

Independent Verification of Statewide Savings from Energy Efficiency in Texas

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Introduction

Many states require utilities administering energy efficiency (EE) programs to engage third-party contractors to conduct independent measurement and verification inspections at project sites. The purpose is to ensure that measures are installed as claimed by project sponsors and to lend credibility to utility savings reports. Texas has pursued a program delivery approach where contractors (project “sponsors”) deliver the energy efficiency services, and the utilities themselves are responsible for adequate oversight of project activities. While this approach helps to keep administrative costs low, it does require an independent review process that can assure regulators of the legitimacy of the savings claimed by utilities from EE program activities.

This paper presents details of the process employed in Texas to validate utility savings claims, including methods used to address the limitations of an after-the-fact evaluation that does not include the expense of on-site M&V. The overall realization rate of verified to reported demand savings was approximately 102% in both 2003 and 2004, reflecting the fact that *the net impact of the evaluation was to increase the savings attributable to the utility programs*. The utilities were required by regulation to pay for the evaluation, and there were no guarantees—or even expectations—that the result would be to augment program savings. However, based on an evaluation cost of roughly \$300,000 and an increase in demand savings of 7,770 kW, the net effect of the evaluation was the utilities’ acquisition of additional demand reductions for less than \$40 per kilowatt.

It should be noted that since the M&V review described in this paper is primarily a *desk audit* of the energy and demand savings reported by the utilities, the scope of work did not include a true impact evaluation of programs, but rather a thorough review of the programs’ delivery methods and savings claims based on interviews, program databases, and paper records. No on-site inspections, metering, or customer billing analyses were conducted. Recommendations were made by the audit team for revising program rules and planning, improving program delivery and documentation of savings, and conducting other activities that may facilitate greater precision and reliability in verifying future savings.

Background

In 1999 the Texas legislature mandated that the state’s investor owned utilities (IOU) develop and implement energy efficiency programs that achieve a 10% reduction in forecasted annual demand growth. Six Texas utilities quickly ramped up programs that achieved peak demand savings well in excess of the state goals, according to the utilities’ Annual Reports filed each year with the Public Utility Commission of Texas (PUCT). However, with administrative costs limited by regulation to 10% of program expenditures, the utilities relied primarily on internal staff to conduct site inspections and ensure proper application of deemed savings values.

In order to verify the savings claimed by the utilities, an Independent Measurement and Verification (M&V) contractor was engaged to develop and implement a method for auditing program records and validating savings calculations for all six utilities across nine program types (31 unique programs) for the 2003 and 2004 program years. Specifically, the six utilities covered in the study included the following:

- American Electric Power (AEP)
- CenterPoint Energy (CNP)
- Entergy – Gulf States (Entergy)
- Texas-New Mexico Power (TNMP)
- TXU Electric Delivery (TXUED)
- Xcel Energy (Xcel)

The programs offered during the 2003-2004 program years, including both standard offer programs (SOPs) and market transformation programs (MTPs), are listed, by utility, in Table 1. The programs, in aggregate, achieved the following *reported* savings in those two years, exceeding the goals as defined by the PUCT in § 25.181:

- In 2003, reported demand savings = 150 MW (the goal = 136 MW).
- In 2004, reported demand savings = 192 MW (the goal = 147 MW).¹

Table 1. Utility Programs Included in M&V Audit

Program	AEP	CNP	Entergy	TXUED	TNMP	Xcel	Years
Residential & Small Commercial SOP	✓	✓	✓	✓	✓	✓	2003, 2004
Hard to Reach SOP	✓	✓	✓	✓	✓	✓	2003, 2004
Commercial & Industrial SOP	✓	✓	✓	✓	✓	✓	2003, 2004
Load Management SOP				✓			2003, 2004
ENERGY STAR New Homes MTP		✓	✓	✓	✓		2003, 2004
AC Distributor MTP		✓	✓	✓		✓	2003, 2004
AC Information & Training MTP				✓			2003, 2004
Multi-Family Water & Space Heating MTP		✓		✓			2004
Retro-Commissioning MTP		✓					2004

¹ Peak demand reduction goals were obtained from utility Annual Reports filed in April of the program year to which the goal applies.

