

## LoanSTAR ENERGY AUDITING: UPDATE AND CHANGES

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### ABSTRACT

Annual savings identified by detailed LoanSTAR audits during the period January, 1989 - December, 1991 are \$13.7 million with an investment cost of \$46.1 million. These savings represent retrofit projects in state-owned buildings, local government-owned facilities, and independent school districts, accounting for 80%, 16%, and 4% of the investment cost, respectively. A summary of retrofit projects by type is presented and modifications to chillers and chilled water systems account for 26% of the savings and 32% of the cost, followed by lighting retrofits which account for 24% of the savings and 24% of the cost. The Governor's Energy Office has implemented changes to simplify the audit process by eliminating some calculations. Independent calculations and maintenance and operating procedures calculations are no longer required, and some retrofit projects may depend on standard paybacks to identify cost savings.

### INTRODUCTION

LoanSTAR is a \$98.6 million revolving loan program to accomplish cost saving retrofits associated with energy management in publicly-owned buildings and systems in Texas.<sup>1,2</sup> Projects are funded from Petroleum Violation Escrow accounts as a part of the State Energy Conservation Plan, which is administered by the Governor's Energy Office.<sup>1</sup> As of December, 1991, about \$36 million\* had been loaned based on detailed audits from both LoanSTAR and an earlier audit program.

An earlier program for state agencies known as the Texas Energy Cost Containment Program (TECCP) identified savings shown in Table 1.<sup>2,3</sup> The two types of projects shown in Table 1 are for capital intensive projects (Energy Cost Reduction Measures or ECRMs) and for generally less

\* The amount of the loans is principally to cover the implementation costs of the retrofit projects but includes other items, such as the cost of the audit (which averages about 4% of the implementation cost),<sup>2</sup> and an allowance of 10% to cover contingencies such as unexpected equipment price increases. After construction is complete, the loans are repaid in half-year increments with payments due on February 28 and August 31.

expensive projects which the building staff can perform as part of their regular duties (Maintenance and Operating Recommendations or M&Os).<sup>2,4</sup> Audits for the TECCP were conducted in 1984 and 1986.<sup>3,5</sup>

Table 1. TECCP Audit Results. Dependencies between projects are considered.

	Investment Cost, million \$	Annual Savings, million \$/yr	Payback, yrs
ECRMs	42.8	19.9	2.2
M&Os	0.1	1.4	0.1
Combined	42.9	21.3	2.0

A central funding source at a state-wide level was not evident until 1988. In 1988, surveys of the agencies receiving the TECCP audits revealed that 24% of the ECRMs already had been accomplished with funds secured by the facility operators. Another 5% were scheduled for completion, and 11% were no longer desirable for reasons such as building remodeling and function change. Utility and implementation costs were updated in 1988, and the result was remaining dependent savings of \$10.9 million per year with an investment cost of \$30.5 million for a payback of 2.8 years.<sup>3,5</sup> The longer payback (compared to that of 2.2 years for ECRMs in Table 1) indicates that more lucrative, shorter payback projects were most often selected for accomplishment in the early days.

### AUDIT RESULTS

During the recent five-month period between July 31 and December 31, 1991, 15 detailed audit reports covering 10.9 million square feet and 96 buildings were completed. Table 2 shows these recent surveys and cost results.

Table 2. Recent LoanSTAR Results. Dependencies between projects are considered.

	Investment Cost, million \$	Annual Savings, million \$/yr	Payback, yrs
ECRMs	21.2	6.6	3.2
M&Os	negligible	0.1	0.1
Combined	21.2	6.7	3.2

Table 3 includes similar data for an earlier period (January, 1989, through July 30, 1991)<sup>2</sup> and shows the total LoanSTAR audit results.

Table 3. LoanSTAR Audit Results for the period January, 1989 through December, 1991. Dependencies between projects are included.

	Investment Cost, million \$	Annual Savings, million \$/yr	Payback, yrs
ECRMs	46.1	13.7	3.4
M&Os	negligible	0.2	0.1
Combined	46.1	13.9	3.3

A total of 58 LoanSTAR detailed audit reports covering 28.3 million square feet and 425 buildings have been accepted. The total includes four streetlighting reports (which have no associated area), two fish hatcheries with considerable pumping energy modifications (whose included area is that of some associated buildings), and a physical plant report for Texas A&M University with dependent savings of \$1.84 million per year, an implementation cost of \$6.49 million, and a payback of 3.5 years (which indicates only 71,000 square feet for the physical plant building and does not include area for the many buildings affected). Basing energy savings on area for anything other than self-contained buildings which purchase or supply all their own utility needs is problematic.

