LOANSTAR TECHNICAL GUIDEBOOK

Utility Assessment Report Guidelines, Formats, Program Requirements and Documentation for Use with the Texas LoanSTAR Program and Energy Savings Performance Contracting

SECO
State Energy Conservation Office

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PURPOSE OF THIS PUBLICATION

The SECO LoanSTAR Technical Guidebook is a two-volume set that provides a road map for engineers who will be preparing utility assessment reports for the LoanSTAR Program. Volume I of the guidebook identifies policies to be followed in preparing project calculations and the required format for presenting the project to the State Energy Conservation Office (SECO) for technical evaluation.

Volume II provides simplified calculation methods for many common energy savings measures. These calculation methods are reduced to look-up and fill-in-the-blank procedures and are provided as an aid for all analysts who wish to use them.

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DEFINITIONS OF TERMS

Analyst or technical analyst – The individual performing the utility consumption, cost and potential savings assessment for a facility.

Application part-load value (APLV) – A measure of part-load performance of a chiller based on the ARI Standard 550 – 1998 calculation method. It is computed by defining four load points on the use spectrum of the equipment, then calculating the efficiency of the equipment at those points. The four points used for analysis are 100 percent, 75 percent, 50 percent and 25 percent of load. An average performance is then calculated using the individual performance values and the weighted seasonal use at those conditions. APLV is usually stated in kW/ton. This measure is not interchangeable with energy efficiency ratio (EER), SEER or integrated part-load value (IPLV).

Auxiliary enterprises – Those spaces whose utilities are paid through generated income; e.g., student centers, cafeterias.

Borrower – The entity (state agency, university, school district or hospital) which is applying for or has received a LoanSTAR loan.

Buy down – To fund a portion of a project(s) from another source for the express purpose of meeting the required payback period. For example, the anticipated cost for three proposed energy-saving measures is $600,000. The anticipated annual cost savings realized by the measures is $50,000. The composite project payback is 12 years. To make the measures eligible for LoanSTAR funding, the borrower contributes $100,000 to the project from another source, lowering the amount financed by LoanSTAR to $500,000. Payback for the LoanSTAR-funded portion of these measures then becomes 10 years, making the project eligible for partial financing. Note: The payback for any individual utility cost reduction measure does not exceed the life expectancy of the equipment proposed.

Category I UCRM – A utility cost reduction measure (UCRM) for which there are simplified energy and water cost savings which may be calculated by using paybacks that have been specified by SECO. The implementation cost for this type of UCRM is based on the quantity or amount of material or equipment to be installed. Then, the UCRM savings are determined by dividing the implementation cost by a specified payback, depending on the type of retrofit.

Category II UCRM – A utility cost reduction measure (UCRM) for which energy cost savings are calculated according to QuickCalc simplified calculation procedures (see Volume II of this publication).

Category III UCRM – A complex utility cost reduction measure (UCRM) for which detailed energy and water cost savings calculations and documentation are required. If a retrofit UCRM is not, for calculation purposes, identified as a Category I or Category II UCRM, it must be treated as a Category III UCRM.

Coefficient of performance (COP) – The ratio of the rate of heat removal, or heat delivered, to the rate of energy input, in consistent units (e.g., Btu/h output / watts x 3.413 input).

Composite project – A summation of all individual recommended utility cost reduction measures (UCRMs). The cost savings and implementation costs exhibited will be the sums of the savings and costs from the individual UCRMs. A summary of the composite recommended UCRM project is required in the executive summary of a utility assessment report (UAR).

Composite Project Payback – The weighted average payback of a set of utility cost reduction measure (UCRM) retrofits. It is calculated by dividing the combined implementation costs of all the retrofits by their total annual energy and water cost savings.

Conditioned area – The total square footage of all the space enclosed within the exterior walls of the facility, including areas occupied by auxiliary enterprises, which are provided with heated or cooled air or both, to maintain conditions for an acceptable indoor thermal environment.

Conditioned space – An enclosed space that is cooled, heated or indirectly conditioned. The LoanSTAR program administrator should be contacted immediately if an assessment of unconditioned space is requested in areas other than power plants, stairwells, gymnasiums, vocational areas and machine rooms.

Cost-of-service charge – A charge to adjust the manner in which taxes paid by the utility are charged back to the customer. Some utilities have chosen to call this charge the "House Bill 11 Tax Adjustment Charge." This reflects that it was House Bill 11 passed by the Texas legislature that necessitated this change. The charge is variable, depending upon the rate schedule and the utility.

Customer or facilities charge – The monthly utility bill amount paid by the customer that covers the costs for metering, meter reading, billing and similar administrative functions. This fee is not dependent upon the demand or energy usage.

Demand, actual or measured – The power or demand actually metered within a demand time period window. This figure appears on most utility bills that include demand charges.

