QUANTUM CONSULTING

NATIONAL ENERGY EFFICIENCY BEST PRACTICES STUDY

VOLUME NR1 – NON-RESIDENTIAL LIGHTING BEST PRACTICES REPORT

Submitted to

California Best Practices Project Advisory Committee
Kenneth James
Contract Manager
Pacific Gas and Electric Company
P.O. Box 770000, N6G
San Francisco, CA 94177

Submitted by

PRIME CONTRACTOR
QUANTUM CONSULTING INC.
2001 Addison St, Suite 300
Berkeley, CA 94704

Volume NR1 Report Contractor – Quantum Consulting Inc.

December 2004

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

The Best Practices Study team would like to gratefully acknowledge the participation of the following individuals and their organizations in this report:

- John Cavalli, Quantum Consulting Inc.
- Karen Corfee, KEMA-Xenergy, Inc.
- Steve Culbertson, Southern California Edison
- Lisa Kauffman, Xcel Energy (CO)
- John Matchett, Connecticut Light & Power
- Jill McGhee, San Diego Gas & Electric Company
- Paula Wiesner, Sacramental Municipal Utility District

These individuals participated in lengthy interviews in which they generously shared their expertise and lessons learned in program design, management, implementation, and evaluation. Without their participation and the support of their organizations this report would not have been possible.

In addition, we thank the many individuals that participated in the user needs focus groups conducted at the outset of the project.

We also thank the members of the Best Practices Study's Project Advisory Committee for their inspiration, insights, tireless review and thoughtful direction throughout the project:

- Kenneth James – Pacific Gas and Electric Company
- Pierre Landry – Southern California Edison Company
- Rob Rubin – Sempra Utilities
- Jay Luboff – California Public Utilities Commission, Energy Division
- Eli Kollman – California Public Utilities Commission, Energy Division
- Sylvia Bender – California Energy Commission

Finally, these reports benefited greatly from the diligent technical editing of Betsy Wilkins and the tireless production efforts of Alex Kang.

CONTACT INFORMATION

Kenneth James
Best Practices Study Contract Manager
Pacific Gas and Electric Company
P.O. Box 770000, N6G
San Francisco, CA 94177
415-973-0246
klj1@pge.com

Michael W. Rufo
Best Practices Study Prime Contractor Lead
Quantum Consulting Inc.
2001 Addison Street, Suite 300
Berkeley, California 94704
510-540-7200, ext. 2037
mrufo@qcworld.com

Marissa Myers, John Cavalli, and Mike Rufo
NR1 Non-residential Lighting Chapter Leads
Quantum Consulting Inc.
2001 Addison Street, Suite 300
Berkeley, California 94704
510-540-7200, ext. 2027
mmyers@qcworld.com

ES. EXECUTIVE SUMMARY FOR NON-RESIDENTIAL LIGHTING PROGRAMS (NR1)

ES.1 INTRODUCTION

This volume presents results of a comparative analysis of non-residential lighting programs included in the National Energy Efficiency Best Practices Study ("Best Practices Study"). The overall Best Practices Study objectives, scope, and methodology are briefly outlined in Appendix NR1A of this report. More details on methods and cross-program findings are provided in separate report volumes.

The Best Practices Study team ("Best Practices Team") reviewed six programs for this program area study ("NR1 Programs" and "NR1 Study," respectively) that offer turnkey installations and traditional rebate opportunities to non-residential customers. Although several of these programs offered a range of measures (e.g., refrigeration and HVAC), lighting measures (mostly T8, delamping and CFLs) account for the bulk of energy savings attributed to NR1 Programs. Therefore, these programs are referred to as lighting rather than comprehensive programs for the purposes of the NR1 Study. The NR1 Programs are listed in Exhibit NR1-E1 below and presented in the body of this report. A discussion of the program selection process is provided in Appendix NR1A.

ES.2 KEY CATEGORY THEMES

Three crosscutting issues that affect multiple program components were identified for the NR1 Programs.

A program's target market fundamentally shapes program design, incentive level and marketing approach.

Program Design. A turnkey, or direct installation, approach is often taken to penetrate the small commercial customer market, based on evidence that small customers do not have the expertise, time or available capital to make lighting upgrades. This approach is designed to provide all aspects of lighting installation for the customer and virtually eliminate the barriers of participant hassle and search costs.

Incentive Level. High incentives, often 75 percent or more of measure cost, drive the economics of investment for small, capital-constrained customers who would usually otherwise not participate in energy efficiency programs. Participation and adoption rates increase non-linearly as financial incentives increase.

Marketing Approach. Mass media does not move many small customers to participate in efficiency programs. Contractors more often drive the customer recruitment process. In prescriptive programs with moderate to low incentives, contractors typically recruit customers believed to be able and willing to co-fund project installation. In turnkey programs with high incentives, contractors are often motivated to follow program directives that emphasize census marketing of customers that are qualified for the program, typically by customer size and geography.

Contractor relationships are critical to non-residential lighting programs. In both turnkey and traditional rebate programs, contractors are usually far more involved than customers in the direct program process. Because this high level of involvement is central to the program, strong positive relationships between program staff and contractors is extremely important. Regardless of program approach, streamlining program process to make participating easy, and promoting contractor credibility are key to building and maintaining successful relationships with these trade allies.

Standardized incentives and discrete measure lists offer great potential for automated processes. Some of the NR1 Programs have pioneered innovative ways to use information technology to electronically link program administrators and the lighting contractors that implement projects at customer facilities. Internet-based project management tools offer efficiency gains as well as improved utility turn-around time and real-time tracking capability. To realize the full benefit of such tools they must be robust enough to process a high volume of projects in large programs with minimal staff resources. Limited and standardized program elements facilitate cost-effective development of efficient IT systems. Users of these workflow and project management systems considered them critical to program success.

ES.3 BEST PRACTICES SUMMARY

Best practices are identified in this study for each of the four major program components used to organize data collection and analysis. These program components are Program Design (including program theory), Program Management (including project management, reporting and tracking, and quality control and verification), Program Implementation (including participation process and marketing and outreach) and Program Evaluation. Best practices were developed by analyzing information across programs developed from detailed interviews of program managers and thorough review of all relevant secondary sources such as program filings and evaluations. Exhibit NR1-E2 presents the list of best practices developed from the analysis of R1 programs. Exhibit NR1-E3 provides the rationales associated with each best practice. The remainder of this report provides detailed analysis and discussion of program features and best practice rationales.

The scope of this study also includes a California gap analysis. A comparison of the best practices presented in this report with the practices employed in California's Statewide Express Efficiency Program is in progress and will be published when complete in a separate document.

Exhibit NR1-E1
NR1 Programs: Non-residential Lighting Programs Reviewed For NR1 Study

Program Name	Implementer/s	Abbreviation for NR1 Report
2003 Lighting Efficiency Program	Xcel Energy	Xcel Lighting
2002-2003 Business Energy Services Team (BEST) Program	KEMA-XENERGY	KEMA-XENERGY BEST
2002 EZ Turnkey Program	San Diego Gas & Electric Company (SDG&E)	SDG&E EZ Turnkey
2003 Small Commercial Prescriptive Lighting Initiative	Sacramento Municipal Utility District (SMUD)	SMUD Sm Comm Prescriptive
2002 Small Business Energy Advantage Program	Connecticut Light and Power (CL&P)	CL&P SBEA
2002 California Statewide Express Efficiency Program	Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), Southern California Gas Company (SCG), and San Diego Gas & Electric Company (SDG&E)	CA SW Express

Exhibit NR1-E2
Summary List of Best Practices for Non-Residential Lighting Programs

Program Theory and Design
• Articulate a program theory that clearly states the target for the program, program timing and the strategic approach whether resource acquisition, market transformation or equity • Link strategic approach to policy objectives and constraints
Program Management: Project Management
• Develop and maintain strong relationships with lighting vendors/contractors • Use electronic project management tools
Program Management: Reporting and Tracking
• Collect pre-existing wattage information • Use electronic application processes • Use incentive commitment tracking • Allow program managers to generate standardized reports • Use databases that fully integrate with cross-program energy-efficiency program information systems • Use detailed process flow diagrams • Track vendor activity
Program Management: Quality Control and Verification
• Base quality control practices on a program's relationship with vendors, the number of vendors, the types of measures, the project volume, and the variability in the size of projects • Define product specifications in program requirements and guidelines • Obtain a good random sample of vendor and measure types • Always inspect the first job submitted by a new vendor • Conduct on-site post-installation inspections • Conduct an independent audit or pre-installation inspections • Govern post-inspection levels by cost-effectiveness considerations and results from an initial set of inspections early in the implementation process • For delamping projects, use light level requirements and pre- and post-light level readings to ensure quality • Implement a contractor screening/certification/training process

Exhibit NR1-E2
Summary List of Best Practices for Non-Residential Lighting Programs (Continued)

Program Implementation: Participation Process
• Use an easy, simplified process for vendors to participate • Optimize data collection requirements • Make customer eligibility easy for contractors to determine • Use electronic processing • Use high incentive levels, as appropriate, in segments and for program designs that require high penetration rates to be cost-effective or if policy goals demand high penetration levels • Reduce or eliminate incentives for measures and segments with high penetration rates not caused by program participation • Appropriately incent and bundle delamping with T12 conversion • Set base rebate levels appropriately throughout the program year instead of over-relying on short-term promotions • Offer zero-percent or low-cost financing to offset high cost of capital for small businesses
Program Implementation: Marketing and Outreach
• Leverage utility credibility to help vendors sell the program • Use door-to-door marketing by a turnkey vendor to achieve a high penetration rate, especially among small commercial customers • For prescriptive programs, combine a moderate mass marketing effort with a process of strongly motivating and leveraging contractor marketing for prescriptive programs • Leverage partnerships with cities and community-based organizations
Program Evaluation
• Perform annual evaluations for high-priority issues that are relevant and unique to each individual program year • Spot check the data entry process annually • Review inspection databases annually • Ensure that program tracking databases are correctly calculating program impacts annually • Perform detailed impact evaluations routinely, though not necessarily annually • Evaluate operating hours routinely • Collect pre-wattage information routinely • Determine measure life in estimating the lifecycle benefits of a measure routinely • Perform market assessments routinely, though not necessarily annually • Conduct process evaluations routinely • Conduct evaluations in a timely manner • Involve program staff in the evaluation process and create a culture whereby evaluation findings are valued and integrated into program management • Present actionable findings to program staff at the conclusion of study

Exhibit NR1-E3
Summary of Best Practices Rationale and CA Gap Summaries for Non-Residential Lighting Programs

Best Practice	Rationale
Program Theory and Design	
Articulate a program theory that clearly states the target for the program, program timing and the strategic approach whether resource acquisition, market transformation or equity	Even a relatively simple statement of program logic can reveal gaps in program focus or effort and assure that everyone involved knows what the program seeks to accomplish and why.
Link strategic approach and target to policy objectives and constraints	Program strategic approach and target should be linked to policy objectives and constraints to help ensure the strategic and tactical approaches will lead to the desired results. For example, a direct installation program may be desirable when the primary goal is to maximize penetration in a hard-to-reach segment under a Total Resource Cost test. By contrast, a prescriptive rebate approach with lower incentive levels is often superior at maximizing savings per program dollar (as viewed by the Utility/Program Administrator Cost Test) in segments where sufficient market demand exists. The pivot point between these two approaches may be swayed by several factors, including, market saturation, program costs, participation rates, and levels of free-ridership.
Program Management: Project Management	
Develop and maintain strong relationships with lighting vendors	Vendors are the critical program delivery mechanism for non-residential lighting programs. Strong vendor relationships are especially critical for traditional rebate programs that do not directly subcontract with vendors but do rely on them to market the program.
Use electronic project management tools	Electronic management tools can improve turn-around time and reduce administrative cost. Electronic submission processes are especially useful for high-volume programs.
Program Management: Reporting and Tracking	
Collect pre-existing wattage information	This has proven key to accurate savings and program impact estimates. It may be easier to collect this information through an existing audit process or electronic submission. However, if the incremental effort involved in collecting pre-existing information is too great, considerable value can be obtained by collecting this information on a random sample. This could be done either through the program or through a real-time independent evaluation.

Best Practice	Rationale
Use electronic application processes	Electronic application processes can accelerate program turn-around and reduce administrative costs.
Use incentive commitment tracking	This is useful for programs that enable customers to reserve funds, especially for larger customers or customized measures with longer project cycles. Reservations guarantee funds to customers and help the program administrator anticipate expenditures. Incentive commitment tracking can be part of project status reporting.
Allow program managers to generate standardized reports	Program staff is not forced to rely on programmers, database specialists or IT staff to extract information.
Use databases that fully integrate with cross-program energy-efficiency program information systems	Integration facilitates management review.
Use detailed process flow diagrams	Process flow diagrams help facilitate data entry for high-volume programs.
Track vendor activity	Market activity highlights active vendors and high-volume measures.
Program Management: Quality Control and Verification	
Base quality control practices on a program's relationship with vendors, the number of vendors, the types of measures, the project volume, and the variability in the size of projects	A prescriptive rebate program with no control over vendors may need to require more quality control-oriented inspection. A turnkey program that trains a small pool of vendors and uses a pre-screened list of products may require less *ex-post* product quality review.
Define product specifications in program requirements and guidelines	Product specifications help to ensure installation of high-quality products and enhance participant satisfaction.

Best Practice	Rationale
Obtain a good random sample of vendor and measure types	A stratified random sample ensures that different job types, measure and vendors are inspected.
Always inspect the first job submitted by a new vendor	Inspecting jobs by new vendors helps to ensure they are installing products appropriately and makes clear that quality control is taken seriously.
Conduct on-site post-installation inspections	On-site inspections discourage vendors from failing to fully and properly install all rebated measures (e.g., dropping CFL shipments.) Random inspections of 10 to 20 percent of projects are usually adequate for lower incentive prescriptive programs. The fraction of on-site inspections should be higher for direct installation programs and may need to be increased for any program as conditions warrant.
Conduct an independent audit or pre-installation inspections	An independent audit or pre-inspections by the program administrator ensures a comprehensive, accurate assessment of needed measures, and reduce any tendency of contractors to promote products of most benefit or familiarity to them. However, for mass market prescriptive programs, this may be cost-effective for only a random sample of projects.
Govern post-inspection levels by cost-effectiveness considerations and results from an initial set of inspections early in the implementation process	It may not be cost-effective to perform 100% post-inspections in a high-volume program or a program with small impacts per site. A good rule of thumb is 10-20% for a high-volume program or low impact per site program and 100% for very large projects and problem vendors.
For delamping projects, use light level requirements and pre- and post-light level readings to ensure quality	Delamping can provide significant and highly cost-effective savings but is only appropriate if required light levels are maintained. Light level requirements help ensure customer satisfaction and retention of savings.
Implement a contractor screening/training/certification process	Screening encourages the participation of responsible contractors and helps ensure high-quality installations.
Program Implementation: Participation Process	
Use an easy, simplified process for vendors to participate	Vendors are the most important actor in the prospecting and delivery mechanism, so success depends on a process that facilitates participation and keeps contractor costs modest.
Optimize data collection requirements	Contractors will not participate aggressively if they incur significant costs in application development. Paperwork should be easy for contractors and customers.

