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NATIONAL ENERGY EFFICIENCY BEST PRACTICES STUDY

*VOLUME R7 – RESIDENTIAL AUDIT PROGRAMS
BEST PRACTICES REPORT*

Submitted to

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ES. EXECUTIVE SUMMARY FOR RESIDENTIAL AUDITS PROGRAM AREA (R7)

ES.1 INTRODUCTION

This volume presents results of a comparative analysis of residential audit 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 R7A 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 residential audit programs for this program area study ("R7 Programs" and "R7 Study," respectively), each of which focused on or included residential audits and targeted opportunities for retrofits as well as behavioral changes among residential customers in existing homes. Their scope varied widely: from the provision of information only to a more comprehensive approach to help residential customers identify and implement energy efficiency measures, including insulation, lighting, HVAC, appliances, and others. Some programs had energy savings goals; others explicitly excluded such goals to focus exclusively on the provision of information. The mix of program goals and approaches means that programs are not directly comparable, and it is not the goal of this report to judge one program as superior in design or execution to another. Instead, the focus is on identifying best practices from a variety of programs that have audits as a key component. The R7 Programs are listed in Exhibit R7-E1 below and presented in the body of this report. A discussion of the program selection process is provided in Appendix R7A.

ES.2 KEY CATEGORY THEMES

Four key crosscutting issues that affect multiple program components were identified for the R7 Programs.

One of the key differentiating features among R7 programs was the extent to which audits led to implementation of recommended measures. In some cases program managers see this issue as outside the scope of program goals, since some programs were designed to provide information and education only, and program goals were set and their achievement measured in terms of customers contacted and audits conducted. For these programs, direct impacts associated with or attributable to the audits were not expressed as an explicit part of the program goals.

Other programs were more concerned with measuring or estimating energy savings that could be directly attributed to the program. This was done through follow-up telephone surveys or through the direct involvement of a contractor who visited the customer and installed recommended measures (in a few instances on-site audits included direct installation of low-cost measures). This direct link typically led to higher estimated program impacts.

Finally, some audit programs were explicitly seen as feeder programs for the utility (or other agency) rebate programs. The audits identified promising links between customer needs and available programs and encouraged the customer to participate in the program. In this case,

however, the audit program did not share in the impacts from installation of those measures, since the utility attributed them to the rebate program and could not double count the impacts by also assigning them to the audit program.

Program philosophies often were not spelled out in program plans or statements of intent. Sometimes they were articulated by program managers, sometimes they were the result of a sort of evolution, whereby programs were shaped by a combination of formal and informal evaluation, political pressures (explicit or subtle) to provide high-visibility services to residential customers, and inertia. Similarly, and in part because predecessor residential audit programs had been running for such a long time, R7 programs often lacked a detailed description of program flows. (Few of the program managers interviewed had been involved with the design and initial fielding of predecessors to their programs; instead, most had "inherited" a non-documented institutional memory of program flow.)

A suite of well-designed, field-tested audit tools is available to support almost any level of analysis of residential audit programs due to the maturity of these programs. The tools used to gather and analyze audit data from residential customers have grown dramatically in power, ease of use, and quality of presentation, comprising not only traditional on-site audits, but also computer-based and, increasingly, Internet-based applications.

Comprehensive, easily accessible tracking systems are critical to a complete understanding of audit program success. Since the extent to which audit programs can "claim" energy savings often depends on their role as feeders for other residential programs, it is important to track the timing of audits as well as the measures recommended and implemented – preferably with easy-to-use electronic systems. Moreover, the growing role of online audits means that existing tracking systems should be adapted to the task of linking Web site audits directly to customer data in the CIS.

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 reporting and tracking, quality control and verification), Program Implementation (including participation process, incentive strategies, and marketing and outreach) and Program Evaluation. Best practices were developed by analyzing information across programs developed from detailed interviews of program sponsors and administrators, implementing agencies, and implementation or evaluation contractors, and thorough review of all relevant secondary sources such as program filings and evaluations. Clearly, not all best practices will be relevant for all audit programs, since some program components are not applicable for certain types of programs. Exhibit R7-E2 presents the list of best practices developed from the analysis of R7 programs. Exhibit R7-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 Standard Performance Contract Program is in progress and will be published when complete in a separate document.

Exhibit R7-E1
R7 Programs: Residential Audit Programs In R7 Study

Program Name	Implementer/s	Abbreviation for R7 Report
2002 Home Performance with ENERGY STAR Program	New York State Energy Research Development Association (NYSERDA)	Home Performance with ENERGY STAR
2000 Time-of-Sale Home Inspection Program	Sponsor: Southern California Edison Implementer: GeoPraxis, Inc.	TOS Inspection
2002 Residential Conservation Services (RCS) Audit Program	National Grid	RCS Audit
2002 E+ Energy Audit for Your Home Program	Northwestern Energy	E+ Energy Audit
2002 Residential Energy Advisory Services Program	Sacramento Municipal Utility District (SMUD)	SMUD Audit
2002 California Statewide Home Energy 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 HEES

Exhibit R7-E2
Summary List of Best Practices for Residential Audit 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 referral to other programs • Link the mix of on-site, online, and mail-in audits for each targeted market segment to policy objectives and resource constraints • Adopt a multi-year planning approach when possible • Use a collaborative or coordinated planning approach
Program Management: Project Management
• Utilize electronic project management • Make customer follow-up part of the implementation contractor's responsibility • Actively involve leading businesses in the segment targeted for transformation • Use a single prime contractor as the point of contact with the utility • Support program managers with accurate information about market conditions and market segments
Program Management: Reporting and Tracking
• Integrate marketing, customer, audit, and impact data • Make the audit recommendations, including energy saving potential, part of the program tracking database • Design the program tracking system to support the requirements of evaluators as well as program staff • Utilize databases that fully integrate audit participation and results with other energy efficiency program information systems • Track vendor activity and measure volume where relevant
Program Management: Quality Control and Verification
• Conduct on-site post-installation inspections by a third party where appropriate • Conduct follow-up telephone calls to provide an accurate estimate of the number of measures installed • Use audit tools to check for the reasonableness of savings and payback estimates
Program Implementation: Participation Process
• Provide a range of options • Make program participation part of an existing, routine transaction such as the purchase of a home or the installation of a heating or cooling system • Provide vendors with an economic incentive to participate, as well as an easy, simplified participation process where appropriate • Make the audit flow seamlessly into the adoption of recommended measures • Use rebates primarily to support market transformation strategies • It is not necessary to offer free measures for a program to succeed, although installation of low-cost measures does ensure that every audit delivers at least some energy savings • Use incentives to promote a specific technology or target a specific segment

Program Implementation: Marketing and Outreach
- Provide customers with a single statewide point of contact   - Feature links to residential audits prominently on utility Web sites   - Combine outreach to vendor partners with mass marketing efforts to raise consumer awareness and demand when appropriate   - Use target marketing strategies to ensure that hard-to-reach (HTR) populations are informed about available audit program   - Make marketing materials (as well as the audit instruments themselves) multi-lingual   - Provide contractors or inspectors used to deliver programs with training and resources to enable them to market effectively   - Take advantage of external factors such as heat waves to enhance marketing effectiveness   - For mail-based audits, include the audit form with the audit offer and make the offer letter succinct and compelling
Program Evaluation
- Integrate impact evaluation and measure verification   - Regularly assess program performance and success, such as measuring the level of energy and peak demand savings achieved   - Periodically verify that the audit software is correctly calculating potential impacts   - Conduct detailed impact evaluations that include measurement routinely, though not annually   - Perform market assessments for those programs that have a market transformation component   - Conduct process evaluations closer to the time of the audit than the impact evaluation   - Conduct evaluations in a timely way, or concurrent with programs   - Systematically update measure life every 2-3 years   - Engage the implementation team in evaluation process   - Present actionable findings to program staff both in real time and at the conclusion of study

Exhibit R7-E3
Summary of Best Practices Rationale for Residential Audit 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 referral to other programs	Sound program theory enables the program administrator to think through likely program outcomes and ensure the strategic and tactical approaches will lead to the desired results.
Link the mix of on-site, online, and mail-in audits for each targeted market segment to policy objectives and resource constraints	
Adopt a multi-year planning approach when possible	For programs that seek to transform a market by influencing the behavior of supply-side market actors with incentives, disruptions in funding can undermine otherwise significant gains. Securing funding for several years is more likely to enable program managers to first induce and then sustain changes in the market.
Use a collaborative or coordinated planning approach	In lieu of a competitive solicitation to select audit programs, such a process would encourage better integration of various audit programs that co-exist within a given state or region.
Program Management: Project Management	
Utilize electronic project management	Best-of-class IT solutions for end-to-end business process automation improve access to information for enhanced productivity and cost savings.
Make customer follow-up part of the implementation contractor's responsibility	Extending the implementation team's scope beyond audits alone should encourage greater emphasis on spurring customers to take action.

Best Practice	Rationale
Actively involve leading businesses in the segment targeted for transformation	Ensuring that for-profit parties are allowed an opportunity to realize benefits beyond those provided solely by the direct program management contract or incentives encourages additional private investments, support of upper management, and the creation of private sector stakeholders who have a long term interest in the success of the program objectives.
Use a single prime contractor as the point of contact with the utility	Coordination within and across programs can also be effectively attained through in-house program management, but using multiple contractors to implement different audit programs makes coordination more difficult.
Support program managers with accurate information about market conditions and market segments	Rigorous market research in advance of program design and continuous program evaluation can help ensure customer and trade ally satisfaction and maximize overall cost effectiveness.
Program Management: Reporting and Tracking	
Integrate marketing, customer, audit, and impact data	This will support tracking the effectiveness of marketing efforts, analysis of audit customer demographics, and extent to which various categories of residential customers (including HTR customers) are successfully reached by the program.
Make the audit recommendations, including energy saving potential, part of the program tracking database	A knowledge not just of what specific measures were recommended, but also what kinds of measures were installed and what kinds were rejected can be very helpful in designing follow-up strategies or marketing approaches for other residential programs.
Design the program tracking system to support the requirements of evaluators as well as program staff	This ensures that the kinds of information sought by each group can be readily obtained from the program database.
Utilize databases that fully integrate audit participation and results with other energy efficiency program information systems	This facilitates management review and tracking the effectiveness of the audit program in directing customers to rebate programs.