Demand billing – Utility rate schedules state how billed demand is determined. Some rate schedules state that there is a minimum billed demand that is some percentage of a contract demand. They may also specify that the billed demand is the greater of the minimum billed demand or some variation of the following: the current month actual demand, a percentage of the on-peak and/or off-peak demand experienced within the last 12 months or the minimum demand level for which the rate schedule is effective

Billed demand may be determined using a single demand window or an average of several. For example, a utility company may use the average of the four highest monthly demands to determine charges on some rate schedules. Care must be exercised when referring to the rate schedule to determine the billed demand because of the complexity of this feature. The section in the rate schedule that describes how the billed demand is determined is usually entitled "Determination of Demand." The billed demand will appear on all utility bills that include demand charges.

Demand charge – A charge paid by the electric utility customer based upon the rate that the energy is taken from the utility; i.e., the rate at which energy is consumed and measured during a 15- or 30-minute "demand window." There are many types of demand, defined below, that impact the utility bills. One or more of these will be shown on the bills, depending upon the method used to specify the billed demand. The demand charge is not a feature of residential and small commercial rate schedules but is usually found on the larger commercial, general and industrial rate schedules.

Demand, contract – Some utilities define this as the maximum demand specified in the rate schedule or agreement for service. Others define it as a percentage of the highest demand, or some other peak demand, experienced by the facility. In some rate schedules, the minimum billed demand is some percentage of the contract demand; this demand value does not usually appear on the bills.

Demand, off-peak – The power or demand measured at the facility during the off-peak period. The off-peak period is defined as those months or hours when demand on a utility grid is commonly below peak levels.

Demand, on-peak – The power or demand measured at the facility during the on-peak period. Depending upon the utility, the on-peak period for Texas electric utilities can be defined as either May through October or June through September. However, some utilities define their on-peak period as certain hours of the day on Monday through Friday during any month of the year. These latter utilities may also define an annual on-peak period as the highest on-peak demand during the last 12 months.

Demand, primary – A concept used by an electric utility to determine "billing demand." If the off-peak demand is equal to or less than the annual on-peak demand, the primary demand is defined as the greatest of the following: on-peak demand, off-peak demand, 85 percent of the annual on-peak or the minimum contract demand of the rate schedule. If the off-peak demand is greater than the annual on-peak demand, the primary demand is defined as the annual on-peak demand.

Demand, ratchet clause – A feature of some utility rate schedules that specifies that the billed demand will be not less than some percentage of the peak demands experienced by the facility; the percentage may vary from 60 to 100 percent.

Demand, secondary – Some utilities offer this rate schedule feature when the off-peak demand is greater than the annual on-peak demand. Secondary demand is usually defined as the difference between the off-peak demand and the annual on-peak demand. The utility applies different rate charges for the primary and secondary demands.

Demand window – The time period over which power is averaged to determine the demand. Typical demand windows in the state vary from 15 to 30 minutes in length. The demand window travels continuously; thus, registered demand is a rolling average of the actual rate of power usage.

Dependent measure – A retrofit measure is considered dependent if energy consumption costs or savings are affected by any other retrofit measure. In considering the effect of dependencies, it is suggested that technical analysts use the following sequence: (1) building loads; (2) distribution systems; (3) primary equipment and (4) energy management systems.

Electrical consumption blocks – Some utility rate schedules specify that the electrical consumption be separated into "blocks" of varying size, and each block is assigned a different price for the kWh consumed. Common methods include flat block sizes of a certain value of kWh. Other methods use a variable block size that is determined by a "block extender" multiplied by the billed demand.

Energy charge – The charge for the quantity of energy consumed. This is the charge that is most familiar to users of electricity because it is common to residential, commercial and industrial bills. This charge may vary in cost per kWh depending upon the type of service and the utility.

Energy cost index (ECI) – A reference expressing the total energy cost (electricity, natural gas or other fuel costs) of operating a building over a given period (usually a year) in terms of cost/gross conditioned square feet. Units are $/(ft2-yr).

Energy efficiency ratio (EER) – A measure of the performance of a cooling system used to evaluate savings and is defined as the unit capacity in Btu/hr. divided by the power input to the unit in watts at a standard operating condition. EER is not directly interchangeable with SEER (see below).

Energy savings company (ESCO) – A company which enters into water, energy and related guaranteed savings contracts.

Energy savings performance contract (ESPC) – A contract by which results (e.g., energy savings) are guaranteed by the contractor to an owner/borrower; specified terms and conditions normally apply. Although the term "energy savings" is used, this type of contract can also apply to water savings.

Energy utilization index (EUI) – A reference expressing the total energy (electricity, natural gas or other fuel source) used by a building over a given period (usually a year) in terms of source BTUs/gross conditioned square feet.