Utilities were given some latitude in the selection of programs within their portfolio, and program templates that could be shared across the state were developed with the assistance of third party contractors. In addition, deemed savings values were approved by the Commission for use by project sponsors in situations where the same measure would yield similar savings when installed in a wide variety of settings or in situations where more extensive measurement and verification activities would prove cost prohibitive. Sponsors have relied upon the deemed savings values for nearly all of the energy efficiency projects completed through the Residential and Small Commercial Standard Offer Program (SOP), the Hard-to-Reach Standard Offer Program, the ENERGY STAR New Home Program, and the AC Distributor Program.

Methodology

Approach to Verification of Peak Demand and Energy Savings

The audit team verified the accuracy of the utilities' reported achievements in a uniform, systematic manner. The approach described below ensured equal treatment of each utility's claims while also allowing for review of the unique aspects of each of the energy efficiency programs. Specifically, the approach helped to ensure that:

- The demand and energy savings reported by the utilities were supported by program databases.
- Information in the databases was valid and was supported by program applications, inspection reports, or similar documentation.
- The sponsors utilized approved deemed savings estimates and applied them in an appropriate manner and/or the sponsors employed appropriate M&V procedures in accordance with the IPMVP (where a "full M&V" approach was used).
- Reasonable efforts were made to verify equipment installations and related activities performed as part of the programs (e.g., through post-installation inspections).

Throughout this process, any differences between the energy savings verified by the Summit Blue team and the savings reported by the utilities were recorded.² The M&V assessment grouped savings into one of three categories, with all reported kW and kWh savings assigned to one of the following:

1. **Verified Savings.** These are the reported savings considered by the review team to be real and verifiable based on program databases and supporting documentation provided by the utilities.
2. **Uncertain savings.** This category represents reported savings that are subject to some uncertainty due to insufficient quantity or scope of supporting

² For major discrepancies, the utilities were contacted to make certain that the Summit Blue team was not misinterpreting the information provided in supporting documentation. Concerted efforts were made to provide opportunities for the utilities to respond to follow-up requests with additional documentation or verbal/e-mail clarification that could resolve apparent discrepancies.

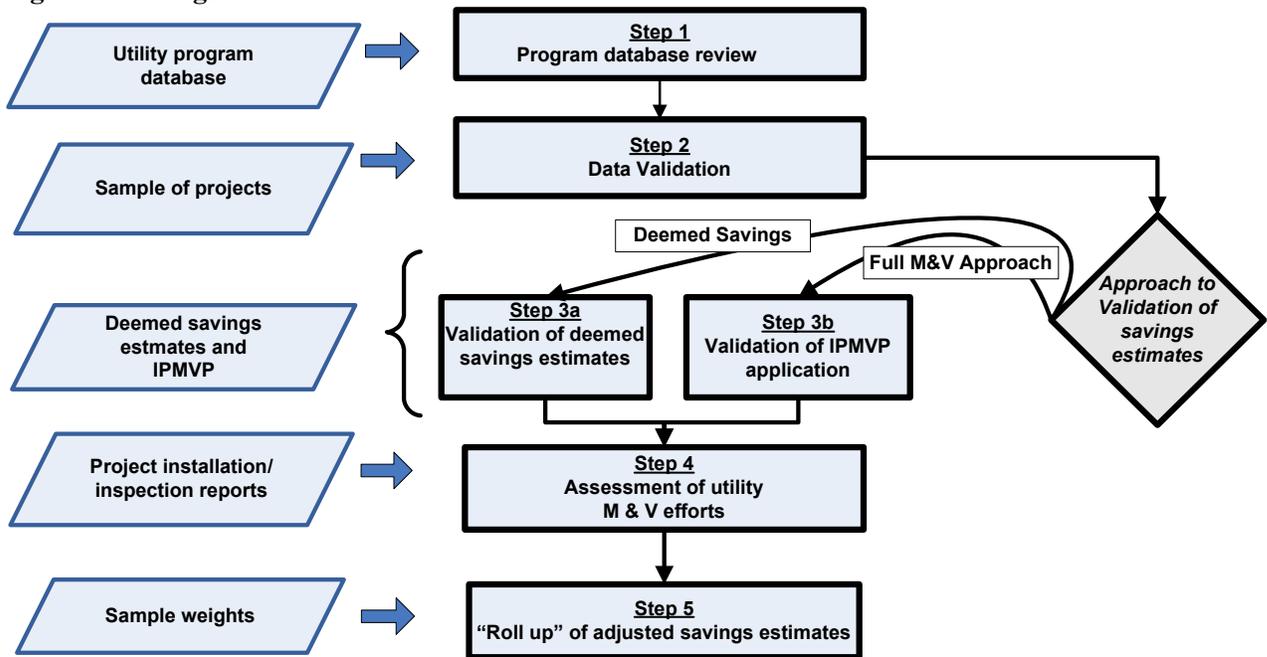
documentation. These savings may or may not have been realized, and their inclusion in (or omission from) savings totals reflects an upper (or lower) bound of verified savings estimates. Depending on the specific reasons for the uncertainty, the best estimate of verified savings typically reflects either 50% or 100% of the uncertain savings.³