Best Practice	Rationale
Track vendor activity and measure volume where relevant	Helpful in assessing relative vendor effectiveness.
Program Management: Quality Control and Verification	
Conduct on-site post-installation inspections by a third party where appropriate	Random inspections of 10 to 20 percent of projects discourage vendors from failing to fully and properly install all rebated measures.
Conduct follow-up telephone calls to provide an accurate estimate of the number of measures installed	This can be done as part of the evaluation function, but should be done in a timely manner to provide program managers with relatively quick feedback on the percentage of audits that lead to action being taken.
Use audit tools to check for the reasonableness of savings and payback estimates	Catching "outliers" through an automated process allows implementation staff to identify shortcomings in the quality of the audit and recommendations.
Program Management: Participation Process	
Provide a range of options	Offering participants a choice of audit paths can hold down the cost per audit.
Make program participation part of an existing, routine transaction such as the purchase of a home or the installation of a heating or cooling system	This makes audits more likely to become a permanent part of the market.
Provide vendors with an economic incentive to participate, as well as an easy, simplified participation process where appropriate	For those programs were vendors are the most important actor in the prospecting and delivery mechanism, success depends on a process that facilitates participation and keeps contractor costs modest.
Make the audit flow seamlessly into the adoption of recommended measures	Linking audit results to specific actions increases the likelihood of installation and associated impacts.
Use upstream or midstream market actor incentives primarily to support market transformation strategies	Vendors face higher costs to modify their business practices.
It is not necessary to offer free measures for a program to succeed, although installation of low-cost measures does ensure that every audit delivers at least some energy savings	Programs with free measures do not have substantially higher installation rates or impacts than do programs without them.

Best Practice	Rationale
Use customer rebates to promote a specific technology or target a specific segment	Rebates may be an appropriate strategy for encouraging greater participation among HTR customers, if that is deemed to be an explicit program goal.
Program Management: Marketing and Outreach	
Provide customers with a single statewide point of contact	Use of an 800 number that can direct customers to the appropriate utility or other organization depending on their location or need makes it easy for consumers to respond to marketing initiatives.
Feature links to residential audits prominently on utility Web sites	Online audit participation improves when links to the online audits are moved to the home page of utility Web site instead of being located several layers down.
Use target marketing strategies to ensure that HTR populations are informed about available audit program	Sending direct mail to targeted markets helps ensure HTR customers have access to audits.
Make marketing materials (as well as the audit instruments themselves) multi-lingual	This will help make audits available to a broader range of potential respondents, including those in the HTR population.
Provide contractors or inspectors used to deliver programs with training and resources to enable them to market effectively	Vendors who deliver program-related service may not have any training or background in marketing, yet their ability to market the program can be crucial.
Take advantage of external factors to enhance marketing effectiveness	Utilities and audit program managers report an upswing in interest following heat waves or energy shortages. Marketing efforts should be tied to such events where possible (and consistent with the program's ability to respond to the demand).
For mail-based audits, include the audit form with the audit offer and make the offer letter succinct and compelling	Participation rates in mail-in audits with compelling offer letters can be as high as 20 percent or more in some segments. The offer part of the letter should be no more than one page. Including examples of audit reports and emphasizing that the results will be truly customized to the unique characteristics of the participant has also been shown to be effective.

Best Practice	Rationale
Program Management: Program Evaluation	
Integrate impact evaluation and measure verification	The verification of measures installed (including comparison of actual installations to those that were recommended) should be a basis for more robust estimates of program impacts. This would also allow evaluators to address persistence issues.
Regularly assess program performance and success, such as measuring the level of energy and peak demand savings achieved	Performance assessment is high priority.
Periodically verify that the audit software is correctly calculating potential impacts	A 2002 study found that audit software over- or under-estimated measure impacts by as much as 50%; moreover, there is always a risk that either the customer or the auditor enters data incorrectly; while internal validation routines will capture most such problems, evaluators should periodically examine a few audits in great detail.
Conduct detailed impact evaluations that include measurement routinely, though not annually	While audit programs have not been required to demonstrate impacts, they will increasingly be called on to do so if emphasis shifts to resource acquisition.
Perform market assessments for those programs that have a market transformation component	By using established indicators to verify the extent of market transformation, program effectiveness can be measured.
Conduct process evaluations closer to the time of the audit than the impact evaluation	While it is appropriate to wait a year before conducting follow-up contacts to determine installed measures, questions regarding customer satisfaction and the effectiveness of program delivery should be addressed using data collected within a few months of the audit.
Conduct evaluations in a timely way, or concurrent with programs	Timely evaluations give real-time feedback to program staff and contribute to program planning.

Best Practice	Rationale
Systematically update measure life effectiveness every 2-3 years	Measure life is a key parameter in estimating the lifecycle benefits of audit-recommended measures and therefore program cost. Measure life studies using a panel of program participants that are visited or interviewed every 2 to 3 years over the study life greatly enhances the accuracy of program assumptions, minimizing customer attrition and allowing the evaluators to better pin point the time at which measures fail.
Engage the implementation team in evaluation process	Involving program staff encourages their buy-in, and encourages them to express research issues and their perspective on program activities.
Present actionable findings to program staff both in real time and at the conclusion of study	Key findings from evaluations should be well-distilled and disseminated (i.e., via workshops, good executive summaries, two-page briefs).

1. OVERVIEW OF REVIEWED PROGRAMS

The R7 Programs targeted opportunities for retrofits as well as behavioral changes among residential customers in existing homes. Their scope ranged from the provision of information only to a more comprehensive approach to help homeowners identify and implement energy efficiency measures, including insulation, lighting, HVAC, appliances, and others.

- **The 2002 Home Performance with ENERGY STAR Homeowners Program implemented by NYSERDA (Home Performance with ENERGY STAR)** provided on-site Comprehensive Home Assessments (CHA) as the first stage in a one-stop shopping experience for customers in existing one - four family residences in New York. To meet its market transformation goals, Home Performance with ENERGY STAR created consumer demand for CHAs and treatments through an aggressive multi-media marketing campaign while also stimulating infrastructure development through the use of financial incentives targeted to mid-stream market participants such as contractors. Customers who complete home performance work can take advantage of low-interest financing options such as Fannie Mae's Home improvement Loan, a New York Energy $martSM Loan, or a 10 percent Homeowner Financing Incentive. The primary goal of the program is to have comprehensive home improvement work completed by trained and certified professionals. In 2002 approximately 2,000 households received home energy assessments, and 1,025 households installed energy-efficient equipment through the program.

- **The 2000 Time-of-Sale Home Inspection Program sponsored by Southern California Edison and implemented by GeoPraxis, Inc**. (**TOS Inspection)** trained and equipped home inspectors to identify energy-saving opportunities in existing residential homes in Southern California during a traditional time-of-sale (TOS) home inspection as part of its market transformation activities. To promote resource acquisition, TOS Inspection provided incentives to inspectors to perform a free comprehensive home energy rating audit (EnergyCheckup™) which qualified homeowners to receive rebates, free energy-saving measures, and Energy-Efficient Mortgage (EEM) financing to make home improvements, purchase energy-efficient appliances, or stretch the maximum loan amount. In 2000, 4,170 customers in the SCE service territory participated in TOS Inspection.

- **The 2002 Residential Conservation Services Audit Program implemented by National Grid (RCS Audit)** was a statewide mandated fuel-blind audit program which provides one-stop shopping to Massachusetts residential utility customers for energy efficiency and renewable energy services. RCS offers two tiers of service; Tier One customers receive low-cost educational assistance, access to technical information, self-audit tools, and online resources. Tier Two customers receive an on-site Home Energy Assessment (HEA) and are eligible for incentives up to 50 percent of the cost of allowable measures up to a maximum of $1,000 (plus $300 to replace inefficient refrigerators). In 2002, over 6,250 customers participated in the RCS Audit.

- **The 2002 E+ Energy Audit for Your Home Program implemented by Northwestern Energy (E+ Energy Audit)** was an on-site energy audit program for residential customers whose space and/or water heating fuels were delivered by Northwestern Energy. The audit included the installation of water measures, a gas appliance inspection, and customer education supported through a blower door analysis of air infiltration. Customers received a bill disaggregation as well as an analysis of recommended major measures with a payback of less than seven years. The goal was to achieve cost-effective energy savings in residential facilities on Northwestern Energy's system. In 2002, 3,500 on-site audits and 2,500 mail-in audits were completed through the program.

- **The 2002 Residential Energy Advisory Services Program implemented by the Sacramento Municipal Utility District (SMUD Audit)** was designed to help residential customers improve the energy efficiency of their homes. Customers received a choice of three relatively low-cost energy survey products: an online survey on SMUD's Web site, a survey on CD that was mailed out to customers, or a mail-in questionnaire. Customers who had significantly high bills or other special needs were eligible for the more costly in-home audit. In 2002 1,500 in-home audits and 6,000 self-audits were completed through the program.

- **The 2002 California Statewide Home Energy Efficiency Survey Program (CA SW HEES)** was implemented by the four largest investor-owned utilities (IOUs) in California: Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), Southern California Gas Company (SCG), and San Diego Gas & Electric Company (SDG&E). The statewide program provided multi-lingual mail-in and on-line audits to help customers better understand and manage energy use in their homes, recognizing that customers have distinct needs that may make one type of delivery channel more appealing than another. The HEES program was positioned to reach the largest number of customers possible, including hard-to-reach (HTR) customers who in the past have had less access and fewer program alternatives. Both mail-in and on-line audits used sophisticated software tools to disaggregate customer bills, produce customized reports of energy usage, and provide recommendations on measures to install. Links to available rebates and incentive programs were also provided. In 2002, the program delivered 48,590 mail-in and 22,431 online audits.

Summary program characteristics are presented in Exhibit R7-1.

Exhibit R7-1
Summary of R7 Programs

	Home Performance with ENERGY STAR	CA SW HEES	TOS Inspection	RCS Audit	E+ Energy Audit	SMUD Audit
Period Reviewed	2002	2002	2000	2002	2002	2002
Cost						
Average retail price of electricity	$0.12	$0.16	$0.16	$0.10	$0.07	$0.10
Program budget	$4,000,000	$2,014,000	$282,000	$2,815,000	$1,300,000	$1,052,000
Total Incentives Paid	$1,200,000	$0	$146,000*	$987,000	$0	$0
Participation						
Eligible Participants	Single-family and 1-4 unit residences	All residential customers	Existing homes (single & multi-family, mobile homes, low income). Some geographical limitations depending on program sponsor.	All residential customers	All residential customers in homes more than 5 years old	All residential single-family customers (detached, duplex and mobile homes with either gas- or electric-heat)
Eligible Measures	Building Envelope, HVAC, Lighting, Water Heating, Appliances	Building Envelope, HVAC, Lighting, Water Heating, Appliances	Building Envelope, HVAC, Lighting, Water Heating, Appliances	Insulation, HVAC, Water Heating, Appliances	Building Envelope, HVAC, Lighting, Water Heating, Appliances	Building Envelope, HVAC, Lighting, Water Heating, Appliances
Number of Audits/Sites	About 2,000 audits, 1025 that led to action	48,590 Mail-in 22,431 Online	4,170	6,251	3,500 onsites 2,500 mail-in	7,500
Energy Savings Accomplishments						
MWh achieved (net)	741	8,770**	1,974	2,677	4,713	400
kW achieved	80	4,190**	Not reported	406	884	70

 * $35 inspector incentive per audit

** Based on 2001 SCE Residential Audit Evaluation net impact estimates of 123 kWh and .06 kW per site for both mail-in and online audits

2. CONTEXT

2.1 POLICY ENVIRONMENT

Utilities and other program administrators and energy efficiency policy makers have fielded a variety of audit programs for the residential market over the past 25 years. Over that time, both the regulatory environment and the technology available to support residential audits have changed substantially. Predecessors to the R7 Programs were in operation from a few years to more than two decades. As a result, they reflect the evolution of both the policy environment and the technology base. A thumbnail summary of the history of policy changes in California is provided below:

- **1980s** – Early conservation programs focused on providing energy audits and other information aimed at encouraging residential customers to turn off lights when not in use, set back thermostats, increase insulation levels, and install high-efficiency heating and cooling systems. Rebates were also used increasingly in the latter half of the 1980s to support the installation of high-efficiency HVAC systems and appliances.

