16.30%**	3.00%	**7.30%**	2.60%

Motors: Shares of New Motor HP Entering Plants by Purchase Path



Motors: Other Selected Findings

Question and Responses	SIC 20, 35, 36		SIC 21-34, 37-39	
	Estimate	Std. Error	Estimate	Std. Error
Plant has a standard clause or policy to purchase NEMA-Premium efficiencymotors when ordering packaged equipment	24.2%	5.9%	6.6%	3.0%
When buying replacement motors such as those stocked in an onsite store room, do you have a policy about the efficiency level to buy?				
• Premium efficiency (Phase 1 only)	28.8	6.8%	NA	NA
• NEMA Premium efficiency (Phase 2 only)	NA	NA	1.1%	0.4%
• "Efficient" (but not necessarily NEMA Premium efficiency (Phare 2 only)	NA	NA	4.5%	2.5%
• Buy Regular	5.4%	2.1%	3.1%	1.6%
• Consider tradeoffs between efficiency & price	NA	NA	2.3%	2.1%
• No particular policy on energy efficiency	44.8%	7.1%	71.7%	5.5%
Respondendent understands that the term "premium" efficiency motors means NEMA Premium efficiency	NA	NA	16.3%	4.2%
When asked why rewind motors, proportion who cited the following reasons (of available choices):				
• Lower first cost	55.9%	11.7%	69.7%	4.1%
• Faster turnaround time	39.5%	10.2%	41.2%	4.2%
• To keep older motors, that are built better	28.8%	11.7%	6.5%	1.7%
When having a motor rewound, do you require any of the following quality assurance features:				
• Oven chart recorder burnout temperature	1.9%	1.1%	8.4%	2.3%
• Repair report	22.5%	9.5%	44.8%	4.0%
• Winding resistance test results	12.9%	8.9%	25.0%	3.5%
• Core-loss test results	5.8%	3.4%	9.9%	2.4%

Fluid Pumping System Upgrades (for sites with >= 50 hp pumping)

Questions and Responses	SICs 21-34, 37-39	
	Upgrade ever performed	Upgraded in last 3 years
Please indicate which of the following other industrial pumping system upgrades have ever been performed. (check all that apply).		
Trimmed pump impellers	11.8%	5.2%
Installed or modified pump control system	23.7%	18.3%
Redesigned pipe layout to reduce friction losses	49.0%	42.9%
Replaced with higher efficiency pumps	41.8%	34.4%
Increased piping diameter	47.1%	38.6%
Replaced worn impellers or bearings	77.0%	4.1%
Other	8.5%	0.0%

Gas Process Heating: Gas Boiler Energy-Efficiency Options

Questions and Responses	SICs 21-34, 37-39	
	Estimate	Std. Error
Industry gas process heating energy efficiency options present on boilers		
Stack heat recovery	22.2%	5.5%
Condensate heat recovery	20.9%	5.5%
Other heat recovery	7.5%	4.5%
Automated tuning (O_2 trim control)	13.8%	4.9%
Electronic ignition	31.1%	4.9%
Turbulators for firetube boilers	9.9%	4.8%
Industry gas process heating energy efficiency options installed on boilers in the last three years		
Stack heat recovery	10.7%	4.8%
Condensate heat recovery	3.0%	1.7%
Other heat recovery	0.0%	0.0%
Automated tuning (O_2 trim control)	1.9%	1.0%
Electronic ignition	11.8%	4.9%
Turbulators for firetube boilers	0.7%	0.7%
Increased pipe and boiler jacket insulation	22.1%	1.3%
Reduced boiler blow-down cycle	3.6%	1.6%
Reduced steam pressure	37.6%	0.7%
Variable speed drives on larger forced-draft and induced-draft fans	2.4%	1.5%
Automatic flue damper	4.3%	2.1%
Smaller boiler for low-load conditions	0.7%	0.7%
Other	0.2%	0.2%

Refrigeration: Market Saturation Ratios for Selected Refrigeration Efficiency Options (asked of sites with >= 20 hp of refrigeration)

Questions and Answers	2001 – 2002*		2002 - 2003	
	SIC 20		SICs 21-34, 37-39	
	Estimate	Std. Error	Estimate	Std. Error
Percentage of refrigeration hp with heat recovery	**8.8%**	4.8%	**1.5%**	0.4%
Percentage of refrigeration hp with floating head	**25.7%**	11.1%	**4.3%**	4.3%
Percentage of refrigeration hp that is ammonia-based	**79.6%**	6.6%	**4.3%**	4.3%

* Refrigeration questions were not asked of SIC 35 and 36 respondents in Phase 1.