Estimated useful life – The average number of years that a particular type of mechanical/electrical equipment, normally maintained, can be expected to perform reliably with reasonable efficiency. Typical life expectancies will be as follows:

Rooftop unit	15 years
Split systems	
Air-cooled condenser	15 years
Electric heat air handler	15 years
Gas-fired furnace	20 years
Water-source heat pump	20 years
Air-cooled chiller	20 years
Water-cooled chiller	23 years
Cooling tower (galvanized, stainless)	20 years
Boiler (steel, water tube)	24 years
Pumps, base-mounted	20 years
Pumps, pipe-mounted	10 years
Pumps, condensate	10 years
Terminal air handlers, VAV	20 years
Hydronic air handler	20 years

Exceptions to these life expectancies may be considered at the discretion of the technical reviewer if, in their opinion, sufficient evidence has been presented to warrant variance from the stated norms.

Facility – Any major energy-using building (or buildings) or system which is owned or operated by the owner/borrower, budgeted by the owner/borrower and billed by the local utility as one entity.

Franchise fees – A charge to reimburse a utility for franchise fees paid to the municipalities in which it operates. Many utilities include this fee in their energy charges; i.e., not as a separate charge. However, some utilities do include it as a separate item on their bills.

FSCR – See Systems Commissioning Report – Final (FSCR)

Fuel charge – A charge paid by the customer for the cost of fuel that was used by the utility to generate electricity. It is usually described in a rider to the rate schedule and may be entitled "Fuel Cost Rider." The charges for this expense are billed in cost per kWh.

Fuel refund – A refund to the customers who are billed on forecasted fuel rates which are then adjusted to actual fuel costs of the utility. Some utilities adjust their bills to include applicable refunds every month while others make lump-sum refund adjustments every six or 12 months.

Gross area – The total square footage of all the space enclosed within the exterior walls of the facility, including areas occupied by auxiliary enterprises, indoor parking facilities, basements and penthouses. Includes all space such as hallways, lobbies, stairways, mechanical rooms and elevator shafts.

Heating seasonal performance factor (HSPF) – The ratio of the total heating output to the total seasonal input energy, usually applied to heat pumps.

Implementation costs – All the costs directly associated with cost-saving measures. This includes direct labor to install the retrofits including supervisory labor, engineering design cost, material and equipment costs and financing costs. Implementation costs also may include the cost of the utility assessment report (UAR), cost to purchase and install any metering or monitoring equipment or a systems commissioning cost that may apply at the request of a borrower and may be included in LoanSTAR loans, as approved by the State Energy Conservation Office (SECO).

Independent measures – A retrofit measure is considered independent if the energy or water consumption and costs are not affected by any other retrofit measure.

Integrated part-load value (IPLV) – A measure of the performance of water chilling equipment (greater than five tons) which is capable of significant unloading. IPLV is calculated by using ARI Standard 550/590 – 1998 for a defined set of conditions that closely reflect actual operating experience in the field for a single chiller. IPLV is usually given in kW/ton, but it is also given in the energy efficiency ratio (EER) or coefficient of performance (COP) by some manufacturers.

ISCR – See Systems Commissioning Report – Initial (ISCR)

Limited calculations – Sometimes referred to as "dipstick," "deemed" or "stipulated" savings calculations. These calculations are used for Category I utility cost reduction measures (UCRMs). Paybacks are stipulated for these UCRMs, and savings are calculated by dividing implementation costs by specified paybacks.

Major renovation – A renovation or improvement to a building where the implementation cost is $2 million or more, based on the initial cost estimated. Any project classified as a major renovation in a state-owned or public higher education facility is required to meet the current state energy code requirements, and a compliance certification must be filed with the State Energy Conservation Office (SECO). Projects funded by SECO in buildings not owned by the state must meet state energy code requirements and all local and county building code requirements, as applicable.

Measure – A single modification of building loads, distribution systems, primary equipment, control systems or other actions designed to reduce utility costs.

Measurement and verification (M&V) – A method of confirming whether guaranteed savings are being met as specified under an energy savings performance contract. The method used for this on SECO-funded contracts follows the International Performance Measurement and Verification Protocol (IPMVP) that was developed through a cooperative effort between industry and the U.S. Department of Energy.

Net area – The square footage of a building determined to be the net leasable or assignment area; same as gross area except the following areas are not included: public restrooms, public stairwells, elevators, hallways, janitorial and other maintenance-related rooms or areas, mechanical rooms and any other public areas determined as not assignable.

Non-standard part-load value (NPLV) – A measure of part-load performance of a chiller based on the ARI Standard 550/590 – 1998 calculation method. It is computed from a weighted average of the part-load energy efficiency at 100 percent, 75 percent, 50 percent and 25 percent load points at conditions other than integrated part-load value (IPLV) conditions (e.g., 42°F leaving water temperature). NPLV is usually stated in kW/Ton or the energy efficiency ratio (EER) but can also be stated as coefficient of performance (COP).

Operating and maintenance recommendations (O&Ms) – A recommended action that does not require loan financing and one which the building staff should perform as part of their regular duties.

Payback – A calculated time period over which the average annual savings of a measure or project will equal the initial cost of installing that measure or project. The maximum payback period for LoanSTAR funding is 15 years.