3. **Reported savings that were not achieved.** Values of kW and kWh in this category represent savings reported by the utilities but for which essential supporting documentation was not provided or for which the review team has identified information in program records indicating that the savings were not realized.

There were five discrete steps in the verification process. In Step 1, program databases obtained from the utilities were used to document any discrepancies between official program records and the utilities' reported savings. Program applications, customer acknowledgement forms, and other documentation from a sample of projects/customers were reviewed in Step 2 in order to identify energy savings claims that were not fully supported by program documentation. In Step 3, energy savings from either the Step 2 sample or from entire program databases were recalculated using approved deemed savings values (or by verifying the adequacy of M&V documentation compared to the IPMVP) to identify the need for adjustments to savings for individual projects. Quantitative adjustments were not made in the Step 4 review of utilities' inspection/verification procedures, although findings were noted and contributed to recommendations for process improvements. In Step 5, findings from all prior steps were combined, including extrapolation of results from the sample of projects/customers to the entire population of participants. The five steps of the verification process are presented in Figure 1, along with the key inputs feeding the analysis.

³ In general, if the M&V team thinks that reported savings have occurred, but if insufficient documentation is available to support to utility claims, then up to 100% of the "uncertain" savings are included in the best estimate of verified savings (but not more than the average realization rate of all other customers in the sample for whom savings are not uncertain). However, if the lack of documentation precludes the M&V team from verifying savings beyond a reasonable doubt, then the best estimate is assumed to be only half of the "uncertain" savings. Statistical uncertainty from sample extrapolation also contributes to the values of the upper and lower bounds.

Figure 1. Savings Audit Flowchart



Step 1: Confirmation that Program Databases Support Reported Savings

The first step of the savings verification ensured that program databases contain savings figures corresponding to the values claimed by the utilities in their Annual Energy Efficiency Report filings to the PUCT. As necessary, utilities were asked to provide additional documentation or clarification supporting the values reported to the Commission. In particular, the utilities often were consulted to identify the specific customers and installations in the databases that formed the basis of the reported savings. If it was determined that a program database could not fully support reported savings, the verified savings from the M&V analysis reflected this difference.

The database was further validated by a comprehensive review that looked for anomalies suggesting data-entry errors. For example, one ENERGY STAR Homes participant was listed as having an invalid HERS rating of over 100, which is not possible.

Step 2: Random Sample Validation of Database Information with Supporting Documentation

Once the M&V team established which customers, installations, and savings values in a program database were reported by a utility, the validity and accuracy of the information in the database were verified. This entailed identifying a random sample of customers and reviewing utility-provided invoices and supporting documentation that pertain to the customers in the sample. The goal of this review was to confirm, where possible, that the number and type of equipment installations and the customer/site characteristics (particularly those such as square footage, which affect deemed savings calculations)

match the entries in the database. Any errors were noted and the resulting impacts on demand and energy savings were calculated.

For most programs, the sample of customers was identified through simple random selection, with 2003 and 2004 receiving an equal number of customers selected for review. Only the C&I SOP – in which savings varied significantly between customers – warranted a stratified random sample. This sample was based on energy savings reported in the program database. A census of all participating customers was selected for the Emergency Load Management and Retro-Commissioning programs, which had nine and four participants, respectively.