Best Practice	Rationale
Make customer eligibility easy for contractors to determine	Determining customer eligibility is important to a streamlined process and quick turn-around.
Use electronic processing	Electronic application processing improves the program implementer's responsiveness and reduces administration cost.
Use high incentive levels, as appropriate, in segments and for program designs that require high penetration rates to be cost-effective or if policy goals demand high penetration levels	High market barriers among small customers and high fixed marketing costs typically require a high penetration rate to achieve desired cost-effectiveness.
Reduce or eliminate incentives for measures and segments with high penetration rates not caused by program participation	Program resources should be focused on achieving high net effects. Where market penetration is high and self-sustaining, standards should be considered to capture the remaining resource potential while program dollars are shifted to new measures with lower levels of market penetration.
Appropriately incent and bundle delamping with T12 conversion	This combination measure delivers very cost-effective savings but must be implemented conservatively.
Set base rebate levels appropriately throughout the program year instead of over-relying on short-term promotions	Sale periods create processing bottlenecks and slower turn-around. Occasional sales help promote a specific technology or target a specific segment, but should be used sparingly.
Offer zero-percent or low-cost financing to offset high capital for small business	Zero-percent financing, with convenient terms and short repayment periods, can improve customer acceptance rates by overcoming the high cost of capital for small businesses.
Program Implementation: Marketing and Outreach	
Leverage utility credibility to help vendors sell the program	Customers consider utilities as more credible than contractors in some markets. In these cases, leveraging utility credibility is usually effective.
Use door-to-door marketing by a turnkey vendor to achieve a high penetration rate, especially among small commercial customers	Face-to-face marketing and turnkey services reduce the hassle and information search costs for small businesses that might otherwise not participate.

Best Practice	Rationale
For prescriptive programs, combine a moderate mass marketing effort with a process of strongly motivating and leveraging contractor marketing for prescriptive programs	This combination works to create program awareness and close sales.
Leverage partnerships with cities and community-based organizations	Partnerships offer marketing leverage for a program administrator and credibility and economies of scale for contractors by brining vendors, utility representatives and customers together to provide education, demonstrate products, and sign the customer up for rebated measures.
Program Evaluation	
Perform annual evaluations for high-priority issues that are relevant and unique to each individual program year	Due to the volume of contractors and measures typically involved in non-residential lighting programs each year, accurate routine verification and tracking of related data is a high-priority element to ensuring customer satisfaction and useful program assessment.
Spot check the data entry process annually	
Review inspection databases annually	
Ensure that program tracking databases are correctly calculating program impacts annually	
Perform detailed impact evaluations routinely though not necessarily annually	Impact evaluations (e.g. which involves inputs to total resource cost, such as energy savings, free-ridership, measure life and cost) should occur when some change is suspected in these metrics due to different behavior, changing target market, or an external event like an energy crisis. In order to effectively evaluate impacts, accurate operating hour, pre-wattage and measure life information is critical.
Evaluate operating hours routinely	For non-residential lighting programs, operating hours are one of the key parameters that drive energy savings, and should be evaluated routinely using lighting logger or other end use monitoring techniques.
Collect pre-wattage information routinely	Pre-wattage information is also a key parameter to collect as part of the program tracking process. If impacts are not calculated based on customer specific pre-wattage information, pre-wattage assumptions should be revised on a routine basis.
Determine measure life in estimating the lifecycle benefits of a measure routinely	Measure life studies are most accurate when based on empirical data collected over many years (as many as 10 years for some measures).

Best Practice	Rationale
Perform market assessments routinely, though not necessarily annually	Market assessments should occur when the market or program design change significantly or when longitudinal indicators are being tracked to assess longer term market effects.
Conduct process evaluations routinely	Because vendors are key to program success, vendor input on processes and vendor satisfaction should be obtained for process evaluations. Because non-residential lighting programs have relatively high volume, the application, incentive payment and inspection processes should be thoroughly review every few years.
Conduct evaluations in a timely manner	Timely evaluations give real-time feedback to program staff and contribute to program planning. In some instances these evaluation can be conducted concurrent with the program.
Involve program staff in the evaluation process and create a culture whereby evaluation findings are valued and integrated into program management	Involving program staff encourages their buy-in, encourages them to express research issues and express their perspective on program activities.
Present actionable findings to program managers at the conclusion of study	Presentations bring implementers into the feedback loop and encourage them to act on study recommendations. Key findings from evaluations should be well distilled and disseminated (i.e., workshops, good executive summaries, summary briefs) so appropriate actions may be taken to improve future programs.

1. OVERVIEW OF REVIEWED PROGRAMS

The NR1 Programs targeted discretionary retrofit opportunities among non-residential customers. Two types of program models, turnkey and prescriptive rebate, were used primarily. Turnkey (or direct installation) programs are designed to have all program aspects, from the initial marketing and ensuing audit process through the final equipment installation, conducted by a third party. Prescriptive rebate programs place more responsibility on participants, requiring them and their contractors to complete application requirements, and usually, though not necessarily, pay lower incentives than direct installation programs.

Although several of the NR1 programs offered a range of measures (e.g., refrigeration and HVAC), lighting measures (mostly T8, delamping and CFLs) account for the bulk of energy savings attributed to them. Therefore, these programs are referred to as lighting rather than comprehensive programs for the purposes of the NR1 Study. Several NR1 Programs targeted small business customers, as defined by energy usage/rate schedule. Although size definitions varied by programs (as described in Exhibit NR1-1), the NR1 Study uses the following definitions in broad discussions of programs and best practices: Very Small: <20 kW; Small: 20-99 kW; Medium: 100-500 kW; and Large: > 500 kW. NR1 Programs are briefly summarized below and basic program characteristics are presented in Exhibit NR1-1.

The 2003 Energy Lighting Efficiency Program implemented by Xcel Energy (Xcel Lighting) served commercial/industrial (C/I) and <500 kW business customers in Minnesota. Xcel Lighting offered low-cost energy assessments, low-interest financing and prescriptive and custom rebates for change-outs of existing lighting equipment and lighting installations in new construction. Xcel Lighting focused on resource acquisition of high quality, equipment-specific products, offering rebates on measures until their use was judged to be "standard practice." Nearly 900 prescriptive lighting projects were completed through the program in 2003. Program participation and impacts were tracked.

The 2002-2003 Business Energy Services Team Program implemented by KEMA-XENERGY (KEMA-XENERGY BEST) targeted the ≤ 100 kW commercial market. KEMA-XENERGY BEST was implemented via several local programs regulated by the California Public Utilities Commission (CPUC), including those administered by the Oakland Energy Partnership, the San Diego Regional Energy Office, and the City of Long Beach. The NR1 Study focuses on information associated with implementation of the Oakland Energy Partnership program. A key objective of this local program was to gain the participation of "hard-to-reach" businesses (as defined by the CPUC) in economically depressed areas. The program performed audits and installed cost-effective high-efficiency lighting measures, as well as some HVAC, refrigeration, and customized measures. Key features of KEMA-XENERGY BEST were its complete turnkey service, door-to-door marketing, high incentive levels, mandatory pre- and post-inspections, and outreach by city and local organizations. There were 179 applications for the subject program as of March 2004.

San Diego Gas & Electric Company's 2002 EZ Turnkey Program (SDG&E EZ Turnkey) provided energy savings opportunities to economically disadvantaged, <20kW, hard-to-reach customers through energy assessments and installation of free energy-saving measures,

primarily lighting. Customers who received on-site audits through SDG&E's Small Business Energy Assessment (SBEA) program were eligible to receive SDG&E EZ Turnkey program benefits. Audited customers received a list of free program-eligible measures that were installed at no cost to them. The audit program costs are included in the program cost and costs per unit impact comparisons provided in Exhibit NR1-13 below.

The 2003 Small Commercial Prescriptive Lighting Initiative run by Sacramento Municipal Utility District (SMUD Sm Comm Prescriptive) targeted hard-to-reach customers in the commercial sector with peak demand less than 150 kW. This contractor-driven program required minimal customer effort, as lighting contractors performed all marketing and implementation, and received incentives that covered up to the full cost of the efficient lighting equipment installed. In 2003, nearly 1500 projects were completed under SMUD Sm Comm Prescriptive, the highest participation volume of any SMUD energy efficiency program.

Connecticut Light and Power's 2003 Small Business Energy Advantage Program (CL&P SBEA) provided direct turnkey services, incentives, and education for cost-effective lighting, refrigeration and HVAC measures installed by <100 kW annual demand commercial and industrial customers in the CL&P service territory. CL&P SBEA offered a zero-percent financing option for program measure costs to credit-worthy customers and designed the loan repayment term to maintain positive cash flow for the customer. An estimated 605 customers participated in CL&P SBEA in 2003. Lighting measures accounted for the majority of CL&P SBEA energy savings.

The 2002 California Statewide Express Efficiency Program (CA SW Express) was operated by four California investor-owned utilities (IOUs): Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), Southern California Gas Company (SCG), and San Diego Gas & Electric Company (SDG&E). CA SW Express offered rebates of up to $25,000 for < 500 kW non-residential customers (commercial, industrial and agricultural) for any combination of eligible energy-efficient equipment replacement. Eligible measure areas included lighting, HVAC, refrigeration, motors & other technologies, food service, and gas technology. 9,621 projects were completed through CA SW Express, with CFLs accounting for more energy savings than any other measure.

Exhibit NR1-1
Summary of NR1 Program Characteristics

	Xcel Lighting		KEMA-XENERGY BEST	SDG&E EZ Turnkey	SMUD Sm Comm Prescriptive	CL&P SBEA	2002 CA SW Express
	C/I	Small Business					
Period Reviewed	2003	2003	2002-2003	2002	2003	2003	2002
Cost							
Average retail price of electricity	$0.05	$0.05	$0.16	$0.16	$0.10	$0.08	$0.16
Program budget	$2,289,229	$1,087,314	$941,000	$1,317,000	$2,729,000	$4,570,000	$21,656,000
Total Incentives Paid	$1,513,000	$658,665	$598,000	$685,000	$2,347,000	$3,806,000	$12,856,000
Participation							
Eligible Participants	All C/I business customer	<500kW customers	Small businesses (<100kW) in economically depressed areas	Very small (<20kW) customers	Hard-to-reach small commercial customers (peak demand less than 150 kW)	All C/I customers (excluding government) with average yearly peak demand up to 100 KW	Small and medium customers (<500 kW)
Eligible Measures	Lighting	Lighting	Lighting, HVAC, Custom and Gas	Lighting	Lighting	Lighting, Refrigeration, HVAC	Lighting, HVAC, Refrigeration, Motors & Other Technologies, Food Service, and Gas Technology
Number of contracts/sites	343	535	179	687 audits 643 installations	1478	605	9621
Energy Savings Accomplishments							
kWh achieved (net)	41,780,188	19,433,451	2,704,000	3,121,000	19,865,000	16,167,000	244,346,000
kW achieved (summer)	7,896	3,928	559	570	3,920	3,570	43,000

Data Sources:

Xcel Lighting: Cost and savings based on achievements reported in the 2003 MN Conservation Improvement Program Status Report, Xcel Energy.
KEMA-XENERGY BEST: 2003-2003 Planning data for portion of program implemented under Oakland Energy Partnership.
SDG&E EZ Turnkey: 2002 Planning data (includes Small Business Energy Assessment costs)
SMUD Sm Comm Prescriptive: Participants reflect total number of projects completed. Data from Small Commercial Prescriptive Lighting Program. Summary Savings and Costs Report - All Projects from 1/1/2003 to 12/31/2003, SMUD.
CL&P SBEA: Participants estimated for 2002 from ACEEE, 2002. Cost and savings projected from 2003 CL&P proposed C&LM budget.
CA SW Express: Cost and savings integrated statewide from the 4th Quarterly Report.

2. CONTEXT

2.1 POLICY ENVIRONMENT

Utilities and other program administrators and energy efficiency policy makers have utilized a variety of different approaches to achieve cost-effective energy savings in the non-residential lighting end-user market over the past twenty-five years. Approaches enjoyed different, and for some, repeated periods of favor as market conditions and policy objectives changed. A thumbnail summary of this history in California is provided in the bullets below:

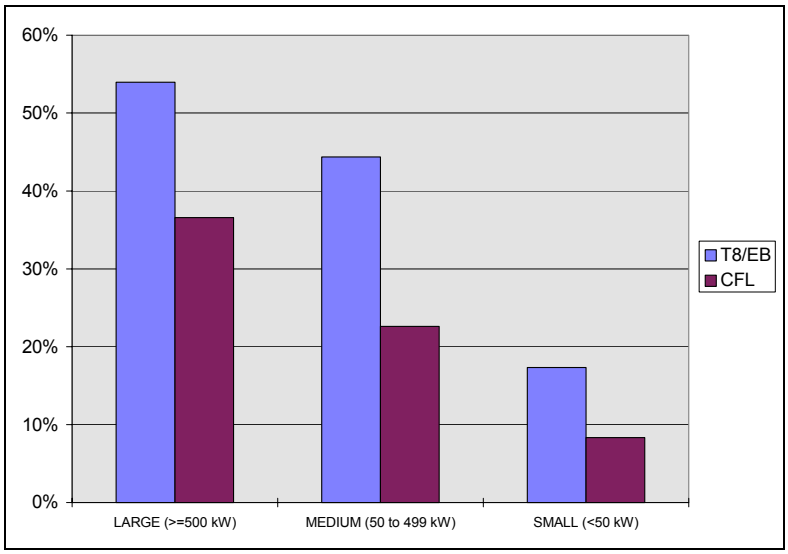
- **1980s:** Early conservation programs focused on providing energy audits and other information designed to encourage non-residential customers to turn off lights when not in use, switch from standard lamps and ballasts to energy-saver lamps (e.g., 34-watt, T-12s) and ballasts (energy-efficient magnetic). The use of rebates for energy-efficient equipment increased in the latter half of the 1980s.

- **Early- to mid-1990s**: Early in the 90s, there was a shift from a "conservation" to a "resource planning" paradigm to justify and evaluate programs as part of integrated resource planning. Investor-owned utilities in California operated under direct financial incentives to achieve and measure program savings. Overall funding for energy efficiency initiatives increased significantly during this period. Audit and information programs continued to run much as they had in the prior decade, while incentive programs offered increasingly large financial rewards and were more aggressively marketed. These California programs, along with similar efforts in a few other parts of the country, led to a marked increase in the market penetration of T-8 lamps and electronic ballasts. These programs were particularly effective in transforming the lighting market in the medium and larger customer segments (Rosenberg and Rufo 2000; Xenergy 1998). Direct installation programs were implemented during this time to achieve high penetration rates in hard-to-reach segments, particularly the small commercial sector, and in geographic areas with transmission and distribution constraints (Warner 1994).

- **Late-1990s**: Recognizing their long-term value, California maintained efficiency programs and funding during the energy industry restructuring of the late 1990s, at a time when other states completely eliminated them. Nonetheless, programs during this time faced several challenges. Funding levels were lower than during the earlier part of the decade, policy objectives shifted from resource acquisition to market transformation, and the nexus of program oversight shifted temporarily to the California Board for Energy Efficiency (CBEE). Research conducted at this time highlighted the fact that although programs had been effective in reaching medium and larger customers, they continued to have much less affect among smaller non-residential customers. In particular, it was found that the shift towards a program portfolio focused more on information and training and less on incentives was resulting in very little program participation and market penetration among small commercial customers (Lee et al. 1999; Quantum Consulting and XENERGY 2002; XENERGY and Quantum Consulting 1999). A graph (reproduced as NR1-2) developed from the 1999 PG&E Commercial

Energy Survey illustrates this inequitable penetration rate across non-residential customer segments.

Exhibit NR1-2
Saturation of T8 Lamps/Electronic Ballasts By Customer Size, PG&E Territory (1997)



- **2000 to 2003**: In 2000, energy efficiency in California began a quick and dramatic shift back toward a stronger focus on resource acquisition in response to the state's restructuring-related energy crisis. CPUC and state goals called for programs to be designed to achieve immediate, cost-effective energy and peak demand savings. Also during this period, several emergency energy bills were passed that provided one-time funding for a set of conservation, energy efficiency, and demand response programs. Most of these efforts were contracted and managed through the California Energy Commission (CEC). Another important event during this period was the CPUC's decision to fund approximately $100 million of efficiency programs for the two-year period 2002-2003 from new locally-oriented programs (approximately two-thirds of which were not administered by utilities). The CPUC selected many of these programs with the expectation that they would provide marketing services or impacts in customer segments or geographic areas that had not participated extensively in the IOUs' statewide programs or had newly identified, untapped energy savings potential. Of particular relevance to the NR1 Study is the CPUC's decision to select a number of direct installation lighting programs aimed at reaching small commercial customers.[1]

The policy and funding history described above for California is somewhat indicative of the patterns that played out in other regions of the country, though often not as dramatically and

[1] Two of the NR1 programs, SDG&E EZ Turnkey and KEMA-XENERGY BEST, were funded through the CPUC's 2002-2003 local programs initiative, as adopted in CPUC Decisions 02-03-056 and 02-05-046. Several other programs with small commercial elements were also funded under that effort, including programs by ASW, Ecology Action of Santa Cruz, and Energy Coalition. Those programs were not reviewed for this report.

without the direct experience of the energy crisis of the most recent years. Other contextual factors related to NR1 Programs include the following:

- Though not directly affected by the energy crisis, state funding was granted to a SMUD Sm Comm Prescriptive predecessor program due to its high-incentive, direct installation orientation.