A total of 80% of the recommended ECRM's investment cost shown in Table 3 was for state agencies, which were eligible for this program from the beginning. The earlier audit program (TECCP) was for state agencies and their continued participation in, and familiarity with, LoanSTAR was natural.

Sixteen (of the 58 accepted) detailed reports are for local governments (which include towns, cities, and counties) and three reports are for school districts. The program was expanded to include local governments and independent school districts in mid-1990. Table 4 shows the ECRM project results, including four streetlighting projects for local governments. Contributions due to M&Os for local governments and school districts were negligible.

Table 4. LoanSTAR Audit ECRM Results for Local Governments and School Districts. Dependencies between projects are accounted for.

	Investment Cost, million \$	Annual Savings, million \$/yr	Payback, yrs
Local Governments	7.2	2.2	3.3
School Districts	2.0	0.36	5.6
Total	9.2	2.56	3.6

The ECRM investment values in Table 4 for local governments and for school districts represent 16% and 4% of the LoanSTAR total of \$46.1 million, respectively. Through the end of December, about \$3.8 million in loans had been made to local governments and school districts based on detailed audits. The LoanSTAR program has \$20 million and \$16 million available for local governments and school districts, respectively, and the program is being aggressively marketed to them.

#### RECOMMENDED PROJECTS

Table 5 gives a summary of the estimated implementation cost and predicted cost savings by category for the facilities receiving detailed LoanSTAR audits. The recommended ECRMs have been divided into eight categories in Table 5, and dependencies between ECRMs are not considered in this data.

According to this information, chiller and chilled water retrofits have the largest share of the implementation cost (32%) and cost savings (26%) with a payback of 3.9 years. Replacement of steam absorption chillers by steam driven chillers and energy efficient chiller replacements constitute the major part of this implementation cost.

Lighting retrofits have the second largest implementation cost share (24%) and cost saving share (24%) with a payback of 3.1 years. Energy analyses of commercial and institutional buildings typically recommend lighting modifications. These modifications include energy efficient fluorescent lamps, energy efficient ballasts, changing incandescent to screw-in fluorescent lamps, reflectors, exit sign replacement and motion sensors.

ECRMs concerning boiler and steam retrofits have the shortest payback. A majority of the ECRMs in this category are steam trap replacements and have very short paybacks. Paybacks for variable speed drives for the air handling units, variable speed pumping and HVAC system retrofits vary from 3.8 to 3.6 years.

#### CHANGES IN THE AUDIT PROCESS

During fiscal year 1991, twelve consulting engineering firms were under contract to the Governor's Energy Office to perform energy audits; however, only nine of the firms submitted detailed audit reports, and some were more active than others. For 1992, 27 firms have contracts to produce audit reports. Much of this work will be in the area of simplified energy audits, which are, as their designation implies, simpler than the detailed audits generally described in this paper.

Evolution of the LoanSTAR audit format and guidelines has been covered previously.<sup>2</sup> Changes implemented in early 1992 include categorizing ECRMs into three areas. A Category I ECRM is one for which there are no calculations

Table 5. LoanSTAR Independent ECRM Results for the period January, 1989 through December, 1991

ECRM Recommendations	Implementation Cost (million dollars)	Fractional Implementation Cost (%)	Annual Cost Savings (million dollars)	Fractional Cost Savings (%)	Simple Paybacks (Yrs)
Chiller & CHW Retrofits	15.2	32	3.9	26	3.9
Lighting Retrofits	11.2	24	3.6	24	3.1
Motor/VSD/VSP Conversion	7.2	15	1.9	13	3.8
HVAC System Retrofits	3.6	8	1.0	7	3.6
EMC Systems	3.6	8	1.1	7	3.3
Others	3.4	7	0.9	6	3.8
Boiler & Steam Retrofits	2.4	5	1.9	13	1.3
Pumping System Retrofits	1.0	2	0.6	4	1.7
Total	47.6	100	14.9	100	3.2

or estimations of energy savings. The implementation cost is based on an estimate of the quantity or amount of material or equipment to be installed. The cost savings are determined by dividing the implementation cost by a standard payback for the particular type of retrofit. A Category II ECRM is one calculated according to the computer procedure SimpCalc,<sup>6</sup> and a Category III ECRM is a complicated project for which detailed calculations and documentation are required. These category definitions are from LoanSTAR audit guidelines.<sup>4</sup>

Category III ECRMs are generally described in detailed energy audit reports which are reviewed by Texas A&M personnel. The simpler categories are designed for presentation in simplified audit reports which can be completed, reviewed, and funded in a shorter time than the more complicated, detailed ECRMs of Category III.