For each program, utilities were asked to provide “appropriate program documents/files that can verify specific equipment installation or actions taken at specific customer sites.” The following specific information was requested for each customer in the sample:⁴

- Applications
- Invoices from Sponsors
- Inspection reports (if there was an inspection for the project)
- Customer affidavits or other confirmation of participation in the program
- Any other supporting materials (*e.g.*, additional paperwork with information about the customer/site)

Utilities responded to these requests by providing copies of paper and/or electronic files from program records. The M&V team then reviewed the content of the files with utility staff as needed and, in many cases, made written follow-up requests for clarification or additional documentation. Utilities were given ample opportunity to provide missing documentation, respond to follow-up requests, or clarify the documentation provided prior to completion of the draft report. Where obvious errors were detected in calculating or reporting savings, the appropriate adjustments were made. Where documentation for customers in the sample was missing, the savings were determined to be somewhat uncertain:

- Where key documentation was missing for a customer even after any follow-up requests (*e.g.*, signed customer acknowledgement forms in the Residential SOP), 10% of the reported savings was classified as “uncertain,” resulting in a lower bound of verified savings of 90% of the reported savings.
- Where documentation was missing completely, 20% of the reported savings was classified as “uncertain,” and the lower bound of verified savings was 80% of the reported savings.

For most programs, missing paper documentation was not, in itself, reason for disqualification of savings so long as the customer was listed on a sponsor invoice. The rationale for this decision is based largely on the fact that in all of the programs in Texas,

⁴ The sample documentation requests for the Residential and C&I SOPs, the Emergency Load Management program, and the Retro-Commissioning program were customized for each utility based on interviews with utility staff.

the program databases contain the primary record of activity. Further, the inspection process, where applicable, sufficiently validates installations by identifying the presence of “phantom” customers if any sponsors reported installations that did not occur.

Step 3: Verify Appropriate Application of Deemed Savings Estimates and IPMVP

Deemed Savings

Demand and energy savings were often calculated by sponsors using deemed savings estimates approved by the Commission.⁵ These estimated energy savings are a function of not only the measure installed (as verified in Step 2), but also the assumptions used in estimating savings, such as operating hours. Since these assumptions are a major determinant of savings, the M&V team explicitly verified that the appropriate values were utilized in determining energy and demand savings. For example, the peak demand savings from air conditioners vary not only by the type and size of the unit, but also by the climate zone in which they are installed. The first step in this process involved having the M&V team ensure that program databases appropriately capture the necessary information and that the appropriate deemed savings value is applied to each project reviewed. Depending on the nature of the program and database structure, this verification was performed on all customers or, if that were not feasible due to format of the records, at a minimum, on the sample of projects as described in Step 2 above.

Approved deemed savings values are not contained in a single document, but rather are found in an assortment of regulatory filings, approved state codes, and market effects studies. The M&V team confirmed which documents contain applicable deemed savings assumptions and estimation methods through discussions with the utilities and their contractors. Additionally, interviews with the key staff at Frontier Associates, the utilities’ primary contractor, and other contractors⁶ were conducted to review questions regarding savings assumptions to their source, and to determine whether these assumptions were appropriately applied.

IPMVP

The C&I SOP is the only program for which a “full measurement and verification” approach (*i.e.*, IPMVP) was used. For those sampled projects employing IPMVP, the review looked for adherence with the following principles:

- Establishment of a site-specific M&V plan that specifies the metering/monitoring to be conducted and states how the baseline is to be established
- Identification in the M&V plan of how calculations were to be made and how quality assurance was to be maintained and the ability to replicate confirmed.
- The reports to be prepared, their contents and formats, and a stipulated timeframe during which they should be furnished.
- Terminology consistent with IPMVP definitions.

⁵ Note that the Market Transformation Programs were not required to use deemed savings estimates.

⁶ ICF Consulting and Nexant both provided savings estimates from engineering models for some programs.

Most importantly, this review determined whether the most suitable IPMVP option was chosen for a given project, whether appropriate baselines were chosen, whether the field data were gathered correctly, and whether savings calculations using these data were then properly applied.

Step 4: Assess Adequacy of Utilities' Verification/Inspection of Project Activities

In order to verify that projects were carried out as reported, the M&V team reviewed evidence of steps taken to verify installation of the measures included in the program databases. Utility program staff was interviewed to understand the inspection process and, for some programs, the utilities provided inspection reports in response to the team's Step 2 request for documentation for a sample of participating customers. Reported savings were verified to ensure that reasonable inspection procedures were employed and that inadequate measure installations identified through inspections were reflected in the databases through a reduction in savings.

No quantitative adjustments were made to the reported savings on the basis of the inspection documentation review since it was confirmed that the utilities already used the inspections to adjust savings figures prior to their annual reporting. The impact of inspections can be observed in the program databases by comparing initial savings estimates with the adjusted savings values.