- Xcel Lighting predecessor programs operated under arguably the most stable regulatory and market environment of all of the predecessors to NR1 Programs. They were implemented under a consistent regulatory incentive structure for some time that rewarded Xcel Energy (as implementer) for achieving cost-effective energy savings. In addition, few major changes in policy or market conditions occurred in the late 1990s associated with the market transformation movement or electric industry restructuring. As a result, Xcel Energy's non-residential lighting programs have remained remarkably consistent for many years. However, in 2000, a program run by a non-profit received state approval to serve commercial customers with 10 to 200 kW of peak load with a turnkey lighting program. This turnkey program offers the hard-to-reach small business customers a free lighting audit, higher incentives, lower financing and a list of qualified lighting contractors.

- 2002 and 2003 were challenging years for CL&P's efficiency programs, as all of Connecticut's public goods funded energy efficiency programs faced a massive funding reduction due to the state's overall budget shortfall. There are several other contextual issues related to CL&P's programs. The three most significant follow. Connecticut's two IOUs, CL&P and United Illuminating, administer public goods funded efficiency programs on a consistent statewide basis. The programs are managed by the Energy Conservation Management Board, which includes utilities, regulatory staff, and other stakeholders and reports to the Public Service Commission. The state faces peak demand resource constraints, particularly for a transmission-constrained area in the southwest of the state.

A few important contextual conclusions relevant to the NR1 Programs can be drawn from the summary and secondary sources cited above and include:

- Traditional prescriptive rebate programs successfully used moderately high incentives and mass market approaches to achieve significant, and probably self-sustaining, market penetration of first generation T-8 lamps and electronic ballasts in large and medium commercial customer segments in the 1990s.

- These types of programs did not achieve significant market penetration among smaller commercial customers or in the industrial sector (Aspen 2004).

- Turnkey, direct installation programs targeted at smaller customers were experimented with in the early to mid-1990s but were largely abandoned due to their higher cost

(particularly as viewed from a Utility Cost Test perspective)[2] as compared with the significantly lower costs of lighting savings easily attained from large customers through prescriptive and custom rebate programs.

- Turnkey, direct installation programs have experienced a resurgence, particularly in California, in response to two policy objectives: responding to the energy crisis with aggressive programs that achieve immediate, cost-effective savings; and ensuring that smaller customers receive program benefits commensurate with their contribution to the public goods funds.

2.2 PROGRAM STRATEGY AND GOALS

The NR1 Programs focused primarily on resource acquisition and equity across customer segments using both prescriptive and turnkey, direct installation approaches as illustrated in Exhibit NR1-3. (Note that while the NR1 Programs were oriented toward resource acquisition and replacement of lighting system components, there are a number of program efforts throughout the country that complement or replace the traditional focus of promoting equipment with the goal of transforming lighting design practices.[3])

As discussed above, ensuring that public goods funds are distributed equitably among different customer classes has affected the design of a number of non-residential programs in recent years. The majority of these programs focus on small customers or those in economically distressed areas. For example, SMUD Sm Comm Prescriptive limited participation to customers with account loads of 50 kW and below. Connecticut regulators' concern with equity caused CL&P SBEA's focus on generating electrical savings through turnkey services to small business customers with demand below 100 kW. Local energy efficiency programs in the California cities of Oakland and San Diego target customers with demand under 100kW and 20kW customers, respectively. By contrast, Xcel Lighting and CA SW Express were open to all commercial and industrial customers.

[2] As discussed later in this report, the Utility Cost Test includes only program costs, whereas the Total Resource Cost (TRC) test includes both program costs and participant costs. Direct installation programs are not necessarily more expensive than prescriptive rebate programs from a TRC perspective. However, because they typically have much higher incentive levels, they are usually much less cost-effective from a Utility Cost Test perspective.

[3] Examples include efforts by the Energy Center of Wisconsin, the Design Lights Consortium, BetterBricks in the Pacific Northwest, and lighting design resources provided through the Savings by Design Program and energy centers in California. See also Mosenthal, Richards and Lacey 2002.

Exhibit NR1-3
NR1 Program Goals and Approaches

Program	Type of Measure	Customer Size	Program Goals	Program Approach
Xcel Lighting C&I	Lighting	all	Resource Acquisition	Prescriptive and Custom
Small Business	Lighting	<500kW	Resource Acquisition	Prescriptive and Custom
KEMA-XENERGY BEST	Mostly Lighting	<100kW	Resource Acquisition; Equity	Turnkey
SDG&E EZ Turnkey	Lighting	<20kW	Resource Acquisition; Equity	Turnkey
SMUD Sm Comm Prescriptive	Lighting	<150kW	Resource Acquisition	Turnkey
CL&P SBEA	Mostly Lighting	<100kW	Resource Acquisition; Equity	Prescriptive
2002 CA SW Express	Mostly Lighting	<500kW	Resource Acquisition; Equity	Prescriptive

3. COMPARISON OF PROGRAM COMPONENTS

This section compares the NR1 Programs across the four major program components used to organize data collection and analysis. These program components are Program Design (including program theory), Program Management (including project management, reporting and tracking, and quality control and verification), Program Implementation (including participation process and marketing and outreach) and Program Evaluation.

3.1 PROGRAM THEORY AND DESIGN

For the most part, the NR1 Programs did not have formally developed program theories as part of their design or evaluation processes. Program theories were common for a brief period in California during the period in the late 1990s in which market transformation was the primary programmatic emphasis (XENERGY and Quantum 1998; Rufo and Landry 1999; Goldstone et al. 2000). However, even during this period, these theories were usually developed by the program evaluators rather than by program designers and implementers directly.

Nonetheless, each of the program managers interviewed for the NR1 Study was able to articulate a program design logic that was based on hypotheses about the barriers to implementing measures in their target markets. In particular, all of the California NR1 Programs followed the CPUC's proposal requirements for 2002-2003 programs which include specification of market barriers, discussion of hard-to-reach goals and objectives, and explanation of how the proposed program approaches will achieve the overall program goals.

The NR1 Programs can be categorized according to two fairly distinct program models: turnkey or direct installation, and prescriptive rebate.

Turnkey programs, some of which are also referred to as Direct Installation programs, are designed to have all program aspects, from the initial marketing and ensuing audit process through the final equipment installation, conducted by a third party, typically a lighting contractor. Program participants are not responsible for the application process, hiring contractors or developing project specifications. Turnkey programs often cover 75 percent or more of the cost of an energy efficiency retrofit under the rationale that high incentives are necessary to induce participation by small customers and that a high participation rate is required to justify the site-specific marketing involved in the program model.

NR1 Programs include two sub-types of turnkey programs, those that use only one or two contractors working for the program implementation organization to complete all customer-related tasks, and those that use multiple contractors. In both cases, participating contractors typically agree to perform program-related services for a specified fee and adhere to a standardized measure cost price list. (In some cases, contractors are simply encouraged to use the standardized prices through faster application processing. Exceptions to the standardized prices are allowed but must go through an individual approval process.) SDG&E EZ Turnkey is an example of a program that used one or two contractors for all site-related services - one firm conducts the marketing and audit and another performs the installation. SMUD Sm Comm

Prescriptive and KEMA-XENERGY BEST used pools of pre-qualified contractors to conduct program marketing and all of the site work, including the audit.

Traditional **prescriptive rebate** programs require that participants and their contractors complete application requirements, and usually, though not necessarily, pay lower incentives than direct installation programs. Customers are responsible for hiring contractors (which are not typically pre-approved by the program implementer) and developing project specifications. A broad customer class is typically eligible for prescriptive programs (e.g., small, medium and large customers). The program implementer is responsible for program marketing, which typically occurs through direct mail and mass media.

These programs offer greater flexibility in contractor selection as customers may hire any contractor to install program-qualifying measures. Xcel Lighting and CA SW Express are examples of traditional prescriptive rebate programs. Their predecessors, also prescriptive rebate programs, have been shown to have had significant effects in penetrating medium and large commercial markets throughout the 1990s. (KEMA-XENERGY 2003)

Program objectives and constraints, which are shaped by policy goals, largely predict whether a program administrator adopts a turnkey or prescriptive rebate approach. Traditional rebate programs are well-suited to maximize savings per program dollar when incentive levels are sufficient to induce enough market demand to expend program funds. They are often able to offer lower rebate levels because their target markets are large and can be reached through mass market methods.

Prescriptive rebate programs do not need a high penetration rate to be cost-effective because they are marketed to thousands of utility customers. Furthermore, large lighting rebates may not be as necessary for larger customers, who recognize and more easily realize the favorable economics of lighting retrofits. In addition, traditional rebate programs, which leverage a large number of vendors, may be better suited to serve a large utility territory. By contrast, turnkey programs, which tend to serve tight target markets by relying on a small number of vendors, may have difficulty covering a large service area.

Turnkey programs are typically delivered to small customers and are therefore usually adopted in a policy environment that emphasizes equity and aims to ensure public goods funds reach this customer class. Industry literature suggests that numerous factors make the small commercial market difficult to penetrate. It is widely recognized that barriers to participation are highest for the smallest customers (<20kW). Time constraints, first cost/lack of capital, lack of information, high cost of financing, split incentives, skepticism about contractors, and language barriers all prohibit the small customer from using energy efficiency products and practices (Lee et al. 1999; Wellinghoff et al. 2000). Barriers to serving this customer segment also exist on the supply side, as vendors may avoid the small business market due to higher transaction costs and lower profit margins.

The resulting program design implications are clear. First, high incentives are required to move the small commercial market to action. Second, customers that lack time and/or expertise are more likely to respond to a program that provides start to finish services, including project analysis, vendor bid coordination, equipment selection, contract negotiations, construction management and project supervision. The turnkey approach meets these needs, offering handholding and high incentives that sweeten the economics of investment. Such an approach

involves little time commitment and does not demand expertise that the small business owner may not have. The success of SDG&E EZ Turnkey and KEMA-XENERGY BEST reaffirms previous research showing that participation and adoption rates increase non-linearly as financial incentives increase, and that direct installation programs are well suited to achieving high program penetration rates in the small commercial market (Warner 1994; Mosenthal and Wickenden 1999).

Prescriptive programs are usually more cost-effective at reaching mass markets and medium and large customer segments, particularly from a Utility/Program Administrator Cost test perspective. These programs may also set a wider range of incentive levels than turnkey programs which incur high per prospect marketing costs. In addition, prescriptive programs have shown more flexibility in adjusting incentive levels over time in response to changes in market demand.

Best Practices

Program Theory and Design
• Articulate a program theory that clearly states the target for the program, program timing and the strategic approach whether resource acquisition, market transformation or equity. • Link strategic approach to policy objectives and constraints.

- **Articulate a program theory that clearly states the target for the program, program timing and the strategic approach whether resource acquisition, market transformation, or equity**. Even a relatively simple statement of program logic can reveal gaps in program focus or effort and assure that everyone involved knows what the program seeks to accomplish and why.

- **Link strategic approach to policy objectives and constraints**. Program strategic approach and target should be linked to policy objectives and constraints to help ensure the strategic and tactical approaches will lead to the desired results. For example, a direct installation program may be desirable when the primary goal is to maximize penetration in a hard-to-reach segment under a Total Resource Cost test. By contrast, a prescriptive rebate approach with lower incentive levels is often superior at maximizing savings per program dollar (as viewed by the Utility/Program Administrator Cost Test) in segments where sufficient market demand exists. The pivot point between these two approaches may be swayed by several factors, including, market saturation, program costs, participation rates, and levels of free-ridership.

3.2 PROGRAM MANAGEMENT: PROJECT MANAGEMENT

Exhibit NR1-4 summarizes the program management structure and tactics of the NR1 Programs. The exhibit illustrates responsibility assignment for key program activities, from administration to inspection, and underscores the different roles of contractors in turnkey versus traditional prescriptive rebate programs.

It is interesting to note that only one of the NR1 Programs conducts pre-inspections, a quality control practice examined later in this chapter. For some programs, the application process occurs after the measure is installed, so pre-inspection is not possible. Other programs may not realize the value of pre-inspection if audits are conducted in-house or by a turnkey contractor.

The NR1 Programs that used a turnkey approach were designed to leverage contractors to manage workflow and track projects. Some of these programs pioneered innovative ways to use information technology to electronically link program administrators and the lighting contractors that implement projects at customer facilities. These are discussed in more detail in the next section on project management.

In the prescriptive rebate programs run by Xcel Energy and the California IOUs, in-house program staff approved projects, tracked projects, processed applications, and verified installations.

In direct installation programs, a single or small pool of approved contractors is charged with facility assessments, equipment installation and completing paperwork for the customer. The program management role of the program implementer is to review vendor proposals, and perform post-installation verification and/or quality control. Turnkey programs usually require fewer management resources than traditional rebate programs, a plus for utilities with small staffs. Utility coordination with turnkey contractors is a key management issue in direct installation programs.

As described above, effective coordination between program implementers and contractors is critical to program success. Such coordination is facilitated both by strong relationships and project management systems.

Program staff unanimously emphasized that contractor relationships are critical to non-residential lighting programs. In both turnkey and traditional rebate programs, contractors are usually far more involved than customers in the program process. In many turnkey programs, the customer plays the critical role of approving a lighting project but the contractor provides all aspects of the lighting installation. Traditionally, contractors fill out a rebate application and mail the paperwork to the program implementation organization, where a program manager reviews the application and enters the information into a program database.

Exhibit NR1-4
Program Management Roles and Tactics

Program	Administration and Reporting	Audit	Pre-Inspection	Post-Inspection	Project Tracking	Tactics
2002 CA SW Express	In-house	Any vendor conducted audit	No	In-house	In-house	• In-house program staff approved projects, tracked projects, processed applications, verified installations
KEMA-XENERGY BEST	In-house	Participating vendor conducted audit	Yes (XENERGY)	In-house	In-house / vendor	• Contractors agreed to standardized pricing on program measures for quick approval (or go through lengthier review process) • Contractors did on-site assessments • XENERGY managed projects and contractors electronically through a Web-based software tool • XENERGY trained contractors to use the software to generate proposals and track project status • XENERGY followed up a contractor audit with pre-inspection
SDG&E EZ Turnkey	In-house	Audit contractor conducted audit	No	In-house	In-house/ vendor	• Turnkey contractors were charged with on-site assessments • Contractors agreed to standardized pricing on program measures • Daily electronic upload/download of audit data and quick dispatch of installation contractor • SDG&E monitored and verified implementation
CL&P SBEA	In-house	Participating vendor conducted audit	No	In-house	In-house / vendor	• Turnkey contractors were charged with facility assessments and completing paperwork for the customer. • CL&P performed post-installation quality control
Xcel Lighting	In-house	Any vendor conducted audit	No	In-house	In-house	• Xcel Energy staff processed rebate checks • Either the vendor, customer, or an Xcel Energy sales representative was responsible for submitting customer-approved paperwork
SMUD Sm Comm Prescriptive	In-house	Participating vendor conducted audit	No	In-house	In-house / vendor	• A SMUD Program Manager approved project proposals and entered tracking data

A few of the NR1 Programs pioneered innovative ways to use information technology to manage projects by electronically linking program administrators and the lighting contractors that implement projects at customer facilities. Users of these workflow and project management systems considered them critical to program success.