Performance contract – A contract under which specific results (e.g., savings) are guaranteed (see energy savings performance contracts).

Power cost recovery factor charge (PCRF) – A charge to reimburse the utility provider for power that is purchased from generation facilities. This charge is not a feature of all utility rate schedules in the state, but it is included in several of them. It is usually found in rate schedule sections entitled "Power Cost" or in "Rider PCRF." Charges are quite variable depending upon the utility provider. This charge is also referred to as "purchased power cost" and "cogeneration power cost recovery factor."

Power factor – This is the ratio of the actual power (kW) to the apparent power (kVA). The actual power, or the actual demand, is a measure of the metered power to the load. The apparent power is a measure of the actual power supplied by the utility to service the load. In resistance loads, such as incandescent lights, they are equal. However, in inductive loads such as motors, fluorescent and high-intensity discharge lights, welding machines, etc., they are not equal. Most utilities have established a minimum power factor for their commercial and industrial customers. When a customer's power factor falls below this prescribed minimum value, the power factor adjustment clause of the rate schedule may be used to adjust their billing. The minimum power factor requirement by utilities in the State of Texas range from 80 percent to 95 percent.

Power factor adjustment – The power factor adjustment clause is used to increase the demand charge by the percentage that the actual power factor falls below the minimum specified power factor. For some utilities, if the minimum specified power factor is 85 percent and the actual measured power factor is 78 percent, the demand charge will be increased by 7 percent. Other methods of adjusting for power factor also are used.

Preliminary energy audit (PEA) – A multi-page document that describes in some detail selected utility cost reduction measures (UCRMs) along with their expected costs, savings and paybacks. This document can be used to reserve LoanSTAR funds during a specified time period when a utility assessment report (UAR) or initial systems commissioning report (ISCR) is being prepared for approval and funding.

Project – A group of measures to be installed at the same time where combined costs, savings and paybacks have been documented in a utility assessment report (UAR) [see composite project].

Project assessment commitment (PAC) – A one-page form to be filled out by an applicant to reserve LoanSTAR funds during a specified time period when a utility assessment report (UAR) or initial systems commissioning report (ISCR) is being prepared for approval and funding.

QuickCalc – Sometimes referred to as simplified calculation procedures (see Volume II of this publication) that enable an analyst to calculate the energy savings from a measure manually or on a spreadsheet, rather than using the original SimpCalc software that is no longer supported. Utility cost reduction measures (UCRMs) using the QuickCalc forms are defined as Category II UCRMs.

Renewable UCRM – A energy savings measure incorporating renewable projects such as solar photovoltaic, wind or rainwater harvesting.

Retrofit measure – A technique or technology, usually applied through software or hardware, which is designed to increase efficiency and reduce utility costs at an existing facility.

Seasonal energy efficiency ratio (SEER) – A measure of the performance of a cooling unit. It is defined as the ratio of the total seasonal cooling output measured in BTUs to the total seasonal watt-hours of input energy. SEER ratings are based on the recognition that a typical cooling system operates at standard full-load conditions for a small part of its annual use. SEER ratings are generally applied to residential/commercial cooling equipment of five tons and less which are served with single-phase electric power. SEER is not directly interchangeable with EER.

SECO – Texas State Energy Conservation Office

SECO representatives – Either SECO employees or contractor employees acting on behalf of SECO.

SimpCalc – An energy savings calculation program that is no longer supported but was originally developed for SECO; forms the basis for the currently used QuickCalcs.

Simple payback – The cost of the project, including engineering, installation and equipment, divided by the annual utility cost savings. Other savings or costs such as reduced maintenance or operating costs, audit costs, financing costs or metering costs are usually not included in this type of payback.

Submittals – Technical data such as cut sheets and/or drawings as requested by the engineer to confirm products or methods of installation that the contractor is proposing to use.

Systems commissioning (SC) – The process of documenting, modifying and verifying the performance of energy-related building systems to cause them to operate with optimum efficiency.

Systems commissioning plan (SCP) – The format of this document is not specified, but it is a detailed plan for executing systems commissioning work in specified buildings. This plan must correlate with a previously submitted initial systems commissioning report (ISCR – see below) and detail such actions as control strategy changes, replacement of malfunctioning equipment, training to be provided to the building operators and the schedule for completing the commissioning process, including delivery of a formal report [Final Systems Commissioning Report (FSCR) – see below].

Systems commissioning report – final (FSCR) – This is the document that records the entire commissioning process that has transpired in specified buildings. It should demonstrate correlation with findings and changes included in previously submitted documents (ISCR and SCP). It should also document all changes to control strategies and equipment, along with requirements to maintain the results obtained in the SC process.

Systems commissioning report – initial (ISCR) – This is the report that must be provided to SECO to support a request for systems commissioning (SC) funding. It should identify major energy savings opportunities, provide commonly accepted engineering calculations of cost savings and follow the outline specified for utility assessment reports.