Step 5: Savings Roll-Up

In this final step, impact adjustments from Steps 1-4 were combined to determine a best estimate and upper and lower bounds for the verified savings for each utility program. First, adjustments affecting all customers/projects (as opposed to just those from the Step 2 sample) were tallied by year as Program-wide Adjustments to the reported savings (Table 2). These adjustments generally include the Step 1 database review, the Step 3 deemed savings review, and sometimes other miscellaneous adjustments such as outliers/data entry errors in the database.

The remaining savings for each year were then adjusted based on findings from the review of supporting documentation for the random sample. Specifically, the verified savings realization rate from the sample was applied to all remaining savings for each year to yield a point estimate of verified savings.

Table 2. Template for Calculation of Verified Savings

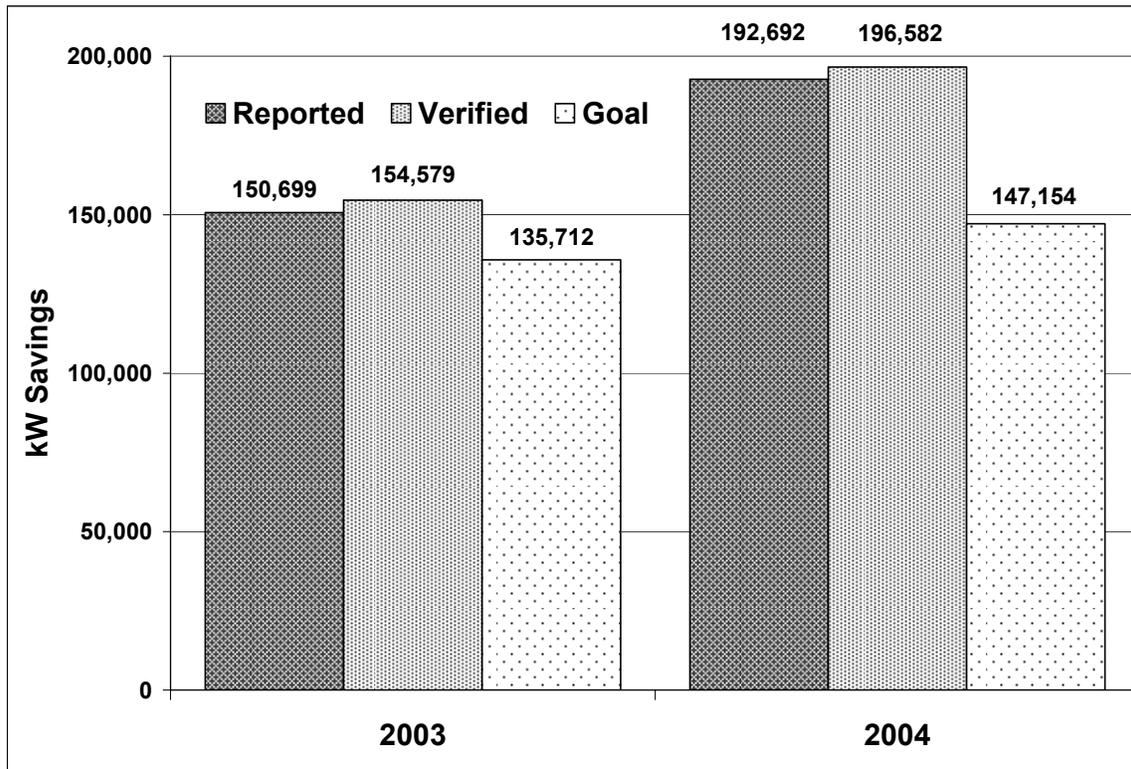
	Calculation	2003	2004
Reported Savings	A		
Program-wide Adjustments	B		
Subtotal	C=A+B		
Sample Realization Rate	D		
Verified Savings	E=C*D		
Total Adjustments to Reported Savings	E-A		
Program Realization Rate	E/A		

The lower and upper bounds of verified savings reflect both statistical uncertainty from extrapolation of the sample results and also the savings uncertainty explicitly identified by the review team. The statistical uncertainty is represented by a plus-or-minus (\pm) savings band around the point estimate and is determined using a 90% confidence interval. Furthermore, these uncertainty bands were determined using the standard error of the *differences* between *claimed* savings in the database and the best estimate of *verified* savings for each customer in the sample. In addition to the statistical uncertainty, further assessments of the potential low and high values were made when necessary. As a result, these ranges are at times not symmetrical.