Prescriptive programs offer great potential for automated project management due to their standardized incentives and discrete measure lists. Automated implementation processes can improve the efficiency of the participation process by reducing turn-around time and shifting the data entry burden to contractors. Program implementers are now developing innovative electronic pathways for managing projects with contractor involvement.

Four of the six NR1 Programs deployed database resources to manage contractor-driven projects. Database technology was used to manage projects along two pathways. In the first path, contractors submitted electronic proposals to the program implementation organization in an upload/download process. The second path went a step further, giving contractors remote access to a program database via the Internet.

In the **electronic upload/download** approach, contractors submitted job proposals or facility assessments electronically to the program implementer. The program manager imported the file to the program database for review and turned around comments and decisions within a day or two. For example, at SMUD, all electronic worksheets were kept on a server by project status. As contractors completed jobs, they sent updated worksheets electronically to SMUD. The program manager interviewed noted that this electronic process was critically important to keeping up with the heavy processing load associated with the SMUD Sm Comm Prescriptive predecessor program in 2002, which was their highest volume program. CL&P used a similar process to manage CL&P SBEA project work.

Two NR1 Program administrators gave contractors **remote, Web-based access** to program databases.

A Web-based customized database that enabled real-time, simultaneous access by implementation contractors and the utility was developed for SDG&E EZ Turnkey. Contractors entered audit assessments, scheduled installations and installation data. The program manager monitored contractor activity, approved projects and generated quick reports. The system also generated contractor invoices.

KEMA-XENERGY developed an Internet-based software tool for proposal generation and project tracking. Contractors, once trained in its use, overwhelmingly supported the KEMA-XENERGY BEST tool. The contractors audited a facility then went online to enter inventory data into the Internet-based database. The software produced a proposal, generating a list of measures appropriate to pre-existing conditions and the financial payback associated with those measures. The database also enabled contractors to check the status of their projects online by logging onto the database for real-time updates on pre-inspection and project approval. Pre-inspection approval automatically generated an e-mail to contractors, enabling them to download and sign work orders and send them to the program manager.

These types of electronic program and workflow management tools serve several uses including managing contractor projects, streamlining participation for contractors, improving utility turn-around time and tracking project status. As a result, program managers obtained

real-time tracking data and achieved reduced administration costs associated with handling detailed day-to-day program transactions.

Best Practices

Program Management: Project Management
• Develop and maintain strong relationships with lighting vendors/contractors. • Use electronic project management tools.

- **Develop and maintain strong relationships with lighting vendors/contractors.** Vendors are the critical program delivery mechanism for non-residential lighting programs. Strong vendor relationships are especially critical for traditional rebate programs that do not directly subcontract with vendors but do rely on them to market the program. Program implementers can strengthen vendor relationships through a variety of communication methods such as providing updated program information and literature through direct mailings, e-mailing or call with notification of upcoming promotions, seminars, trade shows, and newsletters, and conducting events like vendor breakfasts and face-to-face meetings.

- **Use electronic project management tools.** Electronic project submission by contractors offers two advantages. It conserves program staff resources by putting the data entry burden on contractors, and it improves project turn-around time. Electronic submission processes are especially useful for high-volume programs.

3.3 PROGRAM MANAGEMENT: REPORTING AND TRACKING

All of the NR1 Programs had some process for reporting and tracking the progress and/or impact of program activities. All implementers tracked energy savings and project-level information, but often took different approaches to database management. A variety of project-specific indicators were used for internal project management and regulatory reporting. Tracking activities typically involved fairly detailed monitoring activities, especially progress toward goals and project status. As noted previously, program staff acknowledged the importance of computer databases to automate tasks, reduce data entry demands, generate reports easily and ensure quality control of data inputting.

Key tracking indicators for this program area and their uses are shown in Exhibit NR1-5. Energy savings and incentives were reported to be the most critical indicators tracked, however, a number of implementers found value in tracking other indicators as well, in particular, number of sites and measures implemented.

Exhibit NR1-5
Key Tracking Indicators

Program	Key Tracking Indicators	Purpose
Xcel Lighting	• Energy Savings (kW, kWh) • Incentive Dollars • Number of Sites • Project Status	• Assessment of program performance • Project management • Verification • Regulatory reporting • Internal program management
KEMA-XENERGY BEST	• Energy Savings (kW, kWh) • Number of Sites • Measure Type • Energy Associated with Measure • Pre-wattages • Incentive Dollars • Total Project Cost	• Assessment of program performance • Project management • Workflow management • Verification
SDG&E EZ Turnkey	• Energy Savings (kW, kWh) • Incentive Dollars	• Assessment of program performance • Project management • Workflow management • Verification
SMUD Sm Comm Prescriptive	• Energy Savings (kW, kWh) • Project Cost • Incentive Amounts • Pre-wattages • Project Description • Project Status	• Assessment of program performance • Project management • Workflow management • Regulatory performing • Verification
CL&P SBEA	• Energy Savings (annual & lifetime kWh) • Cost-effectiveness ($ per kWh obtained) • Incentive Dollars • Project Milestones	• Assessment of program performance • Internal program management • Workflow management • Regulatory reporting • Verification
2002 CA SW Express	• Energy Savings (kW, kWh) • Project Milestones • Incentive Dollars • Project Milestones • Measure Type • Hard-to-Reach Information	• Assessment of program performance • Internal program management • Verification • Regulatory reporting

Utilities must balance the need to capture important program information with ease of participation. Reporting large amounts of information places more demand upon contractors and application processing, but clearly certain data must be tracked for effective program management and accurate program assessment. The array of information recorded supports a number of purposes including regulatory reporting, internal performance monitoring and project status tracking. It is necessary to know and clearly articulate data needs as programs are designed.

Pre-existing wattage information is critical to accurate savings estimates, but was only tracked by some NR1 Programs. Savings vary significantly for linear fluorescent retrofits as a function

of whether existing lamps are 34 or 40 watt and whether ballasts are energy-efficient magnetic or standard magnetic. The Xcel Lighting rebate application form called for detailed information about existing lighting being replaced. KEMA-XENERGY required pre-installation wattage reporting and verification of it through pre-inspection for participation in its program.

Xcel Energy had a performance incentive to exceed program goals, and upper management used the system to track weekly performance against goals.

Workflow management was a novel application of tracking systems for NR1 Programs. As discussed in the previous section on project management, four program administrators pioneered innovative ways to use information technology to electronically link program administrators and the lighting contractors who implemented projects at customer facilities. Users of these workflow and project management systems considered them critical to program success.

SDG&E's Track-It database, which records savings (kW, kWh), and incentive dollars spent, two critical metrics to the utility, is an example of such a system. For SDG&E EZ Turnkey, vendors used this database to input audit and installation data which was uploaded each night into SDG&E's main database, the Energy Efficiency Tracking system. The SDG&E EZ Turnkey program manager could view contractor activity including audits, counts and installations and generate quick reports (number audited, number installed).

A few program implementers noted the limitations of their current systems and an interest in expanding the functionality of their tracking systems.

Xcel Energy's two systems meet minimum program needs (e.g., performance assessment, and reporting), but neither supports marketing activities. Xcel Energy relies on a company billing system and a Siebel database that collects data from customer invoices. The company plans to launch a modified Siebel system in 2005 to track vendors and the type of equipment being installed.

CL&P SBEA inherited a tracking system used by an identical SBEA program run by United Illuminating. The database tracked energy savings, incentive dollars, and project milestones. However, measure-level information was not directly available. CL&P seeks to work this information into the process in the future.

SMUD Sm Comm Prescriptive used a stand-alone database for tracking. The program manager found that the database, and electronic application submission, was critically important to processing the high volume of program projects (1,657 in 2003) with minimal staffing. However, the dedicated program database did not integrate with other SMUD programs, which complicated reporting efforts. SMUD is moving to an integrated database in 2004 to facilitate the reporting process.

CA SW Express used a real-time relational database to track application information, but contractors did not have the ability to submit applications electronically. This was not a statewide database; instead, each IOU maintained its own database. The system was used to measure progress against goals and report accomplishments to the CPUC. CA SW Express also had a reservation system by which customers or vendors called a toll-free number to reserve

program funds. Program staff used this reservation system to determine how quickly funds were being committed.

Best Practices

Program Management: Reporting and Tracking
• Collect pre-existing wattage information. • Use electronic application processes. • Use incentive commitment tracking. • Allow program managers to generate standardized reports. • Use databases that fully integrate with cross-program energy-efficiency program information systems. • Use detailed process flow diagrams. • Track vendor activity.

- **Collect pre-existing wattage information.** This has proven key to accurate savings and program impact estimates. It may be easier to collect this information through an existing audit process or electronic submission. However, if the incremental effort involved in collecting pre-existing information is too great, considerable value can be obtained by collecting this information on a random sample. This could be done either through the program or through a real-time independent evaluation.

- **Use electronic application processes.** Such processes can accelerate project turn-around and reduce administrative costs.

- **Use incentive commitment tracking.** This is useful for programs that enable customers to reserve funds, especially for larger customers or customized measures with longer project cycles. Reservations guarantee funds to customers and help the program administrator anticipate expenditures. Incentive commitment tracking can be part of project status reporting.

- **Allow program managers to generate standardized reports** so that program staff is not forced to rely on programmers, database specialists or IT staff to extract information on a timely basis.

- **Use databases that fully integrate with other energy efficiency program information systems** to facilitate management review.

- **Use detailed process flow diagrams** to help facilitate application processing for high-volume programs.

- **Track vendor activity.** Market activity highlights active vendors and high-volume measures.

3.4 PROGRAM MANAGEMENT: QUALITY CONTROL AND VERIFICATION

The NR1 Programs used fairly similar measurement and verification (M&V) protocols, typically requiring invoices and on-site inspections, as illustrated in Exhibit NR1-6.

Exhibit NR1-6
NR1 Program M&V Requirements

Utility	M&V Requirements
Xcel Lighting	• Invoices • Random on-site inspections for 10% of projects
KEMA-XENERGY BEST	• 100% pre-inspection • 100% post-inspection
SDG&E EZ Turnkey	• Random on-site inspections for 20% of projects • Telephone monitoring for customer service issues • Audit contractor spot checks
SMUD Sm Comm Prescriptive	• Random on-site inspections for 10% of projects
CL&P SBEA	• 100% post-inspection in 2002 • Spot inspections in 2003
2002 CA SW Express	• On-site inspections vary by IOU (20-100% of applications) – PG&E: random on-site inspections for 20% of applications; 100% on-site inspections for large applications; 100% on-site inspections for underperforming vendors – SCE: random on-site inspections for 20% of applications – SCG: 100% on-site inspections – SDG&E: 100% on-site inspections • Invoices • Telephone verification (part of evaluation study)

KEMA-XENERGY BEST had the most thorough inspection regime, inspecting all sites before and after installation. For CL&P SBEA, CL&P conducted an on-site census in 2002, but moved to spot inspections in 2003 as a result of staff reductions. Program staff does not yet know the effect of this verification regime, but expects that its quality control practices – particularly contractor pool restrictions that weed out under-performing contractors out of the program – will offset any verification deficits.

In 2002, for their predecessor programs to the NR1 Programs, SMUD and the California IOUs conducted random on-site inspections for 10 percent and 20 percent of projects respectively. The California IOUs and SMUD all conducted 100 percent inspections of contractors for which there was evidence that products (usually CFLs) were shipped to customers but not installed. Finding the right balance between ensuring cost-effectiveness and encouraging proper installation is extremely important, particularly for programs with a high volume of CFLs.

Several NR1 Study interviewees provided evidence of the need for a fairly rigorous inspection process. For example, concerns were raised about vendors leaving products with customers

without installing them. This was a particular concern for high-volume, screw-in CFL measures. Interviewees further noted that on-site verification, set at an appropriate level, helped to identify these types of vendor problems, particularly with vendors that were leaving measures at a site without ensuring installation. SDG&E's CA SW Express program manager found that random inspections of 20 percent of projects was not a sufficient deterrent for all customers, and increased verification to 100 percent. If jobs were not found to be in compliance, contractors were required to reinstall and then pay the utility to verify. Similarly, SMUD learned of a contractor shipping CFLs to customers and not installing them. SMUD then required 100 percent inspections for that contractor, which corrected the problem.

Product specifications are an important and popular way of helping ensure high-quality products are installed in customer facilities. SDG&E clearly defined product specifications (such as lumens per watt, preferred manufacturers) and coordinated with its installation contractor to ensure that high-quality products were installed through SDG&E EZ Turnkey. Xcel Energy used equipment-specific requirements to block poor products from installations, increasing satisfaction with measures and bill savings. KEMA-XENERGY BEST also set equipment specifications and experienced very few customer complaints. SMUD used light level requirements to ensure the quality of delamping projects, which accounted for more load reduction than any other measure in SMUD Sm Comm Prescriptive. Contractors sent SMUD a sketch with pre-existing light level readings and post-installation lumen reading. Project approval depended upon pre- and post-installation levels, to ensure that retrofits were appropriate.

Pre-inspection, which was used by KEMA-XENERGY, is an excellent quality control mechanism, though it comes with an added cost. After a contractor audited a facility and the customer signed a proposal, KEMA-XENERGY pre-inspected 100 percent of sites to make sure that pre-existing equipment matched the contractor audit (e.g., count fixtures, check equipment types). KEMA-XENERGY approved the project if pre-existing conditions were confirmed.

KEMA-XENERGY's Web-based project software also has a quality control dimension. KEMA-XENERGY trained vendors on the software tool, to teach them about measures appropriate to pre-existing conditions, how payback periods vary from measure to measure, and what makes the most financial sense, taking incremental costs into account. This training helped vendors identify suitable measures and make appropriate recommendations informed by customer payback. Furthermore, when vendors used the software tool's standardized tracking system, they selected measures from a fixed list, helping to minimize errors in inventory data entry and the possibility of over-ordering measures.

Best Practices

Program Management: Quality Control and Verification
• Base quality control practices on a program's relationship with vendors, the number of vendors, the types of measures, the project volume, and the variability in the size of projects. • Define product specifications in program requirements and guidelines. • Obtain a good random sample of vendor and measure types. • Always inspect the first job submitted by a new vendor. • Conduct on-site post-installation inspections. • Conduct an independent audit or pre-installation inspections. • Govern post-inspection levels by cost-effectiveness considerations and results from an initial set of inspections early in the implementation process. • For delamping projects, use light level requirements and pre- and post-light level readings to ensure quality. • Implement a contractor screening/certification/training process.

- **Base quality control practices on a program's relationship with vendors, the number of vendors, the types of measures, the project volume, and the variability in the size of projects**. A **prescriptive rebate program** with no control over vendors may need to require more quality control-oriented inspection than a turnkey program. A **turnkey program** that trains a small pool of vendors and uses a pre-screened list of products may require less ex-post product quality review.
- **Define product specifications in program requirements and guidelines.** Product specifications help ensure installation of high-quality products and enhance participant satisfaction.
- **Obtain a good random sample of vendor and measure types.** A stratified random sample ensures that different job types, measure and vendors are inspected.
- **Always inspect the first job submitted by a new vendor.** Inspecting jobs by new vendors helps to ensure they are installing products appropriately and makes clear that quality control is taken seriously.
- **Conduct on-site post-installation inspections** to discourage vendors from failing to fully and properly install all rebated measures. Random inspections of 10 to 20 percent of projects are usually adequate for lower incentive prescriptive programs. The fraction of on-site inspections should be higher for direct installation programs and may need to be increased for any program as conditions warrant.
- **Conduct an independent audit or pre-installation inspections.** An independent audit or pre-inspections by the program administrator ensures a comprehensive, accurate

assessment of needed measures, and reduce any tendency of contractors to promote products of most benefit or familiarity to them. However, for mass market prescriptive programs, this may be cost-effective for only a random sample of projects. Random pre-inspection audits on a sample of projects can be useful for prescriptive programs to develop accurate estimates of wattage savings.