- **Early- to mid-1990s** – With the shift from "conservation" to "resource planning" paradigm for justifying and evaluating 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 increased significantly during this period. Audit and information programs continued but incentive programs became more aggressive.

- **Late-1990s** – In the late 1990s, recognizing their long-term value, California held programs and funding in place during restructuring, at a time when some other states completely eliminated programs and funding. Nonetheless, programs in the late 1990s 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 program oversight shifted temporarily to the California Board for Energy Efficiency (CBEE).

- **2000 to 2003** – Beginning in 2000, energy efficiency in California began a quick and dramatic shift back toward a stronger focus on resource acquisition to achieve immediate, cost-effective energy and peak demand savings in response to the state's restructuring-related energy crisis. Another important event during this period was the CPUC's decision to fund approximately $100 million worth of efficiency programs for the 2002-2003 period from new locally-oriented programs (approximately two-thirds of which were administered by non-utilities). The CPUC selected many of these programs with the expectation that they would provide marketing services or impacts in HTR segments or geographic areas that had not participated extensively in the IOUs' statewide programs (for example, the CPUC funding SCE's local in-home audit program specifically to target HTR customers) or had newly identified, untapped efficiency potential (for example, the incorporation of energy audits into standard time-of-sale home inspections). These types of selections were based in part on concerns about the

equitable distribution of public benefits funds to segments that contributed funds, but that did not tend to participate at proportionate levels. Of particular relevance to the R7 Study is the CPUC's decisions to promote a statewide residential audit program targeted to HTR customers. In addition, as a means of investigating the effectiveness of online audits, in 2001 the CPUC authorized a pilot program to provide interactive consumption and cost information to residential and small business customers. An evaluation found that the resulting California Energy Connection Web site was visited by up to 2,700 unique visitors per month from late 2002 to early 2004. While users found the site easy to navigate, content was found to overlap with the online audit tools provided by individual utilities. (Quantum Consulting 2004)[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 without the direct energy crisis experience. Other contextual factors to consider with respect to the R7 Programs follow.

- Like other audit programs, **SMUD Audit** sought to balance limited funds against the high cost of in-home audits by moving to other, less expensive alternatives such as online and mail-in audit data collection.

- As a utility-sponsored third-party program, **TOS Inspection** emerged from the trend to local programs described above. Since it sought to incorporate energy audits into standard time-of-sale home inspections, the program was strongly oriented toward market transformation, although it also strove to deliver cost-effective energy savings. This program and its predecessors illustrate the uncertainty of the regulatory climate. Since 1999, predecessor programs had been run under "third-party initiative" funding from SCG, SCE and the CPUC. Based on the initial success, SCG increased funding in 1999 and renewed the program in 2000. Also in 2000, SCE adopted the program for delivery in their service area and subsequently approved a modified program design that was implemented under Summer Demand Initiative funding for 2001. In 2002, the CPUC authorized the program's introduction to the PG&E service area through 2004 as a training and information program, with a free low-cost measure distribution element, but without any incentives paid directly to inspectors.

- Like other programs, **E+ Energy Audit** and its predecessors have been in place over more than a decade of major changes in the regulatory and economic environment facing the implementing utility. Initially launched in the early 1990s by Montana Power as a program mandated by regulators and paid for by cost-recovery through rates, the program remained in place both as the region moved through deregulation and as Montana Power was first acquired by Northwestern Energy and subsequently went into bankruptcy. Since 1999 the audit program has been funded by a universal systems benefits (USB) charge as a local conservation program, but the program's initial goals, implementation contractor, and methods employed to deliver audits and information to Northwestern Energy's customers have remained the same.

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[1] Interactive Consumption And Cost Information For Small Customers – Program Process/Customer Response Evaluation – Program Year 2003, Quantum Consulting, February 2004

- **RCS Audit** was a statewide mandated program that traced its origins both to the Federal Residential Conservation Service (RCS) law (established by the federal National Energy Conservation Policy Act of 1978) and to a 1980 state law requiring Massachusetts electric and gas utilities to provide home energy audits to customers on demand, paid for by a surcharge on energy bills. When the federal RCS requirement expired in 1990, most states abandoned the mandated audits, but Massachusetts, with its own law still on the books, kept its program. As in other parts of the country, Massachusetts' 1997 restructuring act put pressure on the state's electric utilities to keep prices low and forced a review of free or low-cost home energy audits and their $160 per home price tag, (exclusive of administrative and other overhead costs.) Despite relatively low adoption rates among audit customers, a decision was made to continue the program using public benefits funds to cover not only the cost of the audit, but also, in an effort to encourage adoption, up to 50 percent of the cost of installed measures.

- **Home Performance with ENERGY STAR** was one of a portfolio of market transformation-oriented programs developed in New York for both residential and non-residential customers. The program was designed by NYSERDA to focus on the 1-4 family residential marketplace and develop a competent home performance contractor infrastructure to service the demand created by the program's marketing efforts. The program also utilizes the expertise of contractors certified and accredited from the Building Performance Institute (BPI) - a national association for building science technology that sets the standards for assessing and improving the energy performance of homes - to transform the way homeowners buy and contractors sell and implement energy-related home improvements. While in the past the individual New York utilities fielded residential audit programs, the emergence of NYSERDA as the primary organization to design and implement energy efficiency programs meant that Home Performance with ENERGY STAR could be developed from scratch in a way that was consistent with NYSERDA's market transformation focus. As a result, Home Performance with ENERGY STAR has much less of the "history" associated with some other residential audit programs.

A few important contextual conclusions relevant to the R7 Study can be drawn from the summary and secondary sources cited above:

- Traditional residential audit programs have been influenced by a variety of trends in energy efficiency policy and politics, and have been fielded for decades with the primary goal of providing customer education. Only some of the more recently initiated programs have explicitly incorporated market transformation into program goals.

- The tension between the customer education, market transformation, and resource acquisition aspects of residential audit programs continues, as evidenced by the recent reversals within California on the appropriate role (or lack thereof) of these kinds of programs.

- Rebates have always played at least a supporting role in most residential audit programs, either through direct installation of low-cost measures, to help fund recommended measures, or as a means of directing residential customers to other programs with associated incentives.

- The longevity of some of these programs means that program theories and even procedures often predate current program managers, and are not always well documented.

- Similarly, the longevity of many residential audit programs has led to diminishing returns from marketing and audit efforts for some programs as the more receptive customers have all been reached, making the programs less cost-effective.

- Online audits have attracted significant attention as a possible means of delivering very low-cost customized audits. However, they have not yet achieved the level of market penetration as have well-executed mail audits.

2.2 PROGRAM STRATEGY AND GOALS

The R7 Programs focused primarily on customer education and market transformation to achieve energy efficiency, with less emphasis on actually verifying demand and energy savings, as illustrated in Exhibit R7-2.

As discussed above, ensuring the equitable distribution of public goods funds among different customer classes has affected the design of a number of residential programs in recent years. While most of these programs are open to all residential customers, there are more specific requirements for some. TOS Inspection, for example, focuses on energy audits conducted as part of the home inspection process. Other programs are available to all residential customers, but seek to minimize the number of customers who receive the highest-cost in-person audits. Some of these programs focus on HTR customers, defined as those with a specific house type, rural locations, income level, or membership in a population where language barriers limit program participation. Specifically, HEES was explicitly required by the CPUC to mail at least 50 percent of mail-in audit solicitation packages to HTR customers (English, Spanish, and Chinese). National Grid's program, while not focused on HTR customers, reflected a concern with equitable distribution of public benefits revenues that caused it to continue its RCS program despite relatively low implementation rates.

Exhibit R7-2
Program Goals and Approaches

Program	Type of Measure	Customer Size	Program Strategy	Incentive
Home Performance with ENERGY STAR	Building Envelope, HVAC, Lighting, Water Heating, Appliances	1-4 family residences	Market Transformation	Financing, 10% Rebate in Lieu of Financing, General Education & Trade Ally Training
CA SW HEES	Building Envelope, HVAC, Lighting, Water Heating, Appliances, Pool and Spa	All	Increase Consumer Awareness and Encourage Customer Adoption; Focus on HTR	Free Audits
TOS Inspection	HVAC, Lighting, Water Heating, Appliances, Building Envelope	Residential Existing Homes (SF, MF, Mobile Homes, Low Income)	Resource Acquisition & Market Transformation	Free Audits, Trade Ally Training, Inspector Incentives
RCS Audit	HVAC, Water Heating, Appliances, Insulation	All	Provide One-stop Shopping	Prescriptive, General Education & Free Audits
E+ Energy Audit	Building Envelope, HVAC, Lighting, Water Heating, Appliances	All	Cost-effective Energy Savings	Free Measures & Audits
SMUD Audit	Building Envelope, HVAC, Lighting, Water Heating, Appliances	All Residential Single-Family Customers	Reduce Energy Costs and Peak Load	Free Audits

3. COMPARISON OF PROGRAM COMPONENTS

This section compares the R7 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

The findings of extensive research on home energy performance and bill disaggregation techniques have, over the years, created a body of knowledge that allows the energy usage of an individual home to be analyzed and the effect of changes in measures or behavior to be predicted and quantified. The overall theory behind all residential audit programs is that it is possible to conduct such an analysis for a specific home with relatively limited input regarding the home's characteristics and the behavior of its occupants. The amount of data and the cost of collecting it vary according to the type of audit conducted. On-site audits have traditionally been conducted by trained auditors who have the time and ability to collect data on a wider range of variables. In contrast, mail-in, telephone, and online audits that rely on customer input limit the amount of data required from customers in order to encourage participation. The potentially greater accuracy of the on-site audit must be balanced against the lower cost of alternative types of audits. (In SCE's 2002-2003 program implementation plan program budget, for example, per audit costs were budgeted at $91 for in-home, $36 for telephone, $25 for mail-in, and $2 for online – exclusive of administrative, marketing, and other program costs.)

For the most part, the R7 Programs did not develop formal program theories as part of their design or evaluation processes. Program theories have been relatively common only since the late 1990s when a justification of how a given set of actions would transform the targeted market became required for some programs. This was particularly important as programs were in competition for a fixed "pot" of public goods money, and those that could better defend market transformation claims had a better chance of winning. As a result, the programs with the most clearly developed theoretical basis are the newer ones with an explicit market transformation emphasis. For several of the longer-standing audit programs, any formal theory behind the programs was developed years ago by people no longer associated with the program.