Where a facility has both simple and complex ECRMs, a simplified report will be issued so that the projects covered there may begin quickly, without waiting for detailed calculations and a more complex report. The results of the simplified report will be added to the detailed report when it is finally issued.<sup>4</sup>

Category I ECRMs and their paybacks are shown in Table 6.<sup>4</sup> In some cases limiting the operating hours or the implementation cost is necessary to obtain the projected paybacks. Data to arrive at the values in Table 6 were taken from manufacturers and LoanSTAR audit reports.

Paybacks for Category I ECRMs (sometimes called "dipstick" ECRMs) are based on three items: an implementation cost per unit to be installed or removed, a good estimate of the number of units affected (detailed counts are not in order), and historical paybacks. The annual cost savings are determined by dividing the total implementation cost by the payback in Table 6.<sup>4</sup>

Category II ECRMs include computerized calculations for exterior lighting conversion, fixture relamping, exterior lighting controls, interior lighting controls, attic/ceiling insulation, window solar gain control, high efficiency motors, replacement of low efficiency cooling units, electric to gas water heater conversion, timeclock control of motor loads, timeclock control of air conditioning/heating unit, additional computer room cooling unit, and programmable thermostats. They are on disk and available to LoanSTAR auditors with a user's manual.<sup>6</sup>

Table 6. Proposed LoanSTAR Category I ECRMs.

ECRM	Payback (Years)	Minimum Annual Operation (Hours)
Delamping	1	N/A
Repair Steam Traps	2	N/A
Incandescent to 18-w Screw-in Fluorescent (cost less than \$20/unit)	2	6500 (replacing 60-w inc.) 3400 (replacing 75-w inc.)
Energy-Efficient Fluorescent Lamps	2	4400
Photocells on Exterior Lights	3	N/A
Time Clock Shut Down of Equipment	3	N/A
Incandescent Exit Lamps to 9-w (or less) Fluorescent (installed cost less than \$35/unit)	3	N/A
Incandescent to H.P. Sodium	4	N/A

Another major change adopted includes the removal of the requirement to identify and calculate savings from M&Os.<sup>4</sup> As can be seen from Tables 1-3, M&Os are not so important as ECRMs, and they can often be treated as ECRMs when necessary.

Also, all calculations will now be done on a dependent basis.<sup>4</sup> Formerly, independent calculations were required in each individual ECRM and dependencies were handled in one last ECRM called a composite ECRM. Independent calculations were needed in the event some ECRMs were accomplished and others were not. This sometimes occurred before a program funding mechanism was identified.<sup>2,3</sup>

However, the funding is now secure and great effort is made to include only projects in the reports which will definitely be accomplished, so the need for independent calculations is less important. In fact, it is sometimes a waste of auditors' time.

In order to lessen the calculations required for two ECRMs which are dependent on each other, a hierarchy of calculations (similar to one used for the Institutional Conservation Program)<sup>7</sup> will allow the auditors to consider major influences in an orderly fashion and without iteration. All projects will be analyzed in the sequence of building loads, distribution systems, primary equipment, and energy management control systems. In a detailed report, any applicable simplified report ECRMs are assumed to be installed.<sup>4</sup>

Project selection guidelines have been prepared for the Governor's Energy Office by the consulting firm of Kinsman and Associates to enable firms to more rapidly complete audits.

In addition, the composite project payback criteria of four years has been lengthened to four to five years, with the possibility allowed for building operators to "buydown" longer payback projects.<sup>4</sup>

## CONCLUSION

Recent detailed audit results from the Texas LoanSTAR program have been reviewed. Savings identified during the first two years of the program (January, 1989 - December, 1991) amount to \$13.7 million per year (for ECRMs) and the investment cost required to obtain those savings is \$46.1 million. As expected, projects frequently deal with heating, ventilating, air conditioning, and lighting.

Savings and investment costs for the various types of retrofits are summarized, with retrofits to chillers and chilled water systems accounting for 26% of the savings and almost one-third of the implementation cost. Chiller and chilled water systems' paybacks are longest, at 3.9 years. Boiler and steam system retrofits with relatively small savings and cost have the shortest paybacks at 1.7 years.

Program changes were covered, with emphasis on changes such as not requiring calculations for independent projects and M&Os. These changes will reduce the effort required to produce energy analysis reports.

## REFERENCES

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