- **Govern post-inspection levels by cost-effectiveness considerations and results from an initial set of inspections early in the implementation process**. It may not be cost-effective to perform 100 percent post-inspections in a high-volume program or a program with small impacts per site. A good rule of thumb is 10-20 percent for a high-volume program or low impact per site program, and 100 percent for very large projects and problem vendors.[4]

- **For delamping projects, use light level requirements and pre- and post-light level readings to ensure quality.** Delamping can provide significant and highly cost-effective savings but is only appropriate if required light levels are maintained. Light level requirements help ensure customer satisfaction and retention of savings.

- **Implement a contractor screening/certification/training process** to encourage the participation of responsible contractors and help ensure high-quality installations.

3.5 PROGRAM IMPLEMENTATION: PARTICIPATION PROCESS

The Program Implementation component includes the sub-components of Participation Process, Outreach and Marketing, and Installation and Delivery. Exhibit NR1-7 summarizes the program implementation tactics and responsibility assignment for marketing and outreach and installation activities for the NR1 Programs. Approval of applications and payment of incentives is, by definition, always performed by the implementation organization, and is therefore not included in the exhibit although it is a key function.

4 A 100 percent post-inspection for "problem" vendors should only be tolerated on a temporary, probationary basis. If evidence of poor performance continues, the individual contractor should be permanently excluded.

Exhibit NR1-7
Program Implementation Roles and Tactics

Program	Marketing and Outreach	Installation	Tactics
2002 CA SW Express	In-house, leverage any vendor for mass marketing	Any vendor	• In-house program staff paid invoices • In-house program staff marketed program via mass media and direct mail to end-users and vendors
KEMA-XENERGY BEST	Small vendor pool used for door-to-door marketing	Small vendor pool	• Contractors did door-to-door marketing and equipment installation
SDG&E EZ Turnkey	Audit contractor used for door-to-door marketing	Single contractor	• Turnkey contractors were charged with door-to-door marketing and equipment installation. • SDG&E created targeted customer lists
CL&P SBEA	Small vendor pool used for door-to-door marketing	Small vendor pool	• Turnkey contractors were charged with implementation, marketing, recruitment, and equipment installation • CL&P solicited and approved vendor proposals and reimbursed contractors.
Xcel Lighting	In-house, leverage any vendor for mass marketing	Any vendor	• Xcel Energy staff discussed lighting options with customers, and performed marketing • A sales force of account managers assisted large customers • Phone representatives assisted small customers • Lighting vendors and/or customers were responsible for completing installation
SMUD Sm Comm Prescriptive	Small vendor pool used for door-to-door marketing	Small vendor pool	• A SMUD Program Manager delivered funds • Three clerical support staff helped customers determine eligibility • A turnkey contractor recruited customers and performed implementation

For many programs, including the NR1 Programs, a tradeoff exists between the program goals of simplicity (making participation easy for customers and contractors) and accountability (ensuring funds are paid only for proper installations and savings are calculated accurately). Exhibit NR1-8 illustrates the steps involved in participating in the NR1 Programs.

Exhibit NR1-8
Participation Process

Program	Participation Process
Xcel Lighting	1. Xcel representatives and/or vendors met with the customer to discuss lighting options 2. Customer or vendor installed qualifying high efficiency lighting equipment at facility 3. Customer, vendor, or Xcel account manager filled out the rebate application form (for retrofits, this included detailed information about existing lighting that was being replaced) 4. Customer had to sign the form stating that the information submitted was accurate 5. Proof of purchase (detailed invoice) had to be submitted with application 6. Xcel Energy conducted random on-site inspections 7. Customer received rebate check in 2-3weeks
KEMA-XENERGY BEST	1. Contractor or XENERGY initiated an audit 2. Proposal generated with XENERGY software tool 3. Determined if customer is eligible for program 4. XENERGY conducted pre-inspection 5. Contractor installed measure 6. XENERGY conducted post-inspection
SDG&E EZ Turnkey	1. SDG&E handed off list of pre-qualified customers to contractor 2. Audit contractor went door to door to customers, explained program, conducted an audit, and demonstrated products to the customer, signed up customer 3. Audit contractor entered audit results into database 4. Installation contractor scheduled an installation 5. Measures installed 6. Contractor updated the database to reflect actual installation 7. Jobs subject to random inspection by the utility
SMUD Sm Comm Prescriptive	1. Contractors recruited customers and sold lighting jobs 2. Contractors called SMUD support staff to determine customer eligibility 3. The contractor electronically submitted contract and a SMUD worksheet for Program Manager approval 4. SMUD paid the contractor after installation 5. SMUD inspected a random sample of sites
CL&P SBEA	1. CL&P solicited proposals from turnkey contractors who had recruited potential customers 2. Turnkey contractors performed assessments of customer facilities and filled out necessary paperwork for the customer 3. Contractors uploaded assessment data electronically into CL&P's system for review and approval (based on reasonableness of the proposed replacement) 4. Once approved by CL&P, the contractor obtained permission from the customer to proceed with installation 5. CL&P conducted post-installation to verify completion as established in the original proposal 6. CL&P reimbursed contractors the incentive cost and any finance fees incurred once customers committed to CL&P SBEA
2002 CA SW Express	1. Customers may have called the utility prior to installation to determine eligibility 2. Customers or their vendors installed eligible measure(s) 3. The customer or vendor filled out and submitted the one-page CA SW Express application form with equipment proof of purchase 4. Online and phone support were available for customers needing application assistance 5. Incentives were paid 4-6 weeks after application processing 6. Random on-site inspections after installation

All of the NR1 Programs reflect the recognition of the importance of simplicity and their application forms were simplified to streamline the participation process, while maintaining the information necessary for tracking and verification.

In the prescriptive rebate programs run by Xcel Energy and the California IOUs, in-house program staff assumed the program implementation role of paying invoices. Contractors typically completed CA SW Express paperwork, whereas Xcel Energy also used its sales force in completing and submitting project applications.

In direct installation programs, a single or small pool of approved contractors is charged with the program implementation components of implementation, marketing and recruitment. The program implementer is responsible for the program implementation task of reimbursing contractors.

Determining customer eligibility can be a sticking point in the participation process for programs with size or geographic[5] restrictions. In particular, it can be difficult to confirm customer size, since this information is usually not readily available at the customer site. After locating an interested customer, vendors for some of the NR1 Programs typically contacted the program administrator to determine customer eligibility. Delays in receiving correct eligibility information can inhibit vendor sales momentum.

Incentive Approaches

The NR1 Study revealed the importance of incentive levels as part of the participation process for non-residential lighting programs. Exhibit NR1-9 summarizes information collected on NR1 Program incentives. Incentive levels vary widely across these programs. Turnkey programs tend to pay over 75 percent of the cost of an energy efficiency measure, while traditional rebate programs typically rebate 25 to 50 percent of measure cost.

[5] Note that geography is used as a proxy for income in some non-residential lighting programs oriented toward hard-to-reach customers.

Exhibit NR1-9
Incentive Approaches

Program	Incentive Approach	Level of Incentive
Xcel Lighting	Maximize savings per dollar of rebate	• Prescriptive lighting rebates ranged from $0.50/square foot for reflectors to $85 for pulse-start metal halide fixtures with 2-level switching • Cap of 50% project cost • Low-interest financing with no down payment • $200-300 comprehensive on-site audit • Co-funded Engineering Assistance Studies (Xcel Energy funds up to 50%)
KEMA-XENERGY BEST	Cover most of measure cost to maximize penetration and reduce per unit marketing cost	• $750/kW peak saved for T8 lighting retrofits, including T8/delamp • $250/kW screw-in CFL • 75-100% of measure cost
SDG&E EZ Turnkey	Cover most of measure cost to maximize penetration and reduce per unit marketing cost	• Incentive covered 100% of measure cost • SDG&E focused on incandescent lighting replacement because CFLs have a high savings per bulb
SMUD Sm Comm Prescriptive	Cover most of measure cost to maximize penetration and reduce per unit marketing cost	• Incentives covered up to the full cost (typically 85-90%) of installed lighting equipment
CL&P SBEA	Cover most of measure cost to maximize penetration and reduce per unit marketing cost Use low-cost financing to reduce program costs	• Incentives for up to 50% (typically 35-40%) of the cost of lighting retrofits • Up to 100% (typically 50-100%) of the cost of non-lighting measures • 0% financing option to creditworthy customers • Total financial incentives typically resulted in a 50/50 split between the incentive paid and the loan amount
2002 CA SW Express	Maximize savings per dollar of rebate	• Lighting incentives ranged from $1/lamp for 2-3 foot lamps to $10 per dimming ballast • HVAC incentives ranged from $0.45 per square foot of reflective window film to $75 per ton of a package/split AC system • Motor rebates ranged from $115 for 25 hp to $630 for 200 hp • Rebates available for LED, Agricultural processes, and refrigeration • Cap of $25,000 per service account (or corporate parent) per fuel per year • Incentives may have increased during seasonal promotions

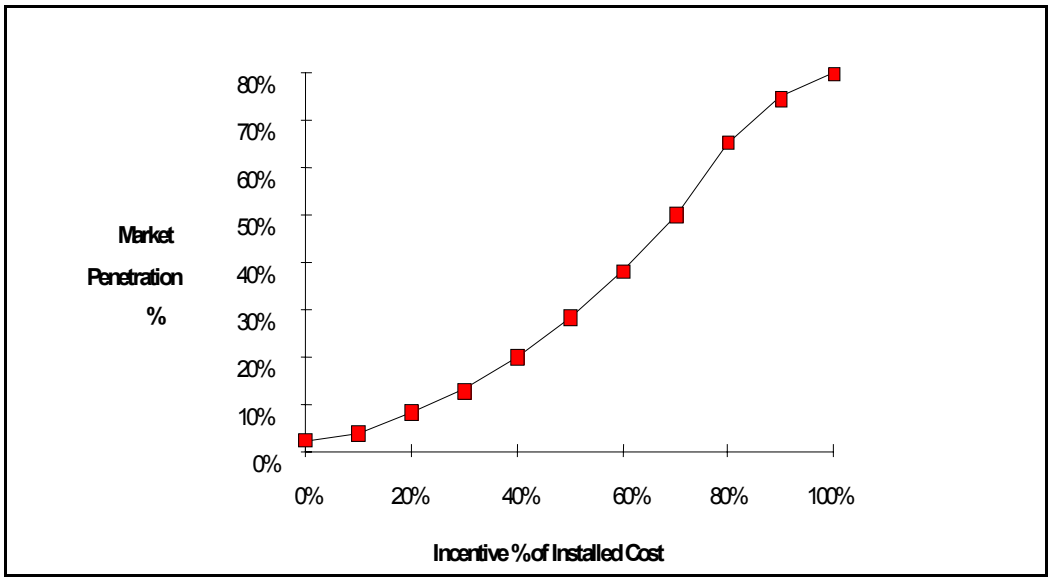
As dictated by basic economics, incentive levels clearly drive participation levels. For example, SDG&E EZ Turnkey covered 100 percent of the measure cost, and over 90 percent of customers accepted these free energy efficiency measures. All of the turnkey programs offered incentives

that covered a large portion of the measure cost under the rationale that small non-residential customers under-participate in traditional prescriptive programs and face greater barriers to participation than medium and large customers. As shown earlier, the saturation of efficient lighting systems by the late 1990s was several times lower among small customers as compared to large ones.

The most cost-effective approach to any program is highly dependent upon the characteristics of the target market for which savings are desired. For certain markets, approaches that involve high levels of effective information dissemination and moderate incentives provide the most cost-effective solution. Experience delivering and evaluating commercial programs shows that this is not the case for small and very small businesses, especially those in economically depressed areas. The historical evidence demonstrates that very small commercial customers will not adopt efficiency measures or participate in efficiency programs at meaningful levels without a combination of high incentive levels and complete turnkey services.

Exhibit NR1-10 displays the estimated relationship between incentive levels and penetration rates among small commercial customers. This exhibit was developed by KEMA-XENERGY based on the company's experience implementing small commercial energy efficiency programs in the mid-1990s. The largest increases in penetration occurred when the incentive was between 50 percent and 80 percent of total installed cost. Incentives of 50 percent resulted in market penetration of approximately 30 percent, while 80 percent incentives encouraged roughly two-thirds of the market to participate.[6]

Exhibit NR1-10
Market Penetration as a Function of Incentive Level for Small Commercial Customers

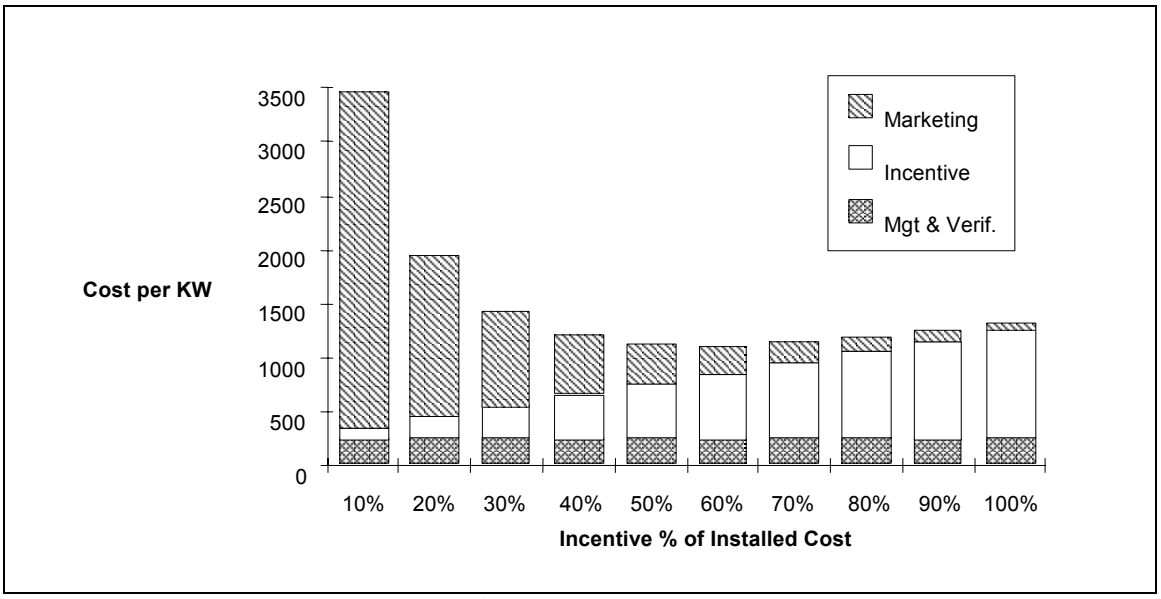


Source: Warner, 1994

[6] A similar curve based on results from aggressive programs targeted toward small commercial customers was recently developed from program experience in New England (Mosenthal and Wickenden 1999). The curve developed by these authors is similar to but slightly less steep than the one developed by Warner.

Exhibit NR1-11 was also developed by KEMA-XENERGY in the mid-1990s and shows the estimated cost per kW saved as a function of incentive levels. Note that **a direct installation program does not make sense if the incentive levels are 40 percent or lower.** More traditional prescriptive strategies work best with lower incentive levels if lower market penetration is acceptable. In addition, the cost per kW is fairly constant for incentive levels between 50 percent and 80 percent. However, increasing the incentive from 50 percent to 80 percent provides additional kW savings without increasing relative costs. Because this also minimizes lost opportunities, many implementers believe that the 70-80 percent incentive level is optimal for the direct installation program model.

Exhibit NR1-11
Direct Installation Program Costs for Small Commercial



Source: Warner, 1994

Participation levels in prescriptive rebate programs are typically much lower on an annual basis than direct installation programs because the entire eligible population is considered the denominator, rather than only those customers marketed to, as is the case for direct installation programs. For example, participation in the CA SW Express predecessor programs was very low in 1999 both for all customers <500 kW (0.4 percent) and those < 20 kW (0.16 percent) (XENERGY and Quantum Consulting 1999; XENERGY 1998). Participation levels increased significantly for small customers in Program Year (PY) 2000 to about 2.8 percent for customers < 20 kW (2.6 percent for all customers < 500 kW). This was primarily because the IOUs significantly increased Express incentive levels for the smallest customers, as well as marketing and outreach efforts targeted at these customers. Over the entire decade of the 1990s, however, both California's and Xcel Energy's non-residential lighting prescriptive programs penetrated a large share of the entire commercial market and played major roles in achieving an overall saturation level of T-8 lighting and electronic ballast technology of 50 percent or more.[7]

[7] Xcel Energy reports a 70 percent saturation level for the remaining T12 systems.