Nevertheless, all of the program managers interviewed were able to articulate a rationale for their program's design logic that was based on hypotheses about the barriers to energy efficiency among residential customers. In particular, all of the California programs followed the CPUC's proposal requirements for 2002-2003 programs which included a specification of market barriers, a discussion of HTR goals and objectives, and an explanation of how the proposed program approaches would achieve the overall program goals.

The R7 Programs can be categorized according to three models: Market Transformation Programs, Information/Education Programs, and Rebate-linked Programs. While most program incorporate elements of more than one model, they are characterized here according to the dominant program theme.

- **Market Transformation Programs** are designed to bring about fundamental changes in aspects of the residential market that influence the extent to which energy efficiency is incorporated into relatively common transactions. Such programs may include incentives as transitional measures to encourage both residential customers and other market actors to take a broader view.

The goal of **Home Performance with ENERGY STAR** was to create a network of contractors who built their business around a "whole-house" approach to energy efficiency – whether they were working with HVAC systems/ducts, windows, or insulation. To facilitate this development, the program paid incentives to contractors for training, BPI certification/accreditation, diagnostic equipment, and whole-house projects completed or referred to other contractors.

TOS Inspection aimed to make it standard practice for home inspectors to identify energy saving opportunities in existing homes during a traditional time-of-sale home inspection. Incentives were offered to home inspectors for each home energy rating they performed.

- **Information/Education Programs** fundamentally address the information barrier as the main reason residential customers do not install optimum levels of energy efficiency measures. By providing detailed, accurate information and specific recommendations, along with costs and expected returns, it is believed audit programs will enable consumers to make informed decisions. Both **CA SW HEES** and **Energy E+ Audit** took this approach. Based on the assumption that information alone would drive customers to action, neither program offered direct incentives (although **Energy E+ Audit** did provide some free low-cost measures). The percentage of customers who have actually taken action as a result of information-only programs has typically ranged from 15-50 percent based on years of data. When audit-based information is derived from costly on-site audits, these numbers limit the cost-effectiveness of such an approach when measured in terms of energy savings. If the information is developed through a lower cost online or mail-in audit, however, it can be a relatively cost-effective means of generating energy savings, although confirming the level of savings adds significantly to program cost.

- **Rebate-linked Programs** pay rebates directly to customers who install recommended measures or direct customers to other programs that offer incentives. In the latter case, the audit program may be seen as part of an integrated residential program portfolio, with the stated purpose of directing customers to appropriate programs. As discussed elsewhere, one of the drawbacks of viewing audit programs in this light is the difficulty of attributing savings to the audit, since most savings are attributed to the program that pays the rebate, making audits appear to have very limited impacts. Several R7 Programs employed this model.

Both **SMUD Audit** and **CA SW HEES** used referrals to other residential programs as one of their strategies. In contrast, **RCS Audit** sought to motivate customers to take actions directly by offering rebates of up to 50 percent of the installed cost of recommended measures.

The mix of market transformation, information-only, or rebated-linked approaches employed by a program tends to be shaped by the policy environment and the specific requirements of the

funding organization. Traditional IOU audit programs resulted from external pressure to provide services and/or information to the politically important residential customer base, and some of the R7 Programs seemed to be guided by such considerations. Similar pressures have led to the use of audits as referral tools, which has enabled utilities to, in essence, enhance the cost-effectiveness of their (typically higher impact) rebate programs. Finally, audit programs have either been designed or have evolved in response to demands by market transformation-oriented funding sources. As these sources increasingly integrate resource acquisition strategies into their overall portfolios, audit programs will probably evolve further to address specific requirements of funding sources. This can be seen already in the requirement that California utilities explicitly target HTR customers and in the growing trend toward lower cost online and mail-in audits to replace site visits.

There are several program design implications of the above. First, the cost of providing information-only audits must be kept down by limiting the number of on-site audits and increasingly relying on mail-in and online audits. Second, audit programs that seek to encourage more lasting changes in the market for residential energy efficiency will probably require incentives for some time to support supply-side actors (contractors and inspectors) who will drive such changes. Third, to the extent that audit programs are a highly visible intervention on behalf of residential customers, funding sources (utilities, public goods funds administrators, regulators) will continue to press for an equitable distribution of funds that ensures participation beyond the traditional "typical" audit customer: a relatively affluent, older, highly-educated consumer in a single-family detached home.

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 referral to other programs.
• Link the mix of on-site, online, and mail-in audits for each targeted market segment to policy objectives and resource constraints.
• Adopt a multi-year planning approach when possible.
• Use a collaborative or coordinated planning approach.

- **Articulate a program theory that clearly states the target for the program, program timing and the strategic approach whether resource acquisition, market transformation, or referral to other programs.** 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. This is particularly important for long-established programs that may have restated their goals in response to the changing policy environment without revisiting the logic behind their program approach. In addition, it is critical to determine whether program success will be defined in terms of the numbers of customer contacts, audits completed, awareness or knowledge levels, measures installed, or energy savings.

- **Link the mix of on-site, online, and mail-in audits for each targeted market segment to policy objectives and resource constraints.** For example, a program that uses on-site audits, rebates for installed measures, and follow-up phone calls may be desirable when the primary goal is to maximize installation of recommended measures among customers who are difficult to motivate or have special issues like high bill complaints. By contrast, a mail-in or online audit with no incentives is far superior at maximizing the number of participants reached per program dollar. In general, on-site audits should be restricted to a narrow niche and minority role in the audit portfolio as they are much less cost-effective than mail and online delivery in the residential sector. An exception may be designs that bundle the audit with delivery of another service, like a home inspection, that results in a lower marginal cost for the audit portion of the visit. While this reduces the number of potential audits, the number of home inspections in California alone tops 500,000 a year, according to the National Association of Realtors.

- **Adopt a multi-year planning approach when possible.** For programs that seek to transform a market by influencing the behavior of supply-side market actors with incentives, disruptions in funding can undermine otherwise significant gains. Securing funding for several years is more likely to enable program managers to first induce and then sustain changes in the market.

- **Use a collaborative or coordinated planning approach.** Use of such an approach in lieu of a competitive solicitation to select audit programs encourages better integration of various audit programs that co-exist within a given state or region.

Program design must be responsive to the policy goals and resource constraints within which the program will be judged. In addition, a sound program theory or design rationale enables the program administrator to think through the likely outputs and outcomes from the program and to ensure that the strategic approach taken will lead to the anticipated results.

3.2   PROGRAM MANAGEMENT: PROJECT MANAGEMENT

Exhibit R7-3 summarizes the project management structure of the R7 Programs, including roles for overall management and audit implementation.

Exhibit R7-3
Program Management Roles

Program	Audit Implementer	Management Approach
Home Performance with ENERGY STAR	Primarily Turnkey Contractor	• Program managed by NYSERDA (1.5 FTE), but implemented by a turnkey non-profit contractor: the Conservation Services Group (10FTE)
CA SW HEES	Primarily Turnkey Contractor, with some In-house Personnel	• Program managers at each IOU coordinate program planning and design and manage contracts with KEMA-XENERGY, a private firm that implements the statewide mail-in audits • Individual IOUs maintain their own online audit tools (KEMA for SCE; Nexus for PG&E; Enercom for SDG&E and SCG)
TOS Inspection	Primarily Turnkey Contractor	• Program managed by GeoPraxis • India-based Web consulting firm also provides IT services as subcontractor • Designed/implemented in partnership with third-party real estate market leader
RCS Audit	Primarily Turnkey Contractor	• The National Grid program manager spends about half his time managing 3 or 4 implementation contractors selected to implement the RCS program
E+ Energy Audit	Primarily Turnkey Contractor	• A project manager at Northwestern Energy manages the contract with KEMA-XENERGY, a private firm that implements the program • There are 8 auditors, plus office staff, plus project managers at K-X and Northwestern Energy
SMUD Audit	Primarily In-house Personnel	• The project is managed and implemented in-house • A team of managers of other residential programs is also involved in program planning

Note that most implementing organizations (e.g., utilities) relied on turnkey contractors to deliver residential audit services as "implementation contractors," with only a single program (SMUD Audit) using primarily in-house personnel to conduct audits. One contractor (KEMA-XENERGY) was responsible for implementing both E+ Energy Audit and much of CA SW HEES, while another (Conservation Services Group) was the primary implementation contractor for both RCS Audit and Home Performance with ENERGY STAR. CA SW HEES program managers note, however, that the IOUs typically handle program design, develop mailing schedules, and implement and coordinate marketing/promotion activities.

Those implementation contractors who were responsible for delivering audits for a program typically designated a single project manager to interact directly and frequently with the utility program manager. This provided the utility with on-going knowledge of program operations and allowed the utility program manager to quickly approve any mid-course corrections that were needed. The implementation contractors for the R7 Programs all had multi-year working relationships with the implementing organization, and communications were consistently described as excellent.

SMUD Audit used in-house program staff to handle all aspects of the program, from marketing and outreach to the actual performance of the audits. Other members of the SMUD residential team were also involved in tracking the project's progress and ensuring smooth interaction with rebate and other programs. For the CD and online audits, SMUD used Nexus software.

Coordination of a single contractor for a statewide multi-utility effort raised management challenges for CA SW HEES in that KEMA-XENERGY was responsible for the mail-in audits for all four participating IOUs, but for only SCE's online audits, which used the KEMA-XENERGY RECAP audit tool. The other utilities used different audit "engines" for their online audits – Nexus for PG&E and Enercom for SDG&E and SCG. The extent to which the online audit captured information about the customer largely determined whether any follow-up activities were possible (either to encourage installation of measures or for evaluation purposes). There was some interest in moving the non-RECAP utilities to the RECAP platform in the interest of consistency. However, this was resisted by the other utilities, who had invested substantial time and money in buying and implementing other online audit tools and argued that climate and territory-specific concerns dictated the use of utility-tailored audit tools.

One of the key functions contributing to audit program success is a follow-up with customers after they have received audit results, regardless of what type of audit was conducted. Unfortunately, this function is rarely explicitly assigned to implementation contractors and most participants receive follow-up phone calls only as part of a program evaluation, if at all. Two programs incorporated follow-up in program design. Home Performance with ENERGY STAR did so by relying on the contractors who conducted the whole house inspection (contractors received an incentive for installed measures or for referral to another contractor who installed them). RCS Audit had the auditor provide a direct link to one of the Tier 2 contractors who could actually install measures. Some programs such as the CA SW HEES were clearly discouraged from providing follow-up by their inability to claim energy savings for the program by the CPUC.

Use of a single implementation contractor appears to be the most effective way of ensuring coordination across various types of audits. Having an effective program database (as discussed below) also adds to the ability of program manager to track audit requests, status, and outcome.

Best Practices

Program Management: Project Management
• Utilize electronic project management.
• Make customer follow-up part of the implementation contractor's responsibility.
• Actively involve leading businesses in the segment targeted for transformation.
• Use a single prime contractor as the point of contact with the utility.
• Support program managers with accurate information about market conditions and market segments.