Technical review – The process of reviewing the entire utility assessment report prepared by the technical analyst, and any other data or documents, to ensure that the report is technically correct, meets the program guidelines and adheres to the report format requirements.

Utility assessment report (UAR) – A technical report that identifies and documents energy, water and other cost-saving measures. This report must be submitted by potential LoanSTAR borrowers for financing approval. The utility assessment report is prepared by a professional engineer using the specified format provided in this manual.

Utility cost reduction measures (UCRMs) – Individual retrofit measures that are expected to reduce energy and water costs.

SECTION I – INTRODUCTION

LOANSTAR HISTORY

The Texas LoanSTAR Program (LoanSTAR) uses a revolving loan mechanism that enables it to continue indefinitely. LoanSTAR stands for loans that are "Saving Taxes and Resources." The program finances energy-related cost reduction retrofits for existing state, public school, college, university and non-profit hospital facilities. Low-interest rate loans are provided to assist those institutions in financing their energy cost reduction efforts. The program's revolving loan mechanism allows borrowers to repay loans through the stream of cost savings realized from the projects. The LoanSTAR program administrator should be contacted for information on current loan interest rates.

The program was initiated by the Texas Energy Office in 1988 and approved by the U.S. Department of Energy (DOE) as a statewide energy-efficiency demonstration program. Program funds were provided from petroleum violation escrow (PVE) funds.

Initially, the weighted average simple payback for all energy cost reduction measures (ECRMs) had to be four years or less in order to qualify for a loan. Project ECRM dollars saved were required to be used to pay back the loan principal and interest. Additionally, all major projects had to be metered and monitored for savings verification. The cost of metering and monitoring was not included as part of the loan.

In 1995, the weighted average simple payback for all ECRMs was lengthened to eight years, and metering and monitoring became an option for the loan recipient. Metering and monitoring costs were allowed to be financed as part of the loan.

In 2001, the weighted average simple payback for all ECRMs was extended to 10 years. That year SECO also received DOE approval that enabled LoanSTAR to begin financing energy savings performance contracts (ESPCs). This approval also enabled LoanSTAR to include water cost reduction retrofits and other utility cost reductions.

The value of demand-limiting and load-shifting measures had long been recognized, but measures that did not save energy (Btus) could not be funded, thus limiting LoanSTAR funding of these types of measures. Thus, an approval mentioned above was sought and granted to fund measures that saved utility costs, not just energy, such as power factor correction, demand reduction, thermal storage and water conservation measures.

In 2010, clarifications were made to the LoanSTAR Program. With water cost reduction retrofits now included, the terminology was updated from ECRM to utility cost reduction measure (UCRM). While the weighted average simple payback for all UCRMs remained at 10 years, it was required that each UCRM must have a payback less than, or equal to, its estimated useful life (EUL). The clarification process also modified the costs to be included to determine the UCRM payback for ESPCs. Loan interest and measurement and verification costs had to be included in ESPC payback calculations.

In 2012, clarification was made to the effect that all financing costs and the cost of utility assessment reports (UARs), construction bonding, any owner's costs and monitoring costs (claimed in the loan application) had to be included in the calculated payback period.

In 2020, qualification for the LoanSTAR program was expanded to include state-funded borrowers who own but may not operate or occupy the facility where the retrofit project takes place. The program maximum loan term for all projects also was extended to 15 years. A new requirement was added for retrofit projects that involve retrofitting HVAC systems, which must degrade the annual savings of HVAC UCRMs on a non-compounding dollar basis at a rate of 0.75 percent annually.

LOANSTAR STATUTORY AUTHORITY

LoanSTAR of the Texas State Energy Plan (SEP) operates in accordance with the Energy Policy and Conservation Act (42 U.S.C. 6321, et seq.) as amended by the Energy Conservation and Production Act (42 U.S.C. 6326, et seq.).

Statutory approval for LoanSTAR is provided through the Oil Overcharge Restitutionary Act, Chapter 2305, Texas Government Code and Title 34, Texas Administrative Code, Chapter 19, Subchapter D Loan Program for Energy Retrofits; the Comptroller of Public Accounts (Comptroller) and the State Energy Conservation Office (SECO).

TYPES OF MEASURES ELIGIBLE FOR LOANSTAR FUNDING

LoanSTAR finances both energy- and water-efficiency retrofits and systems commissioning in existing facilities.

UTILITY-EFFICIENCY RETROFITS

UCRMs financed through the LoanSTAR Program for existing buildings include, but are not limited to, these energy-saving measures:

- Energy-efficient lighting systems
- High-efficiency heating, ventilation and air conditioning systems
- Energy and water management systems
- Energy recovery systems
- Building shell improvements
- Load management measures
- Energy management information systems and metering
- Whole-building systems commissioning in conjunction with other energy-efficiency retrofits

Measures that do not necessarily save energy but do save utility costs are also eligible UCRMs. These measures include but are not limited to:

- Water-efficiency and control measures
- Demand reduction
- Power factor correction
- Load shifting (thermal storage)

In identifying potential measures, technical analysts are encouraged to evaluate renewable energy technologies as well as more traditional energy retrofits. Such measures may include rooftop solar water and space heating systems or electric generation with photovoltaic or small wind systems.