Predecessor programs of both Xcel Lighting and CA SW Express saw participation increase dramatically when bonus promotions were offered. In 2001, Xcel Energy offered a 50 percent bonus for customers to retrofit their existing T12 systems to T8 or T5 system retrofits (compared with a 30 percent additional rebate for T12 to T8 to T5 system retrofits in 2002). No promotion was offered in 2003, but Xcel Energy initiated a 30 percent limited time promotion on any retrofit project in 2004. Similarly, CA SW Express and its predecessor programs often increased base rebate levels as part of seasonal promotions. Over 90 percent of Express Efficiency participation in 2002 occurred during special program sales (e.g., "summer bonuses"), which were used to bring base rebates up to increase sales. Vendors responded by relying on these special promotions, and moving jobs through the program primarily during sale periods only.

Vendors who participated in the 2002 Express Efficiency program preferred consistently higher rebates instead of periodic sales.[8] During sale periods, when rebates were increased significantly, vendors could not accommodate customer demand, utilities were less responsive (there were delays with reservations and communications weren't always timely) and rebate turn-around was slower. Consistent rebate levels instead of periodic sales accommodate customer lead time and schedules, improve utility responsiveness, reduce rebate turn-around time and simplify vendor marketing and business planning.

Zero-percent financing was a unique feature offered by CL&P SBEA, which offered a combination of incentives and loans. Project incentives were frequently realized as a combination of 50 percent rebate, 50 percent financing. CL&P offered a zero-percent financing option to credit-qualifying customers. The loan repayment term was set at a level to maintain positive cash flow for the customer (typically a two-year term). Such attractive financing terms often resulted in loan payments that were smaller than a customer's monthly bill savings. Financing is an attractive program element when interest rates are low.

Financing does introduce some risk to energy efficiency programs and their administrators, but CL&P reports that customer delinquency has not been a big problem. Nonetheless, CL&P instituted new, more stringent criteria in 2003 to screen customers for the financing element of the program. Monthly reports of delinquent accounts are forwarded to CL&P's Collections Department. Other implementers, including KEMA-XENERGY, have begun to add financing elements to their programs.

Another incentive strategy implemented in this program area is measure bundling. Delamping offers a good example of this approach. Bundling delamping with measure conversion offers considerable cost-effective savings potential but must be done with care since inappropriately reduced lighting levels will lead to participant dissatisfaction. Delamping is by definition much more cost-effective than a straight retrofit. It is a practice that has moved in and out of various non-residential programs throughout the country for at least a decade. For example, SMUD used delamping (4-lamp T12 to 2-lamp T8 retrofit) in its 2002 non-residential lighting program, which accounted for more load reduction than any other program measure. SMUD paid a premium for this combination measure, and contractors responded. In addition, SMUD added

[8] In the 2002 process evaluation of the Express Efficiency program, most participating vendors interviewed preferred consistently higher rebates instead of periodic sales, as sales made it difficult to accommodate customer demand, created delays with reservations and slowed rebate turnaround time (Quantum Consulting 2003).

a quality control measure to ensure delamping jobs offered appropriate lumen levels (discussed in more detail in the quality control and verification section above).

Best Practices

Program Implementation: Participation Process
• Use an easy, simplified process for vendors to participate. • Optimize data collection requirements. • Make customer eligibility easy for contractors to determine. • Use electronic processing. • Use high incentive levels, as appropriate, in segments that require high penetration rates to be cost-effective or if policy goals demand high penetration levels. • Reduce or eliminate incentives for measures and segments with high penetration rates not caused by program participation. • Appropriately incent and bundle delamping with T12 conversion. • Set base rebate levels appropriately throughout the program year instead of over-relying on short-term promotions. • Offer zero-percent or low-cost financing to offset high cost of capital for small businesses.

- **Use an easy, simplified process for vendors to participate.** Vendors are the most important actor in the prospecting and delivery mechanism, so success depends on a process that facilitates participation and keeps contractor costs modest.

- **Optimize data collection requirements.** Contractors will not participate aggressively if they incur significant costs in application development. Paperwork should be easy for contractors and customers. Carefully consider what project information is necessary and eliminate elements that add only minimal value

- **Make customer eligibility easy for contractors to determine**. Determining customer eligibility is important to a streamlined process and quick turn-around Use mechanisms like a toll-free number with staff support or a pre-qualified customer list.

- **Use electronic processing.** Electronic application processing improves the program implementer's responsiveness and reduces administration cost. For example, some program administrators have successfully used on-line, real-time systems to improve contractor productivity.

- **Use high incentive levels, as appropriate, in segments and for program design that require high penetration rates to be cost-effective or if policy goals demand high penetration levels** (e.g., turnkey programs targeting small customers with high per

customer marketing costs). High market barriers among small customers and high fixed marketing costs typically require a high penetration rate to achieve desired cost-effectiveness.

- **Reduce or eliminate incentives for measures and segments with high penetration rates not caused by program participation**. Program resources should be focused on achieving high net effects. Even though today's free riders may be market effects from previous years' programs; when non-program induced market penetration become very high and sustainable, standards should be considered to capture the remaining resource potential while program dollars are shifted to new measures with lower levels of market penetration.

- **Appropriately incent and bundle delamping with T12 conversion**. This combination measure delivers very cost-effective savings but must be implemented conservatively.

- **Set base rebate levels appropriately throughout the program year instead of over-relying on short-term promotions** to drive participation or meet goals. Sale periods create processing bottlenecks, participant holdback, and slower turn-around. Occasional sales help promote a specific technology or target a specific segment, but should be used sparingly.

- **Offer zero-percent or low-cost financing to offset high capital for small business.** Zero-percent financing, with convenient terms and short repayment periods, can improve customer acceptance rates by overcoming the high cost of capital for small businesses. Such financing can be combined with moderately high incentive levels (e.g., 50 – 75 percent incentive levels) as an alternative to the very high incentive levels frequently used to achieve significant customer adoption rates in turnkey programs targeted at small customers.

3.6 PROGRAM IMPLEMENTATION: MARKETING AND OUTREACH

Turnkey and prescriptive rebate programs adopt different marketing strategies, depending on the target market and incentive strategy. Marketing and incentive strategies are so intertwined it is difficult to discuss one without discussing the other.

Prescriptive programs usually rely on mass media and direct mail to reach a broad class of customers eligible for rebates (e.g., all non-residential customers or small/medium customers <500kW). Traditional rebate programs still also rely heavily on contractors to sell energy efficiency improvements to customers. Indeed, the importance of contractors, who undertake marketing and implementation functions, cannot be overemphasized in these programs. For example, leveraging vendor relationships to market its program became critical for Xcel Energy after its marketing staff was cut in half in 2001. Contractors were very effective at getting customers to participate in CA SW Express. 12 percent of the general population learned of the program through a contractor compared with 36 percent of program participants. Most of those participants were solicited by a contractor, though customers tend to be skeptical of unfamiliar contractors. Contractors generated their own leads for CL&P SBEA.

By contrast, the Small Business Energy Assessment contractor was responsible for door to door marketing. SDG&E assisted the contractor by creating targeted customer lists to help the contractor canvass door-to-door because the program targeted certain hard-to-reach customers. Direct installation programs, which often serve a local population or tightly drawn market of very small customers, often send marketing staff, auditors, or contractors door-to-door for customer leads.

Of the NR1 Programs, only Xcel Lighting offered prescriptive lighting rebates to all non-residential customers, regardless of size. Xcel Lighting staff reported the key to success in reaching these customers lay with its internal account management team. Xcel Energy's account managers take a proactive sales approach with large commercial and industrial customers, with whom they maintain relationships for a variety of energy-related purposes. However, utilities do not typically assign small customers a utility account representative.

The California IOUs primarily marketed the CA SW Express program through mass media for just this reason. However, mass media – an important sales channel for residential programs – did not appear to move many small customers to participate in NR1 Programs. Surveys of California IOU customers indicate that mass media and direct mail (utility brochures, bill inserts, TV/radio/newspaper ads) made many customers aware of the program, but was not very effective in moving them to participate. However, these awareness campaigns can improve vendor credibility, as customers tend to view utilities as more credible information sources than vendors who approach them without referral or program association. (Quantum Consulting 2003) Thus, vendors' follow-on sales calls may be better received by a customer made aware of the program through a bill insert. This is particularly true for very small (< 20 kW) customers. For example, while 76 percent of small customers learned of CA SW Express through mass media, only 20 percent of program participants learned of it through this channel. Instead, customers that participated in CA SW Express were more likely to have found out about program through contractors, not mass media or direct mail. Xcel Energy and SMUD have also found that direct mail is not very effective in reaching small businesses.

Recognizing the importance of contractors and the limits of mass marketing in the small commercial market, all of the NR1 turnkey programs relied on door-to-door marketing. For SDG&E EZ Turnkey, audit contractors went door-to-door to pre-qualified customers, making cold-call contact with a list of pre-qualified customers. Most participants learned about the program through walk-in contact by a technician, who described and explained the program, conducted an audit, demonstrated products to the customer, gave them a list of free program-eligible measures and, in many cases, signed up the customer. KEMA-XENERGY and CL&P have also found success with turnkey contractors that perform door-to-door marketing to small customers, although in these programs the marketing contractors are the implementation vendors.

To help promote CA SW Express, the California IOUs leveraged community-based organizations (CBOs) to bring contractors and customers together in ways that mitigated vendor cost and increased customer trust. SCE was particularly effective in partnering with CBOs to bring customers to vendors. CBOs not only raised program awareness in hard-to-reach communities, they also organized events that served as one-stop shops, with a vendor and utility representative present to sign customers up.

Best Practices

Program Implementation: Marketing and Outreach
• Leverage utility credibility to help vendors sell the program. • Use door-to-door marketing by a turnkey vendor to achieve a high penetration rate, especially among small commercial customers. • For prescriptive programs, combine a moderate mass marketing effort with a process of strongly motivating and leveraging contractor marketing for prescriptive programs. • Leverage partnerships with cities and community-based organizations.

- **Leverage utility credibility to help vendors sell the program.** Contractors are considered less credible than utilities in some markets. In these cases, leveraging utility credibility is usually effective.

- **Use door-to-door marketing by a turnkey vendor to achieve a high penetration rate especially among small commercial customers**. Face-to-face marketing and turnkey services reduces the hassle and information search costs for small businesses that might otherwise not participate. However, this approach is usually only cost-effective if combined with very high incentive levels.

- **For prescriptive programs, combine a moderate mass marketing effort with a process of strongly motivating and leveraging contractor marketing.** This combination works to create program awareness and close sales.

- **Leverage partnerships with cities and community-based organizations.** Partnerships offer marketing leverage for a program administrator and credibility and economies of scale for contractors by brining vendors, utility representatives and customers together to provide education, demonstrate products, and sign the customer up for rebated measures.

3.7 PROGRAM EVALUATION

Formal evaluations for the NR1 Programs and their predecessors typically encompass program impacts and processes, as shown in Exhibit NR1-12. Most, but not all, of these programs underwent formal evaluation on a regular basis. Xcel Energy does not have a formal utility commission-driven evaluation requirement, but nonetheless reports program impact and some process findings in its annual Status Reports. CL&P does not conduct impact evaluations every year but does go through an annual performance review. The California IOUs conducted rigorous impact evaluations in the 1990s but recent evaluations have emphasized verification activities, process evaluation, and market assessment.

Exhibit NR1-12
Types of Program Evaluation of Non-residential Lighting Programs

Program	Last Major Evaluation	Type of Evaluation
Xcel Lighting	2002	Market Assessment and Potential
XENERGY BEST	in progress	Verification Process
SDG&E EZ Turnkey	2002	Impact Process
SMUD Sm Prescriptive	2003	Impact
CL&P SBEA	2003	Performance Review
2002 CA SW Express	2002	Process Impact

Beyond traditional impact and process evaluation objectives, recent evaluations of programs with hard-to-reach goals sometimes involve assessment of how a program is meeting equity concerns. For instance, equity was an explicit goal in many of California's public goods programs, either through hard-to-reach goals for statewide IOU programs or through local programs targeting underserved populations. The evaluation of CA SW Express found it met its hard-to-reach requirements in 2002. Half of CA SW Express participants were very small customers, although only 25 percent of total energy savings were attributed to them.

For all programs the importance of *closely* involving program implementers in the evaluation process was acknowledged. For California IOU studies, implementation staff participates in study kick-off meetings and is interviewed by the evaluation team. Not only does this practice encourage implementers to "buy into" the evaluation process, it also gives them an opportunity to pose questions and bring their research needs to the evaluation study. In addition, evaluators brief the implementation team on high level, actionable findings in the draft stage and take their feedback and perspective into consideration before finalizing reports.

Process evaluations are common for these non-residential lighting prescriptive rebate programs but the level of effort and depth varies. Key findings from these process evaluations include:

- Xcel Energy's program was found to be easy to use for medium and large customers, but small customers needed a more hands-on approach.

- The marketplace responded very positively to promotions offered through the California statewide and Xcel Energy programs (i.e., 30 percent bonuses for T12 retrofits)

- The non-residential T8 lighting market is becoming saturated in Xcel Energy's Minnesota territory. However, due to the increase in new lighting technology such as high-bay fluorescent lighting, lighting continues to have large impacts on the portfolio savings.

- Similarly, CFLs have surpassed T8 lamps and ballasts as the lighting measure with the largest program share for several years. In addition, the Office segment no longer has the largest program share, possibly an indication of market saturation.

- Contractors are more effective in reaching small customers than mass media.

- California customers rate their IOU as being more credible than contractors, particularly unfamiliar vendors – yet it is precisely these vendors that are the California statewide program's main marketing arm.

Best Practices

Program Evaluation
• Perform annual evaluations for high-priority issues that are relevant and unique to each individual program year. • Spot check the data entry process annually. • Review inspection databases annually. • Ensure that program tracking databases are correctly calculating program impacts annually. • Perform detailed impact evaluations routinely, though not necessarily annually. • Evaluate operating hours routinely. • Collect pre-wattage information routinely. • Determine measure life in estimating the lifecycle benefits of a measure routinely. • Perform market assessments routinely, though not necessarily annually. • Conduct process evaluations routinely. • Conduct evaluations in a timely manner. • Involve program staff in the evaluation process and create a culture whereby evaluation findings are valued and integrated into program management. • Present actionable findings to program staff at the conclusion of study.

- **Perform annual evaluations for high-priority issues that are relevant and unique to each individual program year**, such as verification of measure installation, participant satisfaction, and analysis of tracking data. On-site verification is important as lighting measures are often stocked and are not all installed. Furthermore, persistence issues such as first year failures (burn outs) and removals are common for non-residential

lighting measures. In addition to conducting on-site verification audits, verification activities should include an application/data entry review, a review of the administrator's inspection process, and an audit of the impact calculations embedded in the program tracking data.

- **Spot check the data entry process annually.** Due to the high volume of applications that these programs tend to have, this is recommended to ensure applications are being entered correctly.

- **Review inspection databases annually** to ensure that the inspection process defined by the administrator is being properly adhered to, and that a representative set of measures and vendors are being inspected. The evaluation should also audit a random sample of sites inspected by the program to ensure that the program's post-inspections are rigorous.

- **Ensure that the program tracking databases are correctly calculating program impacts annually.** These programs can also tend to have a large number of measures that are program qualifying. Quite often data entry errors are made when deemed per unit savings values are embedded into formulas used to estimate impacts (e.g., using the wrong net-to-gross value)

- **Perform detailed impact evaluations routinely, though not necessary annually**. Impact evaluations (e.g. which involve measuring program savings on an ex post basis) should occur every 2-3 years, in particular when some change is suspected in these metrics due to different behavior, a shift in measure mix, a changing target market, or an external event like an energy crisis.