- **Utilize electronic project management.** Specify best-of-class IT solutions for end-to-end business process automation and thus improved access to information for enhanced productivity and cost savings. TOS Inspection attempted to do this through the use of a sophisticated database and a team of IT vendors.

- **Make customer follow-up part of the implementation contractor's responsibility.** Extending the implementation team's scope beyond audits alone should encourage greater emphasis on spurring customers to take action. Home Performance with ENERGY STAR did this by offering incentives to the auditing contractors. Alternative approaches include lower cost follow-up phone calls, postcards, or e-mails.

- **Actively involve leading businesses in the segment targeted for transformation**. Ensuring that for-profit parties are allowed an opportunity to realize benefits beyond those provided solely by the direct program management contract or incentives encourages additional private investments, support of upper management, and the creation of private sector stakeholders who have a long term interest in the success of the program objectives.

- **Use a single prime contractor as the point of contact with the utility**. Coordination within and across programs can also be effectively attained through in-house program management, but using multiple contractors to implement different audit programs make coordination more difficult.

- **Support program managers with accurate information about market conditions and market segments**. Rigorous market research in advance of program design and continuous program evaluation can help ensure customer and trade ally satisfaction and maximize overall cost effectiveness.

3.3   PROGRAM MANAGEMENT: REPORTING AND TRACKING

All of the R7 Programs had some process for reporting and tracking the progress and/or impact of program activities. For most programs, the emphasis was on tracking activities (i.e., the number of audits) rather than results (i.e., energy savings). All sponsors/administrators, and implementing contractors tracked 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 typically involved fairly detailed monitoring of activities, especially progress toward goals and project status.

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 R7-4. The number of audits performed was reported to be the key indicator tracked, however, a number of implementers found value in tracking other indicators as well, in particular, the number of phone calls expressing interest in an audit, the number of mail-in audits sent out, recommendations made and associated energy savings, measures implemented, and customer characteristics.

Exhibit R7-4
Key Reporting and Tracking Indicators

Program	Key Tracking Indicators	Purpose
Home Performance with ENERGY STAR	• Number of reporting contractors • Number of homes assessed and treated • Measure costs and paybacks • Amount of financing provided	• Track the performance of individual contractors to see who is active and who is doing a good job • The contractors generate a computerized analysis of the home's performance and identify measure costs and paybacks. These reports are included in the tracking system • Tracking system helped NYSERDA see that many small jobs were not being reported, which led to introduction of incentives in lieu of financing
CA SW HEES	• Number of mail-in audits sent out (by language) • Number of mail-in audits returned (by language) • Number of online audits • % HTR mailed and returned • audit results, recommendations, savings	• Track overall progress against goals • Determine whether HTR percentage is being met • Support impact and process evaluations
TOS Inspection	• Number of inspectors trained • Number of audits • Customers • Measure recommendations • Savings (estimates)	• Data provided to contract managers and used to improve program design/performance

Program	Key Tracking Indicators	Purpose
RCS Audit	• % of customers installing measures • Number of audits • Outcomes • Individual measures installed	• For reporting to the DOER • To determine how well the program is doing • To follow up on customers who claim rebate checks but do not install recommended measures • To determine if the portion of rebate paid by the utility should be increased
E+ Energy Audit	• Customer contacts, customer characteristics • Number of audits, measures recommended	• Northwestern uses the results to prepare reports on the disposition of USB funds • To determine the status of any request or job in the system at any time • Keeps utility informed both in talking to the customer and in preparing audit reports
SMUD Audit	• Number of training sessions • Energy efficiency initiatives • Number of energy audits by type (in-home, mail-in, CDROM, online) • Number of energy audits in comparison to goal • Customers who have participated through various types of audits	• Used in program manager's monthly report to track progress

In designing tracking systems, implementers must balance the need to capture important program and customer information against the significant extra cost of follow-up contacts. Follow-up is primarily used to determine whether recommended measures have been installed so that savings can be estimated. Most implementers of information-oriented programs tend not to track the actions of every audited customer, relying instead on follow-up with a sample of participants for evaluation purposes. Since the program tracking goals of information programs are typically based on the number of audits conducted rather than kW savings, the extra time and cost associated with tracking installed measures is difficult to justify.

Tracking the *potential* impact of audits, on the other hand, is something to which the audit tools used by all the R7 Programs are ideally suited. Since the audit –whether conducted in person, by mail, or over the Internet – captures detailed baseline data, energy savings that the homeowner would be likely to realize if the recommendations were followed could have been calculated easily using engineering algorithms in the audit software. Among the R7 Programs, only the TOS program tracked and reported those potential savings, and at least one program manager lamented the failure of evaluators and funding sources to tap this rich source of data.

The array of information recorded supported a number of purposes. The standard functions were regulatory reporting, internal performance monitoring and project status tracking. For example, Home Performance with ENERGY STAR tracked the performance of individual contractors "to see who is active and is doing a good job." (Fisk, 2003) The tracking system also helped Home Performance with ENERGY STAR program managers see that many small jobs were not being reported by contractors (who did not finance them or seek incentives), which led to introduction of incentives in lieu of financing for small jobs.

Among the more sophisticated tracking systems are the following:

- For TOS Inspection, GeoPraxis used a fully Web-based Home Energy Rating Services (HERS) Server (residential audit application based on IDEA Server™ and DOE-2. The HERS Server used a SQL Server database, and provided MS Access and MS Excel data extracts for third-party evaluation, measurement and verification (EM&V) consultants. The database was remotely hosted (in Virginia), and was accessible over the Internet by IT staff (in India and California), program management contractor staff (in Virginia, Georgia, and California), sub-consultants (in California), trade allies (in California), and consumers (in California).

- Several of the online audit tools used for CA SW HEES captured and stored all the data collected during the audit, as well as the recommendations made, including costs and expected measure level energy savings associated with each. However, these data were not routinely reported in regulatory filings because it was not a requirement for CA HEES.

A few program implementers noted the limitations of their current or previous systems and described recent upgrades or interest in expanding the functionality of their tracking systems.

- After many years of using an internally developed database developed in the mid-1980s, KEMA-XENERGY moved to a sophisticated relational database for CA SW HEES.

- For E+ Energy Audit, KEMA-XENERGY tracked every step of a customer's interaction with the program using an Access database. However, the actual audit results, recommendations, and estimated costs and savings were tracked separately by the RECAP audit software.

- SMUD Audit used a stand-alone database developed in-house for tracking. While this database was useful for determining how many people had received various kinds of audits, the dedicated program database did not integrate with other SMUD programs, which complicated reporting efforts – particularly since one of the goals of the audit program was to direct customers to other programs. SMUD is moving to an integrated database in 2004 to facilitate the reporting process.

Program Management: Reporting and Tracking
• Integrate marketing, customer, audit, and impact data. • Make the audit recommendations, including energy saving potential, part of the program tracking database. • Design the program tracking system to support the requirements of evaluators as well as program staff. • Utilize databases that fully integrate audit participation and results with other energy efficiency program information systems. • Track vendor activity and measure volume where relevant.

- **Integrate marketing, customer, audit, and impact data.** This will support tracking the effectiveness of marketing efforts, analysis of audit customer demographics, and the extent to which various categories of residential customers (including HTR customers) are successfully reached by the program.

- **Make the audit recommendations, including energy saving potential, part of the program tracking database.** Knowledge not just of what measures were recommended, but also what kinds of measures were installed and what kinds were rejected can be very helpful in designing follow-up strategies or marketing approaches for other residential programs.

- **Design the program tracking system to support the requirements of evaluators as well as program staff** so that the kinds of information sought by each group can be readily obtained from the program database.

- **Utilize databases that fully integrate audit participation and results with other energy efficiency program information systems.** This facilitates management review and tracking the effectiveness of the audit program in directing customers to rebate programs.

- **Track vendor activity and measure volume where relevant** to assess relative vendor effectiveness.

3.4   PROGRAM MANAGEMENT: QUALITY CONTROL AND VERIFICATION

The extent to which the R7 Programs used verification protocols varied with the degree of program involvement in measure installation. Programs like CA SW HEES, SMUD Audit, TOS Inspection and E+ Energy Audit limited verification to phone calls or follow-up letters asking customers about the measures they had installed, either as part of the program process or as part of the evaluation. Programs involving contractors who installed recommended measures, on the other hand, conducted verification inspections of a percentage of installations.

Measurement and verification (M&V) requirements of the R7 Programs are summarized in Exhibit R7-5. Home Performance with ENERGY STAR had the most thorough inspection regime, inspecting 15 percent of all sites after measure installation by the contractor. These inspections are conducted by NYSERDA's Program Implementation Contractor (CSG). BPI conducts an additional level of inspections beyond NYSERDA's. Program managers noted that the percentage of sites inspected was higher for new contractors and for contractors who had had problems in the past. In the past (including the year analyzed for this review), National Grid relied on the implementation contractors to self-inspect installations for their audit programs. After several customer complaints, however, program managers instituted a third-party inspection process.

Exhibit R7-5
Measurement and Verification (M&V) Requirements

Program	M&V Requirements
Home Performance with ENERGY STAR	• Random inspections of 15% of completed improvements, plus additional random inspections by the Building Performance Institute • Results of testing are verified to determine if recommendations were sound, and then installation of the measures themselves is verified • Start with a higher percentage of inspections for new contractors, and also increase the percentage if problems are found with a certain contractor, and may go down below that once contractor has a proven track record • For home inspections, measure installation quality, failure rates, implementation quality, and adherence to process • On other jobs, results are reviewed through the program database, which provides information on measures installed for each job
CA SW HEES	• RECAP software for mail-in has built in internal validation routines for reporting results • Follow-up phone calls conducted as part of the evaluation are the only method used to verify installation (education/information only program)
TOS Inspection	• Installation of measures verified by 3rd party evaluator telephone survey • Quality control (QC) of inspectors required by Residential Energy Services Network (RESNET) standards, including observation in field of inspector prior to certification; followup QC • Automated QC procedures in software seek out outliers in all audit reports • All reports receive QC review by specially trained QC auditor • Feedback to inspector if outlier reports are identified
RCS Audit	• Third party verification process to ensure measure installation
E+ Energy Audit	• No verification that measures are installed (other than the direct install measures) but, customers receive a 6 week follow up letter to see if measures have been installed for any recommended major measure with less than 7 year payback • QC includes auditors handing out cards where customers rate the job they did; as well as about 160 follow-up phone calls a year where customers are asked about the process and the results

Program	M&V Requirements
SMUD Audit	• Verification is limited to calling customers and asking if they have installed measures and if they were satisfied with the audit process

In addition to verification of installed measures, several respondents cited a broad range of other quality control measures used to ensure the effectiveness of program delivery. NYSERDA, for example, verified measure installation quality, failure rates, implementation quality, and adherence to process for Home Performance with ENERGY STAR. For TOS Inspection, GeoPraxis mentioned using automated quality control procedures in their audit software that highlighted outliers in audit reports, as well as a certification process for home inspectors required by Residential Energy Services Network (RESNET) standards. SMUD evaluated the quality of SMUD Audit training, and Northwestern Energy reported having auditors hand out cards for customers to rate the quality of the audit, as well as make 160 follow-up phone calls a year in which customers were asked about the process and the results of E+ Energy Audit. All of the online audit tools used by the audit programs reviewed also included internal automated quality control processes based on where actual results fall on a log-normal distribution of expected results, allowing outliers to be identified for follow up (e.g., review for data entry errors, follow-up phone calls).