Summary of Findings

Savings values for some utility programs were reduced from the reported values as a result of the impact assessment, with realization rates (or verified savings as a share of reported savings) ranging from 92.1% to 111.7%. For one program, the verified savings exceeded the reported savings due to corrections that increased calculated savings figures. Across the six utilities the M&V audit verified 154,579 kW of savings in 2003 and 196,582 kW in 2004. Based on these figures, verified peak demand reductions exceeded statewide goals by 14% in 2003 and 34% in 2004 (Figure 2).

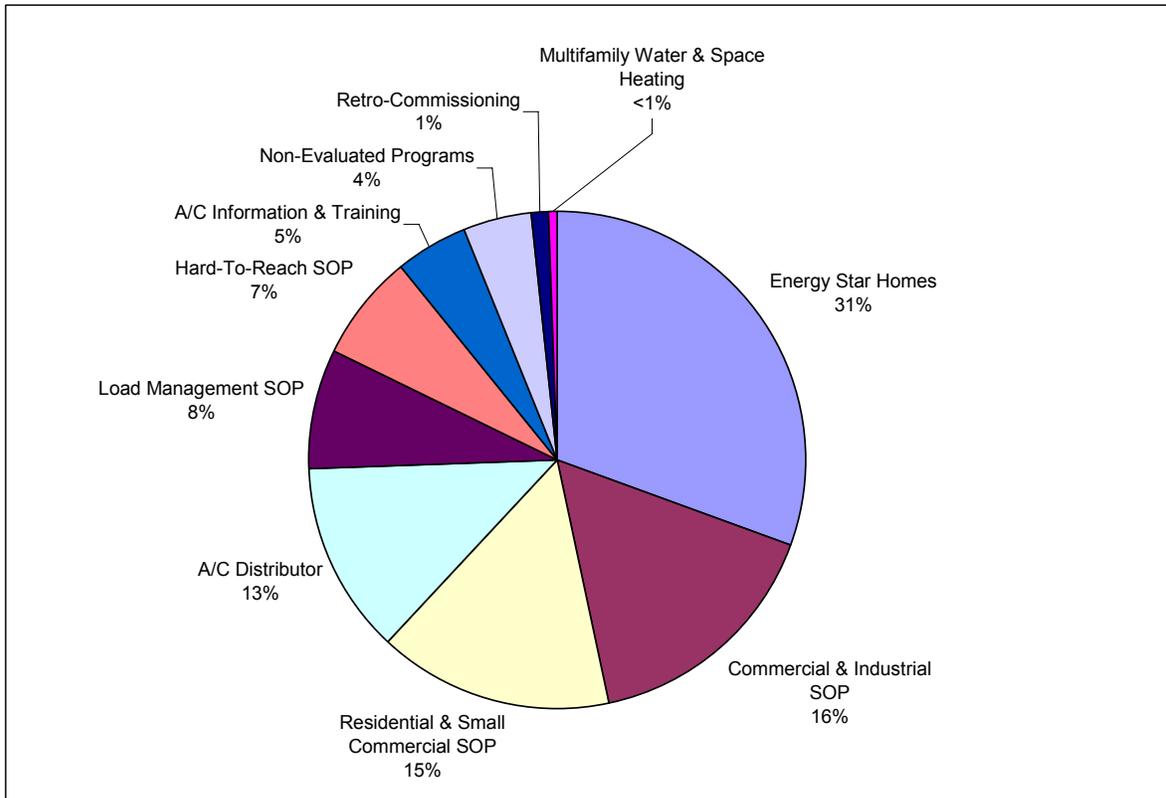
Figure 2. Comparison of Reported and Verified Savings (kW) with Utility Goals, Statewide 2003 and 2004



Verified savings values are point estimates that do not reflect statistical uncertainty from extrapolation of the sample results nor any savings uncertainty explicitly identified by the audit team.

By 2004, peak demand reductions were being realized across nine unique programs (not including a series of smaller programs not included in this study). Energy Star Homes accounted for the greatest share of savings, at 31% of the total, followed by the C&I and Residential SOPs and the A/C Distributor program, each of which accounted for at least 13% of savings (Figure 3). The breakdown of savings by program was similar in 2003, although the A/C programs were significantly smaller, and the Retro-commissioning and the Multi-family Water and Space Heating programs were not being administered.