- **Evaluate operating hours routinely.** For non-residential lighting programs, operating hours are one of the key parameters that drive energy savings, and should be evaluated routinely using lighting logger or other end use monitoring techniques.

- **Collect pre-wattage information routinely.** As discussed, pre-wattage information is also a key parameter to collect as part of the program tracking process. If impacts are not calculated based on customer specific pre-wattage information, pre-wattage assumptions should be revised on a routine basis.

- **Determine measure life in estimating the lifecycle benefits of a measure routinely**, as it is a key parameter. Measure life studies are most accurate when based on empirical data collected over many years (as many as 10 years for some measures). Long term studies should be planned for measures that are emerging and expected to provide significant benefits in the near to mid term, due to the number of years required to conduct the measure life study. Measure life studies benefit when measures installed are tagged and the location of the measure is documented, so evaluators can easily identify the installed equipment over time. Creating a panel of program participants that are visited or interviewed every 2 to 3 years over the study life greatly enhances the accuracy of the study, minimizing customer attrition and allowing the evaluators to better pin point the time at which measures fail.

- **Perform market assessments routinely, though are also usually not necessary annually**. Such assessments are appropriate when the market or program design change significantly or when longitudinal indicators are being tracked to assess longer term market effects.

- **Conduct process evaluations routinely**. At a minimum, small, less formal process evaluations focused on assessing participant satisfaction and basic procedural effectiveness should be conducted or implemented internally annually; larger scale and more formal independent process evaluations are important at least every 2-3 years or as triggered by major changes in program tactics or exogenous market conditions.
  - Because vendors are key to program success, **process evaluations should include vendor satisfaction, and obtaining vendor input** on the program process and on rebate levels.
  - Furthermore, because non-residential lighting programs have relatively high volume, it **is important to thoroughly review the application, incentive payment and inspection processes every few years**.

- **Conduct evaluations in a timely manner**, or concurrent with programs. Timely evaluations give real-time feedback to program staff and contribute to program planning. Some aspects of evaluations require real-time execution, for example, conducting random samples of pre-inspection on-site verification surveys.

- **Involve program staff in the evaluation process and create a culture whereby evaluation findings are valued and integrated into program management.** Involving program staff early and throughout the evaluation is important to obtaining their buy-in to the evaluation process, encouraging them to develop research issues, soliciting their perspective on program activities, and increasing the likelihood they will review and use the evaluation results.

- **Present actionable findings to program staff at the conclusion of study.** Focusing on actionable findings and recommendations is critical to engaging program implementers' attention, obtaining feedback on the findings and recommendations in draft form, and challenging them to act on study recommendations or create their own alternative approaches to achieving similar ends. Key findings from evaluations should be well-distilled and disseminated so appropriate actions may be taken to improve future programs. For example, use workshop teleconferences, well-focused executive summaries, study briefs, on-line access to reports and study databases, and other approaches, in addition to traditional hardcopy reports.

4. COMPARISON OF OUTCOMES

This section presents cost-effectiveness estimates obtained from the programs reviewed. Energy efficiency programs and portfolios are often designed with specific policy objectives in mind, and those objectives can often impact the outcome of a program. For example, programs that target hard-to-reach areas may not exhibit the same rates of participation as those that do not. Key factors that affect cost effectiveness and program outcomes include:

- **Energy efficiency policy objectives –** policies that emphasize different goals such as market transformation, resource acquisition, equity, etc. will drive different program designs and program objectives.

- **Market barriers addressed** – programs that seek to mitigate difficult barriers may have poorer performance-related metrics because they attack tough problems, in contrast to programs that may have excellent ostensible metrics because of cream skimming.

- **Measure mix** – the mix of measures installed in a program can significantly affect a program's cost-effectiveness.

- **Demand/energy** – the extent of peak demand versus energy focus of the program can, by definition, affect the cost-effectiveness of the indicator in question (e.g., a peak demand oriented program may score poorly on an $/kWh metric). This can be considered a part of the measure mix factor listed above.

- **Multi-year policy objectives** – if consistent, help programs to achieve goals that require medium to long-term market presence and extensive program infrastructure; if inconsistent, make achievement of such goals more difficult.

- **Multi-year funding levels** – if consistent, allow programs to set multi-year goals and maintain consistent presence and messages among end-users and supply-side market actors; if inconsistent, makes maintaining a stable market presence more difficult.

- **Program/Market Lifecycle** – where a program or key measure is in its product lifecycle will affect its cost-effectiveness. For example, a program seeking impacts from the last 50 percent of the market to adopt a product that has penetrated the first 50 percent of the market should be expected to be more costly than one attacking a market with a low or insignificant saturation level.[9]

[9] There are at least two reasons for this. First, in more highly saturated markets, it is more difficult to find the remaining measure opportunities and, second, the remaining market is typically characterized by late majority and laggard organizations that are more resistant to adopting new products and practices. In addition, a program in the first-year of a multi-year plan to impact a market may have poor first-year metrics because of the associated startup costs and time it takes to create awareness and other program effects.

- **Climate** – for example, HVAC measures are more cost-effective in severe climates than in mild climates because absolute savings are strongly a function of base usage levels.

- **Customer/target market actor mix** – the mix of customers and trade allies often plays a role in cost-effectiveness, for example, a program in a market with larger commercial customers will tend to be more cost effective than an identical program in a market of smaller commercial customers, all other things being equal; similarly, programs with customer segments with longer full-load equivalent hours will be more cost-effective than those with lower average full-load hours of operation (also related to climate).

- **Customer density** – delivering an energy efficiency program to a relatively dense population base will be less costly than delivering to a sparser population, all other things being equal.

- **Customer Energy Rates** – higher electricity rates should lead to higher levels of measure adoption, all else being equal.

- **Economic Conditions** – willingness to invest in new products and practice changes in response to short-term economic and market conditions, which may vary across regions.

- **Customer Values** – efficiency program effectiveness can vary as a function of differences in customer values, again, all else being equal.

This section presents cost-effectiveness estimates obtained from the NR1 Programs in Exhibit NR1-13. Information is presented on the Total Resource Cost (TRC) test, the associated discount rate and the average measure life, where available. A second cost-effectiveness metric, the Utility/Program Administrator Cost Test, was not widely available. Only Xcel Energy reported Utility/Program Administrator Cost test values. The total program cost shown per kWh saved is an indicator related to the Utility/Program Administrator Cost test in that the numerator includes all program costs and excludes any customer contribution to measure costs. Also shown are non-incentive dollars spent per kW, which offer an indication of the cost to market and administer. Incentive dollars per kW shows the overall average incentive amount per unit of estimated first-year impact.

Program planning assumptions can create large variations in both total resource benefit-cost ratios and program costs per unit of impact. Cost-effectiveness is driven by a set of assumptions about measure cost,[10] measure life, per unit savings, savings per application, net-to-gross and other factors. The benefit side of cost-effectiveness is based on avoided cost, which differs substantially across service territories, as noted above. Furthermore, another factor that affects cost-effectiveness is measure mix. For example, a program that focuses solely on CFLs is likely to have a better TRC than one that focuses on T8 retrofits because CFLs typically have

[10] For example, it is important to note that two of the California IOUs that implement CA SW Express make very different assumptions about the cost of CFLs, a measure that comprises over half of the program benefit. SCE claims $11 for a 26-watt screw-in CFL, whereas PG&E uses $27 as the incremental cost for the same CFL. Consequently, SCE's total resource cost of 5.5 looks very favorable, whereas PG&E's TRC is 2.2. In short, the total resource cost reported in two service territories for the same program varies greatly as a result of a conflicting assumption, a difference that plainly illustrates the problems in comparing cost-effectiveness across programs.

lower costs per kWh saved on a retrofit basis. The exact measure mix was not made available to the Best Practices Team for all of the NR1 Programs, although some qualitative information was available (e.g., SMUD indicated their program had a significant share of delamping projects).

The TRC test is one of the most commonly used metrics to determine if a program is cost-effective. Essentially the TRC is calculated as the ratio of the lifecycle avoided cost benefit of all the energy and demand savings, divided by all of the associated program and measure costs (specifically, full measure costs, not just those covered by incentives). Unfortunately, however, TRC values are not directly comparable across jurisdictions because of the variations in avoided costs, measure cost estimates, measure life estimates, and discount rates mentioned above.

The TRC values of the four small customer-oriented programs are similar, ranging from 1.5 to 2.3, while rebate programs run by Xcel Energy and the California IOUs boast higher TRCs of 2.5 to 3.5. At first glance, these numbers suggest that traditional prescriptive programs are more cost-effective than turnkey programs, all else being equal. For instance, CA SW Express claims the highest TRC of 3.5.[11] However, a significant portion of this difference is likely a result of the market the program targets (mid-sized rather than the smallest customers) and its measure mix than the program structure itself. These results are supported by a recent study that assessed the cost to deliver energy efficiency programs targeted to small non-residential customers, and the effects on program cost-effectiveness (Quantum Consulting 2004). This study concluded that TRCs can be 30-50 percent lower when targeting small commercial customers. Therefore, caution is called for in comparing CA SW Express and Xcel Lighting to small commercial turnkey programs. Differences in TRC-based cost-effectiveness likely reflect target market more than program approach (i.e., prescriptive versus turnkey).

Program cost per unit of impact shows a greater than four-fold variation, within which the two prescriptive rebate programs targeting larger customers (CA SW Express and Xcel Lighting) show significantly lower program costs per unit impact than the turnkey programs serving the small commercial market. The fact that their incentive levels are significantly lower as a percent of full measure costs is the key factor that makes program cost per unit impact numbers more favorable for the traditional prescriptive rebate programs (beyond the factors already discussed that underlie the TRC differences). By definition, it is more difficult to garner as much savings per dollar with a fixed budget from a program that pays out high incentives, such as a turnkey program, than from a program that pays a lower incentive – if there is significant market demand at the lower incentive levels.[12]

---

[11] This single CA SW Express program test value represents an aggregation of the four TRC values reported by the four California IOUs.

[12] Note, however, that the extent of free-ridership and spillover, as well as equity and other market segment objectives, must also be considered in such comparisons. A program with a lower incentive targeted at larger customers would be expected to have a higher free-ridership rate than a program with higher incentives targeted at small commercial customers. If each program had *ex-post* net-to-gross ratios measured for the program years examined, this effect could be captured by focusing comparisons on net impacts; however, none of the programs assessed have had *ex-post* free-ridership or spillover for the program year reviewed.

Exhibit NR1-13
Cost Effectiveness

	Xcel Lighting		KEMA-Xenergy BEST	SDG&E EZ Turnkey	SMUD Sm Comm Pre-scriptive	CL&P SBEA	2002 CA SW Express
	C&I	Small Business					
Net to Gross Ratio[13]	1	1	0.96	0.96	0.96	NA	0.96
Total Resource Cost/Societal test	2.14	1.98	1.53	2.3	NA	1.5	3.5
Utility cost test	9.66	9.73	NA	NA	NA	NA	NA
Average measure lifetime	18	18	14	13	NA	NA	9.5
Nominal discount rate	8%	8%	8%	NA	NA	8%	8%
udget Per Impact							
Program $/first-year kWh saved	$0.08	$0.13	$0.35	$0.42	$0.14	$0.28	$0.09
Incentive Dollars per kWh	$0.05	$0.08	$0.22	$0.22	$0.12	$0.24	$0.05
Non-Incentive Dollars Spent per kWh	$0.03	$0.05	$0.13	$0.20	$0.02	$0.05	$0.04
Program $/first-year kW saved	$290	$277	$1,683	$2,311	$696	$1,280	$504
Incentive Dollars per kW	$192	$168	$1,070	$1,202	$599	$1,066	$299
Non-Incentive Dollars Spent per kW	$98	$109	$614	$1,109	$97	$214	$205

Data Sources:

Xcel Lighting	2003 Minnesota Conservation Improvement Program Status Report
KEMA-XENERGY BEST	2003-2003 Planning data from CPUC workbook.
SDG&E EZ Turnkey	2002 Planning data. Program costs per unit of impact include Small Business Energy Assessment costs. TRC from EZ Turnkey CPUC workbook does not include SBEA costs.
CL&P SBEA	Cost and savings projected from 2003 CL&P proposed C&LM budget
SMUD Sm Comm Prescriptive	Summary Savings and Costs Report - All Projects from 1/1/2003 to 12/31/2003, SMUD
CA SW Express	Cost and savings integrated statewide from 2002 4th Quarter Report. NTG from Energy Policy Manual dating back to mid-1990s

[13] The 0.96 figures for the California programs are ex ante deemed values.

Much of the variation in program costs per first-year kWh saved is likely a function of incentive levels and measure mix. If TRC costs (i.e., program costs plus participant costs) and per unit measure costs and savings were available (and, thus, could be normalized), the variation across programs would most likely be significantly reduced. Cost-effectiveness must be examined in light of the quality, consistency, and reliability of the data and assumptions that drive these outcome metrics (e.g., measure cost, measure life, incremental cost, and savings per measure). In addition, program and policy objectives (in particular, those pertaining to size and types of customers as well as measure mix) and market penetration levels must be taken into account when comparing cost-effectiveness indicators.

5. SOURCES

Aspen Systems. 2004. *California Non-residential Market Share Tracking Study*. Prepared for the California Energy Commission.

Corfee, Karen (Business Unit Director, KEMA-Xenergy Inc). 2004. Best Practices In-Depth Interview, Xenergy Business Energy Services Team (BEST) Program. March 12.

Gansler, Bob (Technical Lead, Xcel Energy). 2003. Best Practices In-Depth Interview, Xcel Energy Lighting Efficiency Program. October 10.

Goldstone, Sy, Michael Rufo, and John Wilson. 2000. "Applying a Theory-Based Approach to California's Non-residential Standard Performance Contract Program: Lessons Learned." In *Proceedings of the American Council of an Energy-Efficient Economy Summer Study on Energy Efficiency in Buildings, Volume 5: Deregulation of the Utility Industry and the Role of Energy Service Companies (ESCOs).* Washington, D.C.: American Council for an Energy-Efficiency Economy.

Kauffman, Lisa (Program Manager, Xcel Energy). 2003. Best Practices In-Depth Interview, Xcel Energy Lighting Efficiency Program. October 10.

KEMA-Xenergy. 2003. *California Statewide Commercial Sector Natural Gas Energy Efficiency Potential Study*. Prepared for Pacific Gas and Electric Company.

Lee, Allen, Michael Rufo, Todd Board, Mary O'Drain. 1999. "Challenges of Upgrading the Energy Efficiency of Small Non-residential Customers." In *Proceedings of the Association of Energy Services Professionals Conference.* Tucson, AZ.

Matchett, John (Program Administrator/Evaluator, Connecticut Light & Power). 2003. Best Practices In-Depth Interview, CL&P Small Business Energy Advantage Program. November 12.

McGhee, Jill (Program Manager, San Diego Gas & Electric). 2004. Best Practices In-Depth Interview, SDG&E EZ Turnkey Program. March 5.

Mosenthal, Philip and Michael Wickenden. 1999. "The Link Between Program Participation and Financial Incentives in the Small Commercial Retrofit Market." In *Proceedings of the 1999 International Energy Evaluation Conference*. Denver, CO.

Mosenthal, Philip, Priscilla Richards and Steven Lacey. 2002. "Light Years Ahead: A New Approach to Transform Commercial Lighting." In *Proceedings of the American Council of an Energy-Efficient Economy Summer Study on Energy Efficiency in Buildings, Volume 4: Commercial Buildings: Program Design and Implementation.* Washington, D.C.: American Council for an Energy-Efficiency Economy.

Quantum Consulting Inc. 2002. *Statewide Small/Medium Non-residential Customer Wants and Needs Study*. Prepared for Pacific Gas and Electric Company.

_____. 2003. *2002 Statewide Express Efficiency Program Measurement and Evaluation Study*. Prepared for Pacific Gas and Electric Company.