Best Practices

Program Management: Quality Control and Verification
• Conduct on-site post-installation inspections by a third party where appropriate.
• Conduct follow-up telephone calls to provide an accurate estimate of the number of measures installed.
• Use audit tools to check for the reasonableness of savings and payback estimates.

- **Conduct on-site post-installation inspections by a third party where appropriate** 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, but the percentage should be higher for newer contractors.

- **Conduct follow-up telephone calls to provide an accurate estimate of the number of measures installed.** This can be done as part of the evaluation function, but should be done in a timely manner to provide program managers with relatively quick feedback on the percentage of audits that lead to action being taken – recognizing that there is a lag between audits and measure installation.

- **Use audit tools to check for the reasonableness of savings and payback estimates.** Catching "outliers" through an automated process allows implementation staff to identify shortcomings in the quality of the audit and recommendations.

3.5   PROGRAM IMPLEMENTATION: PARTICIPATION PROCESS

For many programs, including the R7 Programs, a tradeoff exists between the 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 R7-6 describes the steps involved in participating in the R7 Programs. All of the programs assessed recognize the importance of simplicity and have streamlined participation, while maintaining the information necessary for tracking and verification.

Determining customer eligibility is usually simple for audit programs; the exception is programs that have requirements regarding the age of the home to be audited or the fact that a home can only have one audit (this limit usually does not apply to online audits). Programs that target HTR customers usually do so through marketing efforts rather than by limiting participation of non-HTR customers.

Exhibit R7-6
Participation Process

Program	Participation Process
Home Performance with ENERGY STAR	1. Customers contact a participating Building Performance Institute certified contractor 2. Contractor performs an audit and provides recommendations for energy improvements, including itemized cost estimates for each suggested improvement, a report outlining energy savings for each improvement, and financing options to get the job done 3. If the homeowner proceeds with the improvements, the $100 cost of the audit is deducted from the total cost
CA SW HEES	1. Utilities mass-mail mail-in audit forms to 100% HTR customers, who complete and return, then receive audit report with recommendations; customers can also call and request a mail-in audit form 2. Alternatively, customers can go to their IOUs website and complete and online audit form, which generates an immediate audit report with recommendations 3. All audit recommendations include links to other EE programs and services
TOS Inspection	1. Home inspectors are informed of upcoming training seminars via trade association monthly meetings 2. Inspectors are trained (technical and sales training) and certified (after 3 successful supervised audits) 3. Inspectors begin offering service (included in regular fee or as up-sell option) 4. Inspectors receive per audit incentive based on number of completed audits submitted to server
RCS Audit	1. Any residential customer in the state may call Mass Electric through a statewide 800 number, which forwards those calls to the program's energy efficiency advisor vendor 2. The customer can answer specific questions from the energy advisor or fill out the Nexus ENERGYgram self qualifying form 3. Based on the answers, the ENERGYgram or the energy advisor offers energy efficiency tips and determines whether an on-site audit might be beneficial 4. If an onsite audit is performed, the program offers residential customers an incentive that will cover up to 50% of the cost of all allowable measures, up to a maximum of $1,000

Program	Participation Process
E+ Energy Audit	1. Customers call in and ask for an audit 2. Utility determines whether customers qualify for the on-site audit and if they do, schedule the audit 3. The audit is performed and free measures are installed (water heater blanket, up to 10' pipe insulation, low-flow showerheads and aerators) 4. Results and recommendations are sent out about 5-10 days later, including bill disaggregation and recommendations of measures with paybacks of less than 7 years 5. Customers who have no space or water heat fuels delivered by NorthWestern Energy (or whose homes are less than 5 years old) are sent the E+ Energy Survey, a mail-in audit
SMUD Audit	1. When they contact SMUD, most customers receive a choice of three low-cost energy survey products: online survey on SMUD's website, CD with a Nexus product, or mail in questionnaire for people who do not have a computer 2. Customers who have significantly high bills or other special needs may receive the more costly in-home audit

Incentive Approaches

The R7 Study revealed the importance of incentive approaches as part of the participation process for residential audit programs. Exhibit R7-7 summarizes information collected on R7 Program incentives. For all programs except Home Performance with Energy Star, the basic incentive was the availability of a no-cost audit. However, several of the R7 Programs offered further incentives to encourage measures installation – payments of up to 50 percent of installed measure cost – as part of the program itself. In addition, some programs provided 100 percent incentives in the form of free low-cost measures such as low-flow showerheads and CFLs, while others offered miscellaneous incentives to vendors (home inspectors and contractors) to encourage their participation. These audit programs sometimes also made recommendations for measures offered through other rebate programs offered by the sponsoring utility.

While incentives offered for the installation of recommended measures are beyond the scope of "pure" audits and could be considered separate elements in the residential portfolio, they are included here because the audits are central elements of these programs, and it is not possible to separate the management, delivery, tracking, and evaluation of the different program components.

Program	Incentive Approach	Level of Incentive
Home Performance with ENERGY STAR	• Customer pays for audit, but $100 cost is deducted from total cost if customer adopts recommended improvements • The program offers incentives to ensure that all available cost-effective energy efficiency opportunities are captured. This includes referral incentives because different trades have traditionally operated in isolation, which meant that an HVAC contractor had no reason to address insulation or ducts, for example. The referral incentive was designed to address that • Incentives designed to encourage contractors to pursue whole house opportunities	• Customers have access to low interest financing or can take the 10% financing incentive if they self-finance the work (up to $2000). • NYSERDA pays contractors an incentive equal to 5% of the value of work contracted and completed as a result of a proposal made using a whole house approach. • Contractors are also eligible for a referral incentive of 5% of the value of referred work when and if the referral turns into a contract.
CA SW HEES	• Free audits	• 100% of audit cost
TOS Inspection	• Free audit • Free measures kit	• Per audit incentive of $35 for inspectors (full incremental cost of energy audit) • Free measures kits (2 CFLs, 1 showerhead, 2 aerators, $25 value) mailed to consumer after audit (PY2002-04 only)
RCS Audit	• Free audit • Program provides incentives to encourage customers to install measures	• 100% of audit cost • Rebates of up to 50% of installed cost for qualifying measures, mostly for heating, hot water, insulation, and appliance
E+ Energy Audit	• Free audits • Free measures with on-site audits	• 100% of audit cost • On-site audit customers receive free measures: water heater blanket, pipe insulation, low-flow showerheads; bathroom and kitchen sink faucet aerators
SMUD Audit	• Free audits	• 100% of audit cost

GeoPraxis' experience using or trying to use incentives as part of TOS Inspection illustrates some of the difficulties associated with rebates. When the TOS Inspection predecessor program was rolled out in 2001 by SCG, it paid a $35/audit incentive to inspectors. This proved so successful (27,000+ audits) that SCG declared the market "transformed" and did not renew

funding. Since the market clearly had not been transformed, numerous inspectors who had made efforts to begin offering energy inspections on a fee for service basis were left stranded until the program was re-launched by GeoPraxis in 2002[2].

Some R7 Programs adjusted incentive levels during the course of the program to better meet goals. NYSERDA added a 10 percent incentive to Home Performance with ENERGY STAR as an alternative to low-cost financing for smaller jobs that were being self-financed by the homeowner. National Grid consciously used rebate levels as a means of increasing the percentage of measures installed. When installation levels fell below 20 percent early in the 2003 program year, program managers increased rebate levels to bring installations back to historical averages. It should be noted, however, that EM&V of the CA SW HEES (and before that the audits programs offered individually by the IOUs) reported installation rates higher than this without offering any incentives beyond the free audit.

Best Practices

Program Implementation: Participation Process
• Provide a range of options.
• Make program participation part of an existing, routine transaction such as the purchase of a home or the installation of a heating or cooling system.
• For market transformation strategies, provide vendors with an economic incentive to participate, as well as an easy, simplified participation process where appropriate.
• Make the audit flow seamlessly into the adoption of recommended measures.
• Use rebates primarily to support market transformation strategies.
• It is not necessary to offer free measures for a program to succeed, although installation of low-cost measures does ensure that every audit delivers at least some energy savings.
• Use incentives to promote a specific technology or target a specific segment.

- **Provide a range of options** to offer participants a choice of audit paths and hold down the cost per audit. Online audits offer excellent potential for low-cost audits, assuming participants can be adequately screened for eligibility and provided enough support. However, it is much more difficult to achieve significant participation through online audits than with mail-in audits.

- **Make program participation part of an existing, routine transaction such as the purchase of a home or the installation of a heating or cooling system**. This makes audits more likely to become a permanent part of the market.

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[2] When GeoPraxis proposed a similar program for Northern California in 2003, the CPUC authorized it as a training and information program, with a free low-cost measure distribution element, but without any incentives paid directly to inspectors – apparently because the funds for inspector incentives were quickly depleted..

- **For market transformation strategies, provide vendors them with an economic incentive to participate, as well as an easy, simplified participation process where appropriate**. For those programs were vendors are the most important actor in the prospecting and delivery mechanism, success depends on a process that facilitates participation and keeps contractor costs modest.

- **Make the audit flow seamlessly into the adoption of recommended measures**, for example by providing model numbers of qualifying measures. Linking audit results to specific actions increases the likelihood of installation and associated impacts. This can be facilitated by providing detailed information regarding available rebates and qualifying measures or equipment, including specific model numbers, or other criteria.

- **Use incentives primarily to support market transformation strategies**. Short-term incentives can help vendors offset higher costs associated with modifying their business practices. However, incentives should be used sparingly.

- **It is not necessary to offer free measures for a program to succeed, although installation of low-cost measures does ensure that every audit delivers at least some energy savings**. Programs with free measures do not have substantially higher installation rates or impacts than do programs without them.

- **Use incentives to promote a specific technology or target a specific segment**. Rebates may be an appropriate strategy for encouraging greater participation among HTR customers, if that is deemed to be an explicit program goal.

3.6   PROGRAM IMPLEMENTATION: MARKETING AND OUTREACH

Since most of the R7 Programs targeted a very broadly defined population, a mass marketing and outreach approach was used. Direct mail pieces and bill stuffers were by far the most common types of marketing materials used by the R7 Programs.

- RCS Audit's statewide marketing efforts encouraged people to call a toll-free number, which subsequently directed them to the appropriate utility's audit program.

- For CA SW HEES and other mail-in audit programs (i.e., SMUD Audit and the mail-in component of E+ Energy Audit), the direct mail piece often **was** the audit form. In 2002, approximately 440,000 audits were sent out by the four California IOUs, and approximately 12 percent of those were completed and returned.