Figure 3. Verified Peak Demand Savings (kW) by Program, 2004



Verified savings values are point estimates that do not reflect statistical uncertainty from extrapolation of the sample results nor any savings uncertainty explicitly identified by the audit team.

Among the nine programs reviewed, most were given realization rates (*i.e.*, verified savings as a share of reported savings) of 99% or more for both years. The most notable exceptions are: 1) the C&I SOP, which had realization rates of 96% and 98% across the two years, owing largely to uncertainty in savings calculated by sponsors using the IPMVP protocols for projects requiring M&V, and 2) the Retro-commissioning program, administered by only one utility in 2004, for which reported peak load reductions were adjusted to 92% of reported savings.

Conclusions

The overall realization rate of verified to reported savings of approximately 102% in both 2003 and 2004 demonstrates excellent overall performance, including thorough record-keeping, proper application of approved deemed savings values, and adherence to

program rules. There are few comparable studies against which to benchmark these findings, since this review was a desk audit as opposed to an impact evaluation. Perhaps the most appropriate study for purposes of comparison is the 2004 review of shareholder incentive claims for energy efficiency programs administered by utilities in California. This review verified 96% of the incentive dollars claimed by utilities for energy savings goals.⁷

The audit process uncovered many complicating issues that are often not addressed in energy efficiency program evaluation. For example:

- In an era of online applications and data transfer, there are very few paper records with which to conduct a desk audit. Since the audit team often had to rely on electronic databases as the principal “proof” of project activity, the team placed considerable emphasis on whether there was a rigorous process in place to ensure that data could not easily be manipulated by either the sponsors or the utility staff. The adequacy of the utilities’ random inspections in ensuring proper installation of measures by project sponsors was also considered. While no savings adjustments were made by the audit team based on inspection quality, it *was* recommended that an independent third-party conduct inspections to remove the appearance of a conflict of interest.
- When a sponsor determines energy savings using customized (non-deemed) savings calculations, it can be difficult for a third party conducting an after-the-fact evaluation to verify with certainty the savings values. This is due less to the calculation methods themselves and more to the lack of transparency in M&V documentation. The audit team’s IPMVP expert used best judgment to assign a score to the documentation according to adherence to IPMVP protocols. This score represented the degree of certainty surrounding the savings calculations, and Monte Carlo methods were then employed to determine a distribution of likely outcomes. For those projects deemed to have more than a reasonable amount of uncertainty surrounding their true savings figures, the verified savings value was assigned as based on an 80% confidence level using the constructed distribution.
- As defined by the Commission, Peak Demand Reduction requires only that reductions occur “over a period of one hour during the peak period.”⁸ Since load reductions from measures that reduce load for only a portion of the “peak period” (e.g., for only one hour or only in the month of May) may not be coincident with system peak demand, there is significant uncertainty regarding whether they contribute to a “reduction in growth of demand...measured at the utility’s annual system peak...,” which is the

⁷ In California, utilities were awarded financial incentives for achieving various energy savings goals (including gas savings) and other program milestones. The 96% figure cited here is for “energy savings” milestones only. However, the complex structure of the incentives awards limits the applicability of a direct comparison to realization rates in Texas. See *Review of AEAP Milestone Incentive Awards, Program Years 1999-2002*, SERA, Inc. and Summit Blue Consulting for the California Public Utilities Commission, September 2004.

⁸ Peak Demand Reduction is defined in PUCT Substantive Rule 25.181(c)(26). “Peak Period” is defined as “...from May 1 through September 30, during the hours between 1:00 p.m. and 7:00 p.m., excluding federal holidays and weekends.” [PUCT Substantive Rule 25.181(c)(27)]

basis of the energy savings goals established by the Commission [25.181(f)]. Similarly, savings from some measures (*e.g.*, from chiller lag control and temperature reset) are expected to occur only when temperatures are low or moderate—which is not likely to be coincident with the utility’s summer peak. As a result of these issues, it was recommended that a new definition of Peak Demand Reduction be developed that requires the load reductions to occur throughout the entire Peak Period. At a minimum, the sponsor (or utility) should demonstrate a high probability that the load reduction will occur coincident with the State’s system peak in the summer.

The methods developed to assess the energy savings claims of the Texas utilities successfully overcame the many obstacles regarding massive databases, incomplete paper records of project installations, and limited inspection documentation, among others, to perform a thorough desk audit of the savings reported for the programs. The results were accepted by the PUCT as the final assessment of demand and energy savings for 2003 and 2004.