_____. 2004. *Statewide Study of the Effects on Program Cost-effectiveness Due to Targeting the Small Non-residential Sector*. Prepared for Pacific Gas and Electric Company.

Regional Economic Research, Skumatz Economic Research Associates, Shel Feldman Management Consulting, Xenergy Inc. and Research Into Action. 2001. *A Framework for Planning and Assessing Publicly Funded Energy Efficiency*. Prepared for Pacific Gas and Electric Company.

Rosenberg, Mitchell, Michael Rufo, Athena Besa and Mary O'Drain. 2000. "The Market Effects of SDG&E's and PG&E's Commercial Lighting Efficiency Programs." In *Proceedings of the American Council for an Energy-Efficiency Economy Summer Study on Energy Efficiency in Buildings*, *Volume 4: Commercial Buildings: Program Design: Program Design, Implementation and Evaluation*. Washington, D.C.: American Council for an Energy-Efficiency Economy.

Rufo, Michael and Fred Coito, 2002. *California's Secret Energy Surplus: The Potential for Energy Efficiency. P*repared for The Energy Foundation as part of the Hewlett Foundation Energy Series.

Rufo, Michael and Pierre Landry. 1999. "Evaluation of the 1998 California Non-Residential Standard Performance Contracting Program: A Theory-Driven Approach." In *Proceedings of the 1999 International Energy Evaluation Conference*. Denver, CO.

Warner, Kellogg L. 1994. "Delivering DSM to the Small Commercial Market: A Report from the Field on What Works and Why." In *Proceedings of the American Council for an Energy-Efficiency Economy Summer Study on Energy Efficiency in Buildings*, *Volume 10: Program Design.* Washington, D.C.: American Council for an Energy-Efficiency Economy.

Wellinghoff, John, John L King III, Mark Bailey and Jerry Lawson. 2000. "ESCOs, ESPs and Small Business: A Model for Efficiency." In *Proceedings of the American Council for an Energy-Efficiency Economy Summer Study on Energy Efficiency in Buildings*, *Volume 4: Commercial Buildings: Program Design: Program Design, Implementation and Evaluation*. Washington, D.C.: American Council for an Energy-Efficiency Economy.

Wiesner, Paula (Senior Product Services Coordinator, Sacramento Municipal Utility District). 2004. Best Practices In-Depth Interview, SMUD Small Commercial Prescriptive Lighting Initiative. January 13.

XENERGY Inc. 1998. *Commercial Lighting Market Transformation Study*. Prepared for Pacific Gas and Electric Company and San Diego Gas & Electric Company.

XENERGY Inc. and Quantum Consulting Inc. 1999. *1998 Express Efficiency Market Transformation Study*. Prepared for Pacific Gas and Electric Company.

APPENDIX NR1A – BRIEF INTRODUCTION TO THE NATIONAL ENERGY EFFICIENCY BEST PRACTICES STUDY

INTRODUCTION

This report presents results of a comparative analysis of non-residential lighting programs included in the National Energy Efficiency Best Practices Study ("Best Practices Study"). The overall Best Practices Study objectives, scope, and methodology are briefly outlined in this Appendix. More details on methods and cross-program findings are provided in separate report volumes.

OBJECTIVE AND SCOPE

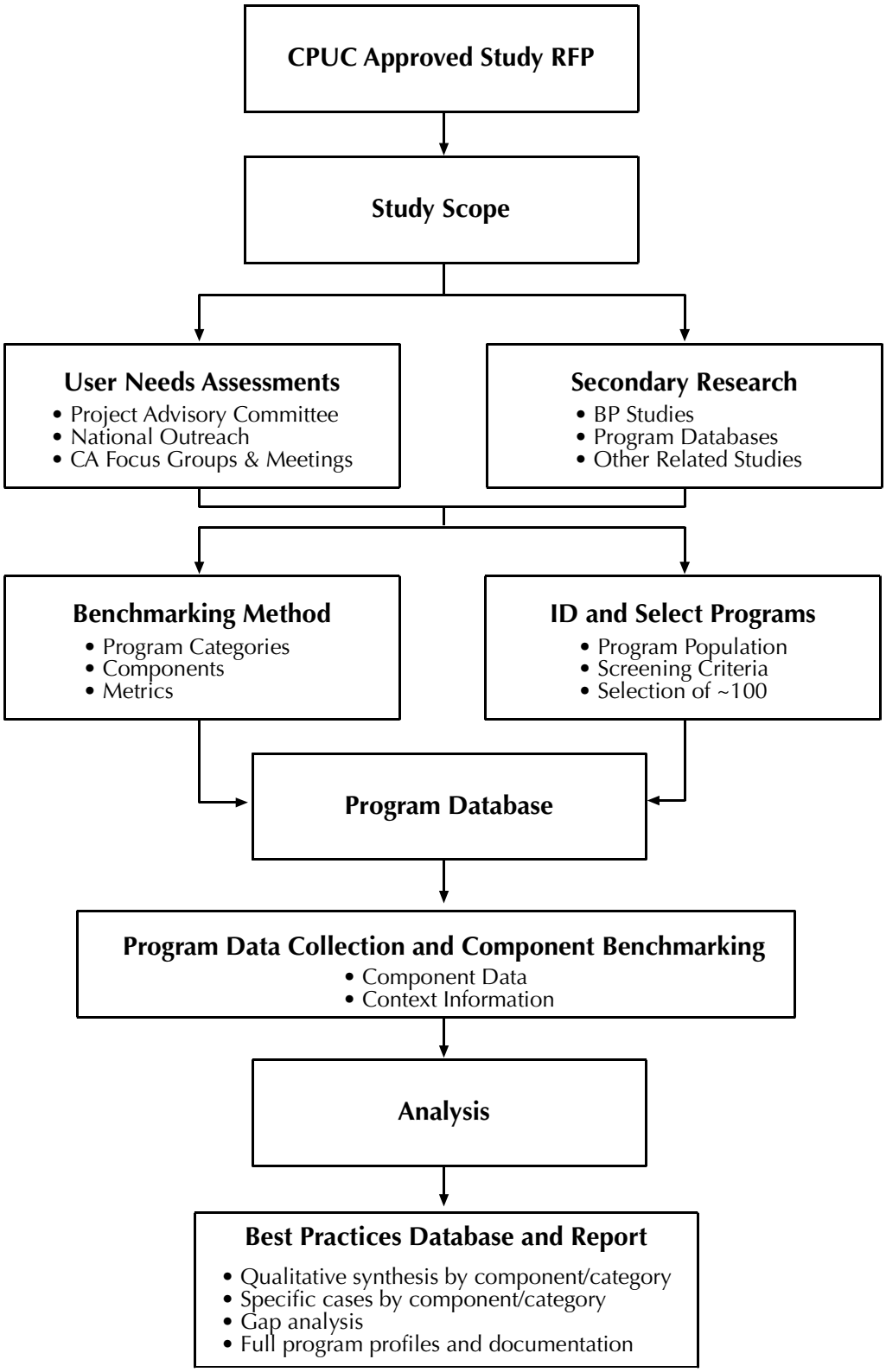
The overall goal of the Best Practices Study is to develop and implement a method to identify and communicate excellent energy efficiency program practices nationwide in order to enhance the design of such programs in California. In particular, program implementers supported through public goods funds are encouraged to use the Best Practices Study's products, along with other resources and their own knowledge and experience, to develop and refine energy efficiency programs.

The Best Practices Study is intended as a first-order effort to identify successful program approaches through systematic cross-program data collection and comparative analyses. It is not intended to produce a census of best practices across all types of programs. Such an approach would be neither practical nor useful given the number of programs that exist; the many differences in policies, goals, and market conditions around the country; the unique needs and market conditions in California; and the importance of encouraging innovation, which by its nature sometimes requires attempting approaches that are not yet proven. If the framework and results of the Best Practices Study prove useful, future phases of the work can expand the number and types of programs covered.

METHODOLOGY

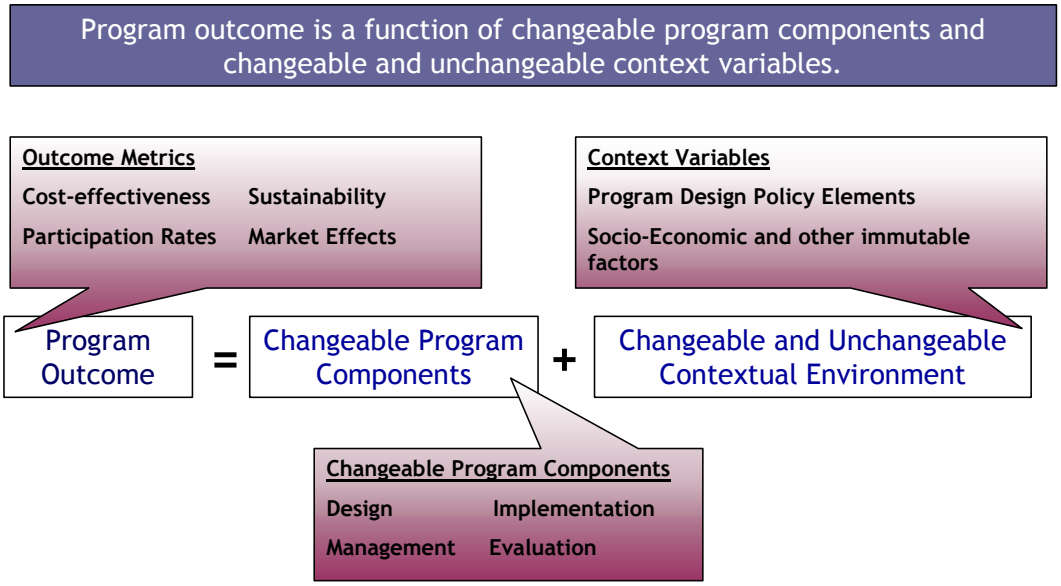
Key aspects of the Best Practices Study include a user needs assessment, secondary research, development of the benchmarking methods, identification and selection of programs to benchmark, development of the program database, data collection and program benchmarking, analysis, and preparation of the best practices report and final database. In addition, outcome metrics will be tracked. An overview of the Best Practices Study key activities is shown in Exhibit NR1-14 below.

Exhibit NR1-14
Overview of Energy Efficiency Best Practices Study



As shown below in Exhibit NR1-15, the outcome of a program – as measured by $ per kWh saved, market penetration or sustainability – can be thought to be a function of changeable program elements, changeable portfolio-level design and programmatic policy decisions, and unchangeable social, economic, demographic, climate, and other factors. All of these factors can influence the ultimate success of an energy efficiency program. Some program elements (such as marketing, tracking or customer service) are directly controllable at the program level and can be modified to affect the success of the program. Other elements (such as the program policy objectives and whether the program has a single- or multi-year funding commitment) may not be changeable at the program level but may be changeable at a policy level. Other elements (such as the physical climate or density of the customer base) are not changeable and cannot be affected by program managers, implementers or policy-makers.

Exhibit NR1-15
Relationship Among Program Outcomes, Components, and Context



PROGRAM CATEGORIES

A program category is defined for the Best Practices Study as the basis for grouping "like" programs to compare across components and sub-components. Program categories may be defined in any number of ways, for example, as a function of target market (e.g., sector, vintage, segment, end use, value chain, urban/rural); approach (e.g., information-focused, incentive-focused [prescriptive; custom/performance based]); objective (e.g., resource acquisition, market transformation, equity), and geographic scope (e.g., local, utility service territory, state, region, nation); among other possible dimensions.

A number of criteria a good program categorization strategy should address were identified and include user accessibility, benchmarking compatibility, potential, compatibility with policy guidelines, and compatibility with scope directives. The number of program categories was

limited to approximately 17 to conform to resource constraints. These are shown in Exhibit NR1-16 below. The final scheme separates residential from non-residential programs, and distinguishes between incentive programs, information and training programs and new construction programs. Programs are also segregated based on targeted end-use and customer type. A Crosscutting section is included to address comprehensive programs that do not cleanly fall within the other 16 categories. Each program category has an associated code, which is used throughout the Best Practices Study for identification purposes (e.g., NR1 Programs = Non-residential Lighting Programs reviewed for the Best Practices Study).

Exhibit NR1-16
Program Categories & Related Codes

Program Category			Code
Residential	Incentives	Lighting	R1
		Air Conditioning	R2
		Appliance and Plug Load	R3
		Single-Family Comprehensive	R4
		Multi-Family Comprehensive	R5
	Information & Training	Whole House Audit with no/minimal incentive	R6
		General & Other Comprehensive	R7
	New Construction Information & Incentives		R8
Non-Residential	Incentives	Lighting	NR1
		HVAC	NR2
		Refrigeration, Motors, Compressed Air, Process	NR3
		Small Comprehensive	NR4
		Large Comprehensive	NR5
	Information & Training	End-Users	NR6
		Trade Allies	NR7
	New Construction Information & Incentives		NR8
Other	Crosscutting		O1

PROGRAM SELECTION

Programs reviewed for each of the program categories in the Best Practices Study were selected through a three step process. First, programs were nominated using recent best practice studies, team member recommendations. Next programs were randomly selected from published data on energy programs to complete the roster. The third step involved conducting outreach interviews with the staff of nominated programs to determine if sufficient information was available to conduct the research. With the final set of programs determined, in-depth interviews were conducted.

PROGRAM COMPONENTS

The Best Practices Study approach focuses on analyzing programs primarily from the perspective of their changeable program characteristics. The Best Practices Team developed a method for breaking programs down into components and sub-components in order to systematically identify and compare specific program features of importance to overall program success. The four primary program components are program design, program management, program implementation, and program evaluation. These components and their associated sub-components are briefly summarized below.

- **Program Design** provides the initial foundation for a successful program. The program design category has two sub-components: **program theory** and **program structure** (which includes policies and procedures). Good program design begins with good program theory and a complete understanding of the marketplace. Good program structure, policies and procedures are necessary to translate program design theories and goals into practical and effective management and implementation actions.

- **Program Management** is the command and control center that drives the implementation process, and may be broken down into the sub-components of **project management**, **reporting and tracking**, and **quality control and verification**. Project management includes the structure and relationship among responsible parties. Reporting and tracking focuses on approaches to identifying and tracking useful and appropriate metrics that can be translated efficiently into reporting effective information. Quality control and verification includes accountability and improvement processes that are typically carried out through implementation and evaluation activities.

- **Program Implementation** is defined by the actual activities carried out in the marketplace to increase adoption of energy efficiency products and practices. Its sub-components include **outreach, marketing, and advertising**, the **participation process**, and **installation and incentive** mechanisms. Good outreach, marketing and advertising efforts should result in relatively high program awareness, knowledge of program specifics, and participation levels. The participation process is a critically important element of a program's ultimate success. Standard measures of market penetration and customer satisfaction provide one indication of a program's effectiveness at enrolling customers and processing their applications. Installation and incentives should demonstrate evidence of installation and delivery follow-through on marketing and outreach efforts.

- **Evaluation and Adaptability** of programs should also be analyzed. The Best Practices Study assesses the adequacy of evaluation efforts and how programs use evaluation results or other feedback mechanisms to improve over time.

DATA COLLECTION

Program information was gathered using primary and secondary sources. Primary data was collected largely through surveys of program managers and review of regulatory filings, annual

reports and program evaluations. The team conducted extensive interviews with program managers using a detailed survey instrument to guide the conversations. The survey instrument collected information on three main areas: policy context and environment, outcome metrics, and information about program components. The first set of questions elicited responses on how the program might have been affected by the broader context in which it operates. Next, respondents provided information on outcome metrics, such as program impacts and costs. The remainder of the instrument was devoted to collecting detailed program information for each program component. For each component, respondents were asked to provide factual information on how the program addressed each issue and qualitative judgments about what practices they felt contributed to the success of this program and what practices should have been avoided or could be improved.

STRUCTURE OF REPORTING

Complete project results are provided in project reports and a Web site that allows users to access information at varying levels of depth, including top-line summaries by program type or component, stand-alone chapters on best practices by program area, documentation of project methods, and individual program profiles.