- For CA SW HEES, the direct mail effort was modified by the requirement that at least half of the marketing be targeted to HTR segments, defined according to the following criteria:
  – Primary language spoken is other than English
  – Income is in the moderate level
  – Multi-family and mobile home tenants

– Geographic areas other than San Francisco Bay area, San Diego area, Los Angeles Basin, or Sacramento

– Renters

To reach these HTR segments, mailings were produced in multiple languages (in English and Spanish for all four IOUs, also in Chinese for PG&E, SCG and SCE, and in Vietnamese for SDG&E) and targeted to the geographic areas described above. Unfortunately, the definitions of HTR that lend themselves readily to direct marketing are all geographically based, which is only a single dimension of the HTR definition, and not a very effective one at that, since many "rural" zip codes are, in fact, relatively affluent "outer suburbs." While the CA IOUs succeeded in achieving their goal of sending more than half their mailings to the targeted segments, the 2002 program evaluation findings suggest that HTR customers were still not fully represented in the mail-in program. (Ridge, 2004) Specifically, the evaluation found that people with a college or graduate degree were overrepresented in the program, while the following were underrepresented:

- Apartment dwellers (nearly 87 percent of participants lived in single-family detached dwellings)

- Households with incomes of less than $50,000/year

- Hispanics and Asian-Americans

- Online audits were marketed using bills stuffers and direct mail, and also via the Internet itself. In addition to online advertising, the audits were promoted by more prominently featuring links to the residential audits on the home pages of the utility Web sites, and at least some of the utilities also utilized an e-mail "blast," a message broadly distributed to a third-party list to inform customers in their territories about the online audit.

For programs that used other market actors – contractors and home inspectors - to deliver the audits, mass marketing was significantly less important. TOS Inspection initially (and effectively) focused its marketing on recruiting inspectors, but later began to focus on helping home inspectors market the program to consumers.

Home Performance with ENERGY STAR relied on contractors for marketing, but supplemented that with a mass market outreach effort designed to increase awareness of the program among homeowners. The comprehensive consumer and contractor awareness/education campaign was focused on "call to action" marketing, creating both consumer demand and contractor participation. The goal of increasing consumer demand was based on the belief that this is the true driver of market transformation. Homeowners received information on the program by accessing the NYSERDA Web site or by calling a toll-free number. As a result of their inquiry, homeowners received an information packet, a video and a list of participating contractors in their area. Providing a homeowner with a list of participating, certified contractors not only served to boost the homeowner's comfort and confidence level in the program, but also generated qualified leads for the contractor.

Program Implementation: Marketing and Outreach
• Provide customers with a single statewide point of contact.
• Feature links to residential audits prominently on utility Web sites.
• Combine outreach to vendor partners with mass marketing efforts to raise consumer awareness and demand when appropriate.
• Use target marketing strategies to ensure that hard-to-reach (HTR) populations are informed about available audit programs.
• Make marketing materials (as well as the audit instruments themselves) multi-lingual.
• Provide contractors or inspectors used to deliver programs with training and resources to enable them to market effectively.
• Take advantage of external factors such as heat waves to enhance marketing effectiveness.
• For mail-based audits, include the audit form with the audit offer and make the offer letter succinct and compelling.

- **Provide customers with a single statewide point of contact.** For all types of audits, use of an 800 number that can direct customers to the appropriate utility or other organization depending on their location or need makes it easy for consumers to respond to marketing initiatives.

- **Feature links to residential audits prominently on utility Web sites.** For CA SW HEES, online audit participation improved when links to the online audits were moved to the utility's Web site home page instead of being located several layers down. In addition, the evaluation of the Internet information pilot cited previously (Quantum Consulting 2004) found that the number of Web site hits increased with the offer of an amazon.com gift certificate as an incentive, but that the number of site visits dropped sharply when the incentive period ended.

- **Combine outreach to vendor partners with mass marketing efforts to raise consumer awareness and demand when appropriate.** This strategy was used effectively by Home Performance with ENERGY STAR to recruit new contractors while making residents aware of the program.

- **Use target marketing strategies to ensure that hard-to-reach (HTR) populations are informed about available audit programs.** Sophisticated tools (such as Donnelly and Microvision codes) are currently being used in California to target mail audits to customers who truly meet the HTR criteria.

- **Make marketing materials (as well as the audit instruments themselves) multi-lingual**. This will help make audits available to a broader range of potential respondents, including those in the HTR population. This is especially important if reaching non-English speaking populations is a goal.

- **Provide contractors or inspectors used to deliver programs with training and resources to enable them to market effectively.** Vendors who deliver program related services may not have any training or background in marketing, yet their ability to market the program can be crucial.

- **Take advantage of external factors to enhance marketing effectiveness.** Heat waves, the energy crisis, and other high-visibility events or trends increase the number of customers interested in residential audits. Marketing efforts should leverage such events wherever possible (and consistent with the program's ability to respond to the demand).

- **For mail-based audits, include the audit form with the audit offer and make the offer letter succinct and compelling.** Participation rates in mail-in audits with compelling offer letters can be as high as 20 percent or more in some segments. The offer part of the letter should be no more than one page. Including examples of audit reports and emphasizing that the results will be truly customized to the unique characteristics of the participant has also been shown to be effective.

3.7 PROGRAM EVALUATION

The history of evaluations of audit programs has varied as widely as the goals of the programs themselves. When audits were funded by IOUs as part of commission-mandated conservation efforts, significant resources were devoted to developing impact estimates using engineering algorithms, modeling, and/or billing analysis. When market transformation became the dominant paradigm, evaluators looked for evidence of reduction in market barriers and other indicators of permanent changes in the marketplace (this remains true for several MT-oriented programs, including those of NYSERDA[3], GeoPraxis[4], and CA SW HEES).

Most of the R7 Programs were funded using public benefits charges, and therefore had to demonstrate that money was effectively spent. Formal evaluations for the R7 Programs typically encompassed program accomplishments in terms of customers reached and audits completed, but not necessarily in terms of impacts achieved, since few of the programs defined their goals in terms of kWh savings. For programs such as CA SW HEES, this created a dilemma in that impacts have not been an explicitly tracked goal for this and other audit programs in the past, but the growing emphasis on resource acquisition forced program managers and evaluators to take a second look at impacts that could be directly tied to the money spent on residential audit programs.

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[3] While a thorough evaluation of NYSERDA's 2002 program had not been done at the time of this report, some evaluation results are now available on NYSERDA's website through 2003. These results incorporate market characterization and causality, M&V, and process evaluation metrics.

[4] A process and impact evaluation of the TOS program (2002-2003, no inspector incentives) is available at www.Calmac.org.

The CPUC mandated that audit-recommended installed measures be assumed to have measure lives of just two years – a reasonable assumption for behavioral actions taken (such as setting back thermostats), but unduly conservative for equipment measures such as CFLs, insulation, or HVAC upgrades. Both the evaluation of the 2001 SCE audit program (Ridge, 2002) and the evaluation of the 2002 program (Ridge, 2004) found that installed measures typically have a significantly longer life, and that per-home impacts can be estimated to average about 300 kWh annually – not high, but more than the zero impacts assumed by the CPUC Energy Efficiency Policy Manual. The 2002 SCE evaluation found that estimated useful life averaged about 3.5-4.5 years for online, mail-in, in-home and telephone audits, while measures installed as a result of time-of-sale audits were estimated to have a useful life of more than 13 years.

This general level of impacts has been confirmed in a number of evaluations that show savings of 2-5 percent of annual usage, which is consistent with the 300 kWh estimated cited above. Examples include an average of 343 net kWh for the 1995 SCE in-home audit program; 391 kWh for the 1997 SDG&E Residential Energy Management Services program; 156 kWh for in-home and 67 kWh for telephone and mail-in audits for the 1997 PG&E Residential Energy Management Services programs; 432 kWh for in-home and 154 kWh for telephone audits for the 2001 SCE Residential Audit programs; and 473 net kWh for the 2000 GeoPraxis TOS program.

Exhibit R7-8
Types of Residential Audit Program Evaluation

Program	Last Major Evaluation	Type of Evaluation
NYSERDA	2003	Process Impact
California IOUs	2002 program	Impact Process
GeoPraxis, Inc.	2002-2003 program	Process Impact
National Grid	2002	Impact
Northwestern Energy	1990s	Impact
	Yearly	Informal customer surveys
SMUD	2004	Informal customer surveys

Beyond traditional impact and process evaluation objectives, recent evaluations of programs with HTR goals sometimes involve assessment of how a program is meeting equity concerns. For instance, equity was an explicit goal of CA SW HEES, which set a 50 percent HTR goal, as described earlier. The evaluation of the program found it met its HTR requirements, with over half of the customers who completed mail-in audits in populations defined as HTR.

One worthwhile practice that was raised across programs is to *closely* involve program implementers in the evaluation process. Both NYSERDA and the California IOUs had implementation staff participate in evaluation kick-off meetings and made them available to be interviewed by the evaluation team. Not only does this practice encourage implementers to buy-in to the evaluation process, it also gives them an opportunity to pose questions and bring their research needs to the evaluation study. In addition, evaluators can brief the implementation team on high level, actionable findings in the draft stage and take consideration of their feedback and perspective before finalizing reports.

Despite good progress in this regard, the evaluator for CA SW HEES would like to see even closer working ties for future programs, creating the ability to provide more rapid feedback to the program managers. Having evaluators provide input into the design of databases, for example, would help ensure that data could be made readily available in a format that would support subsequent analysis.

There are indications that the impacts associated with recommended measures may be miscalculated by some online audit programs. A 2002 paper in Building Energy reviewed more than 50 online and disk-based audit programs, and found that some of the most widely used overestimated impacts by as much as 52 percent (Mills 2002). In addition, interactive effects are not always adequately addressed by such software tools.

A significant issue regarding impact evaluations of residential audit programs is the need to wait a substantial amount of time to allow owners of audited homes to take action. Managers of the reviewed programs reported waiting from six months to a year before following up with customers to determine what measures they had installed. Ridge & Associates, in evaluating the 2000 SCE audit program, recommended that "it would be imprudent not to wait until at least a full year after the end of the program year to assess the full impact of the audit." (Ridge, 2002)

Of course the need to wait for a year for impact results conflicts with the desirability of contacting program participants for process-related questions when the audit is still fresh in their minds. Process evaluations are common for these programs but the level of effort and depth varies. Key process findings from these process evaluations include:

- Customers generally have high levels of satisfaction with the audit, regardless of whether it is delivered in person, by mail, by phone, or electronically.

- Reports are generally considered easy to read and interpret.

- In the evaluation of CA SW HEES, 85 percent of respondents said they were aware of the benefits of energy efficiency measures before they received the audit.

Program Evaluation
• Integrate impact evaluation and measure verification.
• Regularly assess program performance and success, such as measuring the level of energy and peak demand savings achieved.
• Periodically verify that the audit software is correctly calculating potential impacts.
• Conduct detailed impact evaluations that include measurement routinely, though not annually.
• Perform market assessments for those programs that have a market transformation component.
• Conduct process evaluations closer to the time of the audit than the impact evaluation.
• Conduct evaluations in a timely way, or concurrent with programs.
• Systematically update measure life every 2-3 years.
• Engage the implementation team in evaluation process.
• Present actionable findings to program staff both in real time and at the conclusion of study.