SYSTEMS COMMISSIONING

Systems commissioning (SC) is a unique type of energy-efficiency activity that can stand alone as a project or can be part of an energy-efficiency retrofit project. ASHRAE Guideline 0-2005, The Commissioning Process, defines commissioning as "a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria."

In SC, all of the building systems are "tuned" in an integrated manner that takes other building systems into consideration as part of the tuning process. Taking a holistic approach to tuning systems produces additional cost savings and occupant comfort. SC can take place anytime within the facility's life.

SC follows a best practices process. The process begins with collection of utility consumption and expenditure bills and an initial facility survey to establish a baseline of utility consumption and expenditure patterns. As part of this process, the surveyors will determine existing equipment conditions and conduct interviews with on-site personnel to discover if any comfort or operational problems exist. The following steps are then undertaken and reported: field baseline measurements, data analyses and identification of potential energy-saving building system repairs and improvements.

To be eligible for LoanSTAR funding, an initial SC report (ISCR) must be developed and submitted. This report is to be based on initial observations of the affected facilities by qualified analysts. Potential improvements then must be described and potential savings quantified along with costs to complete necessary upgrades. Thus, the ISCR will follow the outline of a UAR and must be certified by a qualified professional engineer (see Volume I, Section V – Utility Assessment Report Format). An ISCR contains recommendations on how building systems can be adjusted (tuned) to work efficiently with each other. There are times when installed building systems may be non-operational or may contain non-compatible components with other existing building systems. When this is the case, the adjustments may include replacement of these non-operational or incompatible operating system components. Backup documentation for the initial findings and corrections are to be provided in the (ISCR).

Examples of improvement opportunities discovered through systems commissioning can be found in Volume I, Appendix A.

Following loan approval a systems commissioning plan (SCP) must be developed and submitted for review by a SECO representative. This plan should correlate with the ISCR but should be much more detailed in describing how the work will be carried out to optimize systems operation. It should include control strategies, description of any necessary replacement of system components etc. and an implementation completion schedule. This plan, in effect, becomes the design document as required for design-bid-build (DBB) projects. Another section of the SCP should include processes for implementation of recommendations. Included in this section will be the recommended methodologies and processes for verifying that the borrower's facility is more energy efficient.

From the processes previously described, the contractor or engineer should be able to quantify the initial project costs, the resulting annual energy savings and the project payback in the ISCR. This information will be used to support the loan application submitted to SECO for review and approval. However, the SCP must also be submitted to SECO for review and approval before proceeding with implementation.

At the completion of SC activities previously described, the results are to be compiled in a written report called a final systems commissioning report (FSCR). This report documents the improvements and control strategies implemented and provides the borrower with a record of how the facility must be operated to remain efficient. Due to the uniqueness of each project, there is no prescribed format for the FSCR. However, this report must be provided in order to complete the project closeout.

If available, the borrower should submit the ISCR to SECO for review when a LoanSTAR Notice of Loan Fund Availability / Request for Application (NOLFA/RFA) is announced in order to gain competitive points and speed up the contract process.

LOANSTAR LOAN QUALIFICATION REQUIREMENTS

LoanSTAR finances energy-efficiency projects for state-owned facilities, public school (K-12) facilities, public institution of higher education facilities, local government facilities and publicly tax-supported hospital facilities.

Energy-efficiency and water-efficiency UCRMs, combined with all related costs, must have a composite simple payback period as posted in the notice of loan fund availability (NOLFA), and each UCRM must pay back within the estimated useful life of the measure. Utility dollar savings are used to calculate the individual UCRM and total project payback periods. These payback periods are used to determine if the individual UCRMs and composite project can be considered for funding. Each UCRM within a project must have a simple payback period that is shorter than the estimated useful life of that UCRM. Borrowers do have the option of contributing a different source of money to help the composite project meet eligibility requirements.

All proposed LoanSTAR projects must be analyzed by a professional engineer (engineer) who meets the criteria outlined in Volume I, Section I, The Utility Assessment Report and Initial Systems Commissioning Report. The engineer is selected by the prospective borrower.

When an engineer analyzes a project, details of the analysis must be submitted in the form of a utility assessment report (UAR) in accordance with the prescribed format outlined in Volume I, Section V – Utility Assessment Report Format. Engineers are encouraged to evaluate renewable energy technologies as well as more traditional energy-efficiency retrofits.

It is recommended that the borrower monitor post-retrofit energy savings to ensure that energy and water savings are realized. Monitoring possibilities include, but are not limited to, utility bill analysis, individual system metering or whole-building metering. Funds can be borrowed for metering of large, complex retrofits if the project remains within the required payback limits after these costs are added.