Compressors: Air Compressor Part Load Control – Multi-Compressor Sequencing (asked of sites with >= 20 hp of compressed air)

Questions and Answers	2001 - 2002								2002 - 2003	
	SIC 20		SIC 35		SIC 36		SICs 20, 35, 36		SICs 21-34, 37-39	
	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error
Use automatic controls to optimally sequence multiple air compressor operation										
Yes	42.1%	22.1%	19.1%	6.5%	51.6%	5.2%	**35.6%**	7.1%	**19.4%**	6.7%
No	57.3%	22.1%	79.5%	6.5%	38.9%	5.2%	**60.8%**	7.1%	**77.2%**	7.5%
Not Sure	0.6%	NA	1.0%	0.4%	9.0%	NA	**3.3%**	0.2%	**3.4%**	3.3%
Missing	0.0%	0.0%	0.4%	0.4%	0.5%	0.5%	**0.3%**	0.2%	**0.0%**	0.0%

Water Recovery: Proportion of Plants with Water Recovery, with and without Heat Recovery

Questions and Answers	2001 – 2002								2002 - 2003	
	SIC 20		SIC 35		SIC 36		SICs 20, 35, 36		SICs 21-34, 37-39	
	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error
Proportion of facilities with a water recovery and reuse system	13.3%	5.2%	11.3%	7.9%	19.3%	9.8%	**13.5%**	5.0%	**11.5%**	3.3%
Proportion of wastewater recovery systems that include heat recovery	11.5%	6.4%	0.0%	0.0%	0.0%	0.0%	**2.5%**	1.4%	**10.9%**	10.2%

Maintenance: Maintenance Policy and Training Patterns

Maintenance Policy:	**Percentage of Responses By Maintenance Practice and SIC**	**Maintenance Practice with Highest Percentage**
As Needed	18% to 61%	Motor belt replacement
Unscheduled Preventive	1% to 6%	Filters
Limited Scheduled Preventive	9% to 35%	Motor lubrication
Aggressive Preventive	6% to 23%	Motor lubrication
Predictive	0% to 2%	Steam traps & pressure regulators

Training In Past Two Years on Energy Topics :	**Phase 1 (2001-2002)**	**Phase 2 (2002-2003)**
Yes	7%	23%
No	93%	76%

Key Findings and Recommendations: More in Report

- Training and Information are needed to increase share of daylighting in the design community
  - –Designers interviewed use these in 0-20% of applications
  - –Other energy-efficient design (technology, controls) used more
- T8 Technology has strong share in commercial, but remains underused in industrial
  - –12% use in industrial applications
  - –Far below 52-55% in “all commercial”
  - –Incentives or other industrial-based programs suitable.
- Industrial energy efficiency training opportunities are present
  - –76% report no training on energy issues in last 2 yrs
  - –84% not clear understanding that “premium” is NEMA Premium
- Motor market pathways include large share of “on-board” equipment:
  - –Need programs aimed at manufacturers to offer premium option
  - –Need to influence machine selection by buyer

Key Findings and Recommendations: More in Report

- Ammonia refrigeration is common in food processing; rare otherwise
  - –Suggest research to uncover other suitable applications
  - –Follow with tailored promotions
- Motor rewinding opportunities:
  - – Many users rewind motors, especially large ones.
  - – Users typically omit specifications that ensure quality
  - – Work with rewinders and EASA to ensure quality standards
  - – Don’t bother trying to dissuade rewinding
- Consider continuation of tracking studies for industrial sector as well as upstream market actors:
  - – Phase I / Phase II showed definite differences
  - – Economic flux will certainly drive these markets

Aspen Systems Corporation

Data Base Demonstration

Database Demonstration

Public-Use Database:

- Structure
- Studies Included
- Variables
- Illustrative Queries