- **Integrate impact evaluation and measure verification**. Most impact estimates currently rely on self-reported data obtained through telephone verification interviews, and apply engineering estimates of per-measure impacts to those measures. The onsite verification of measures installed (including comparison of actual installations to those that were recommended) should be a basis for more robust estimates of program impacts. This would also allow evaluators to address persistence issues such as first-year failures (burn outs) and removals for lighting measures.

- **Regularly assess program performance and success, such as measuring the level of energy and peak demand savings achieved.**

- **Periodically verify that the audit software is correctly calculating potential impacts**. As reported in the 2002 study (Mills, 2002), some algorithms appear to have been programmed incorrectly. Moreover, there is always a risk that either the customer or the auditor enters data incorrectly. While internal validation routines will capture most such problems, evaluators should periodically examine a few audits in great detail.

- **Conduct detailed impact evaluations that include measurement routinely, though not annually**. While audit programs have not been required to demonstrate impacts, they will increasingly be called on to do so in jurisdictions like that of the California IOU's that emphasize energy efficiency as part of an overall resource procurement process.

- **Perform market assessments for those programs that have a market transformation component**. By using established indicators (for example, awareness and knowledge of efficiency measures for customers; use of a whole-house approach for contractors; incorporation of energy efficiency by home inspectors) to verify the extent of market transformation, program effectiveness can be measured.

- **Conduct process evaluations closer to the time of the audit than the impact evaluation**. While it is appropriate to wait for a year before conducting follow-up contacts to determine installed measures, questions regarding customer satisfaction and the effectiveness of program delivery should be addressed using data collected within a few months of the audit.

    - For those programs where vendors are integral to program delivery, process evaluations should include vendor satisfaction, and obtaining vendor input on the program process and on rebate levels.

    - For online audits, special care must be taken to identify the customer actually conducting the audit and then gathering information from them regarding issues like perceptions of using the site, and the quality/usefulness of the report. It may be worth asking a sample of online customers to conduct a brief process-related online survey immediately upon completing the audit.

- **Conduct evaluations in a timely way, or concurrent with programs**. Timely evaluations give real-time feedback to program staff and contribute to program planning.

- **Systematically update measure life every 2-3 years.** Measure life is a key parameter in estimating the lifecycle benefits of audit-recommended measures and therefore program cost-effectiveness. Measure life studies using a panel of program participants that are visited or interviewed every 2 to 3 years over the study life greatly enhances the accuracy of program assumptions, minimizing customer attrition and allowing the evaluators to better pin point the time at which measures fail.

- **Engage the implementation team in evaluation process.** Involving program staff early and throughout the evaluation is important to obtain their buy-in to the evaluation process, encourage them to develop research issues, solicit their perspective on program activities, and increase the likelihood they will review and utilize the evaluation results.

- **Present actionable findings to program staff both in real time and 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.

4. COMPARISON OF OUTCOMES

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.[5]

- **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.

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[5] 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.

- **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 practices 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.

Because a number of the R7 Programs had educational and market transformation goals rather than resource acquisition targets, it is difficult to compare their outcomes.

Information is presented on the Total Resource Cost (TRC) test, the associated discount rate and the average measure life, where available. Also shown are non-incentive dollars spent per kWh, which offers an indication of the cost to market and administer. Incentive dollars per kWh shows the overall average incentive amount per unit of estimated first-year net impact. Cost-effectiveness data made available to the Best Practices Team for the R7 Study are displayed in Exhibit R7-9.

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, 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. Furthermore, measure mix also affects cost-effectiveness. The exact measure mix was not made available to the Best Practices Team for all of the R7 Programs, although some qualitative information was available (e.g., TOS Inspection tended to recommend higher cost, longer lifetime measures than CA SW HEES).

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, 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.

Exhibit R7-9
Cost Effectiveness

Program	Home Performance with ENERGY STAR	CA SW HEES	TOS Inspection	RCS Audit	E+ Energy Audit	SMUD Audit
kWh saved per incentive paid (kWh/$)	0.62	*	13.53	2.71	*	*
kWh saved per non-incentive $ (kWh/$)	0.26	4.08	14.51	1.46	3.63	0.38
Net to Gross Ratio	1	72%	72%	1	1	1
Total Resource Cost/Societal test	NA	NA	1.27	0.61	NA	NA
Utility cost test	NA	NA	NA	0.76	NA	NA
Average measure lifetime	NA	4.6	13.3	7.7	NA	NA
Real discount rate	NA	NA	NA	NA	NA	NA

Data Sources/Notes:

NA: Not available

*: No incentives paid, information only program

NYSERDA: c/b data not available for individual programs, only aggregate

California Statewide HEES: Interview with program evaluator, Ridge and Associates

GeoPraxis, Inc.: Ridge, 2002 (Note: inspector, not customer incentives)

National Grid: 2002 DSM Performance Measurement Report

Northwestern Energy: Annual Report of NorthWestern Energy Electric Utility - 2002

SMUD: Interview with program manager

In addition, a number of utilities/jurisdictions either did not have TRC and other benefit-cost data or were unable to provide it to the Best Practices Team – in some cases because program managers recognized the difficulty of accurately attributing measure installations and associated savings either to an audit-only program or to the audit component of a broader program. To the extent that such data exist but were not made available, it becomes more difficult to develop meaningful comparisons of various approaches to delivering and measuring the results of residential audit programs.

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APPENDIX R7A – BRIEF INTRODUCTION TO THE NATIONAL ENERGY EFFICIENCY BEST PRACTICES STUDY

INTRODUCTION

This report presents results of a comparative analysis of residential audit 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.
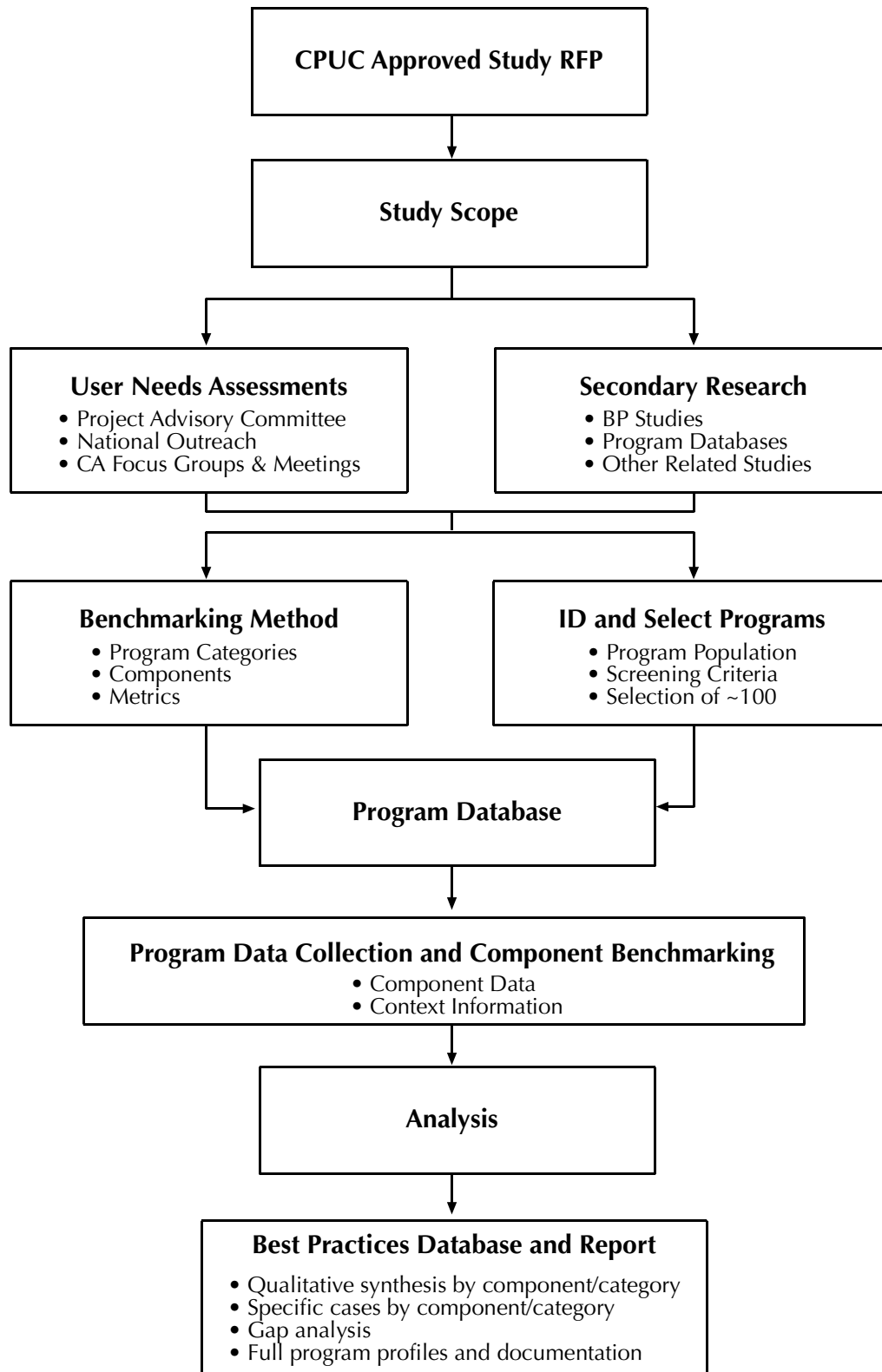
OBJECTIVE AND SCOPE

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 R7-10 below.

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                    │   CPUC Approved Study RFP   │
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                    │        Study Scope          │
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User Needs Assessments • Project Advisory Committee • National Outreach • CA Focus Groups & Meetings	**Secondary Research** • BP Studies • Program Databases • Other Related Studies

Benchmarking Method • Program Categories • Components • Metrics	**ID and Select Programs** • Program Population • Screening Criteria • Selection of ~100

Program Database

Program Data Collection and Component Benchmarking
• Component Data
• Context Information

Analysis

Best Practices Database and Report
• Qualitative synthesis by component/category
• Specific cases by component/category
• Gap analysis
• Full program profiles and documentation

As shown below in Exhibit R7-11, 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 R7-11
Relationship Among Program Outcomes, Components, and Context

Program outcome is a function of changeable program components and changeable and unchangeable context variables.

Outcome Metrics
Cost-effectiveness   Sustainability
Participation Rates   Market Effects

Context Variables
Program Design Policy Elements
Socio-Economic and other immutable factors

Program Outcome **=** Changeable Program Components **+** Changeable and Unchangeable Contextual Environment

Changeable Program Components
Design   Implementation
Management   Evaluation

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 R7-12 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., R7 Programs = Residential Audit R7 Programs for the Best Practices Study).

Exhibit R7-12
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	Cross Cutting		O1

PROGRAM SELECTION

Programs 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 Best Practices 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.