All the above requirements also apply to energy savings performance contracts. However, the UAR must be prepared in the format outlined at the following website: **https://comptroller.texas.gov/programs/seco/resources/espc.php**.

The energy savings company's (ESCO's) savings guarantee in performance contracts must be sufficient to pay for the LoanSTAR loan principal and interest and measurement and verification (M&V) required during and after construction. Post-retrofit energy savings are required to be monitored and reported to the borrower in accordance with the M&V plan to ensure that energy and water cost savings are being realized.

LOANSTAR PAYBACK RULES

SIMPLE PAYBACK REQUIREMENTS – OVERALL LOAN

The simple payback for the composite project shall be less than or equal to 15 years.

SIMPLE PAYBACK REQUIREMENTS – INDIVIDUAL UCRMS

The simple payback for each project UCRM shall be less than or equal to the UCRM EUL.

BUYDOWNS

A buydown is a reduction in the overall loan and concurrently a reduction in the individual UCRM cost(s). Buydown rules shall meet both composite project and individual UCRM requirements.

BUYDOWNS – COMPOSITE PROJECT

If the simple payback for the composite project is greater than 15 years, applicants can furnish their own funds (buydown) to the project to reduce the composite simple payback to 15 years. This scenario assumes that the simple payback for each UCRM is less than the EUL of each UCRM. The maximum buydown amount that can be applied is less than 50 percent of the overall loan. This assumes that when the buydown is distributed over the UCRMs, the maximum buydown amount will be less than 50 percent of each UCRM cost.

BUYDOWNS – INDIVIDUAL UCRMS

A scenario may exist in which the simple payback for the overall loan is less than or equal to 15 years but one or more UCRMs have a simple payback that is greater than the EUL of that UCRM. A buydown can be applied to a simple payback of a UCRM that does not currently meet the simple payback requirements. The maximum buydown amount must be less than 50 percent of the UCRM cost. After the buydown is applied, the simple payback for the UCRM shall be less than or equal to the UCRM EUL.

1. Example: Lighting Upgrade – UCRM 1
   UCRM cost = $100
   Annual energy savings = $5/year
   Simple payback = $100 ÷ $5/year = 20 years
   EUL = 12 years

Conclusion: UCRM 1 does not qualify because the simple payback of 20 years is greater than the EUL of 12 years.

2. Example: Same Lighting Upgrade – UCRM 1 (with owner's buydown)
   UCRM cost = $100
   Owner's buydown = $40 ($49 would be maximum allowed buydown)
   Annual energy savings = $5/year
   Simple payback = ($100 - $40) ÷ $5/year = 12 years
   EUL = 12 years

Conclusion: UCRM 1 is acceptable because buydown is less than 50 percent of the UCRM cost, and the overall simple payback of 12 years is equal to the EUL of 12 years.

BUYDOWN AND O&M HARD COST AND ENERGY SAVINGS – INDIVIDUAL UCRMS

The maximum amount of buydown is less than 50 percent of the UCRM cost, and the O&M hard cost savings must be less than energy cost savings. After the buydown plus O&M hard cost savings plus energy savings amounts are applied, the simple payback for the UCRM shall be less than or equal to the UCRM EUL.

3. Example: Lighting Upgrade – UCRM 2
   UCRM cost = $200
   Annual energy savings = $5/year
   Simple payback = $200 ÷ $5/year = 40 years
   EUL = 15 years

Conclusion: UCRM 2 does not qualify because overall simple payback of 40 years is more than the EUL of 15 years.

4. Example: Same Lighting Upgrade – UCRM 2 (with buydown)
   UCRM cost = $200
   Owner's buydown = $99 (less than 50% of the UCRM cost)
   Annual energy savings = $5/year
   Simple payback = ($200 - $99) ÷ $5/year = 20 years
   EUL = 15 years

Conclusion: UCRM 2 is not acceptable. Although owner's buydown is less than 50 percent of the UCRM cost, the overall simple payback of 20 years is still greater than the EUL of 15 years.

5. Example: Same Lighting Upgrade – UCRM 2 (with buydown and O&M annual savings)
   UCRM cost = $200
   Owner's buydown = $99 (less than 50% of the UCRM cost)
   Annual energy savings = $5/year
   Maximum annual O&M savings = $5/year (O&M savings cannot exceed the energy savings, and O&M savings will last for the standard warranty of the lights. This will be handled on a case-by-case basis.)
   - 7-year Standard Warranty: Annualize O&M savings over the EUL ($5/year x 7 years) ÷ 12 years = $2.92/year for the life of the light.
   Simple payback = ($200 - $99) ÷ ($5/year + 2.92/year) = 12.8 years
   EUL = 15 years

Conclusion: UCRM 2 is acceptable. The owner's buydown is less than 50 percent of the UCRM cost, the O&M savings do not exceed energy savings and the resulting overall simple payback of 12.8 years is less than the EUL of 15 years.

CONSTRUCTION CONTRACTING MECHANISMS USED WITH LOANSTAR FUNDING

It is anticipated that borrowers will use design-build (DB) contracts, design-bid-build (DBB) contracts, or energy savings performance contracts (ESPCs) for the energy and water-efficiency projects including construction. For systems commissioning (SC) projects an engineer or other qualified commissioning authority (CA) will typically be utilized. The LoanSTAR requirements for the DB and DBB contracting processes are described in the following paragraphs. ESPC project requirements can be found at the following website: **https://comptroller.texas.gov/programs/seco/resources/espc.php**.

DB contracts between the borrower and the contractor are contracts where both the design and the construction activities are the responsibility of the same contractor. Borrowers must competitively select contractors in accordance with state law procurement requirements.

DBB contracts generally have a different designer and building contractor. This process is a linear delivery method in which the borrower selects the engineer to design the project. The borrower must follow a competitive process based upon qualifications to select the design. After design documents have been completed, the borrower requests bids from contractors to perform the work. Borrowers must competitively select contractors in accordance with state law procurement requirements.

The design engineer selected to provide design services can be the engineer who prepared the UAR; however, there are several certifications a design engineer must attest to whether he/she is the same engineer who prepared the UAR. These certifications are provided in the following list:

- The design has been conducted in accordance with the requirements of the Texas LoanSTAR Technical Guidebook as administered by SECO.
- The design meets generally accepted engineering practices, and the design is based on the design engineer's on-site investigation of the facilities involved.
- The design engineer will not receive additional financial remuneration (bonuses) beyond salary or fee based on design recommendations.
- Specifications or processes have not been developed in a manner that will result in only one potential supplier meeting those specification or process requirements.
- The design engineer has no undisclosed conflicting financial interest in the design recommendations.
- Equipment recommendations resulting from the design can be fulfilled by a minimum of two bidders for projects under $1,000,000 and three bidders for projects over $1,000,000.
- The design engineer will not influence a borrower to select any one of the recommended equipment manufacturers.

The design engineer will submit their final design documents, along with a signed design engineer certification, for review to the SECO representative. The design engineer certification form can be found in Volume I, Appendix D.

UTILITY ASSESSMENT REPORT AND INITIAL SYSTEMS COMMISSIONING REPORT

The utility assessment report (UAR) and initial systems commissioning report (ISCR) are the foundations of the LoanSTAR loan and a guide to SECO representatives conducting on-site activities. These reports must be clear, concise, objective and technically sound. The UAR and ISCR shall be prepared and signed by a professional engineer (PE), licensed in the State of Texas. These reports are part of the LoanSTAR loan application. As such, they must be reviewed and approved by SECO before financing can be authorized.

The PE analyst stamping these reports shall have practical experience that meets the following criteria:

- Be a mechanical, electrical, architectural or control systems engineer with a current Texas professional engineer registration;
- Have knowledge and experience in facility mechanical, electrical and building envelope systems found in institutional and commercial buildings;
- Have knowledge and experience in energy-efficiency retrofits and a specific understanding of building operations and maintenance procedures; and
- Have knowledge and experience in conducting energy analyses identifying energy efficiency retrofit project opportunities in institutional or commercial buildings and in preparing comprehensive reports on the findings.

The PE that prepares and certifies the accuracy of commissioning activities and ISCRs shall also have documented commissioning experience in institutional or commercial buildings. This PE shall be responsible for a timely response to any comments, questions or necessary revisions resulting from the LoanSTAR technical review.

LOANSTAR FUNDING PROCESS

In September or October of each year, SECO will publish a notice of loan funding availability (NOLFA) indicating that loan funds are available. A request for application (RFA) will also be included as part of the notice. Each NOLFA/RFA notice will contain details regarding the maximum loan amount allowed and loan interest rate. Applicants may submit multiple applications in response to each announcement. SECO reserves the right to award more than one loan to a single applicant.

As part of the application process, applicants shall submit one of the following documents:

- Project assessment commitment for design-bid-build, design-build, energy savings performance contracts or for systems commissioning projects.
- Preliminary energy audit (PEA) for design-bid-build, design-build, energy savings performance contracts and systems commissioning projects. The PEA must be completed by a professional engineer licensed in the State of Texas. PEAs must include UCRMs that will be completed to reduce utility (energy related and water) costs. Costs and simple paybacks must also be documented for each UCRM in the PEA (see Volume I, Section V for PEA format).
- UAR for design-bid-build projects, design-build projects, and for energy savings performance contracts, or
- Initial systems commissioning report (ISCR) for systems commissioning projects.

If a project assessment commitment or PEA is submitted, those applicants will receive a memorandum of understanding (MOU) from SECO. The sole purpose of the MOU is to reserve LoanSTAR funds for the successful applicant during the period the UAR or ISCR are being prepared. This document should not be construed as a loan agreement and does not authorize the expenditure of funds for LoanSTAR projects. LoanSTAR project expenditures cannot be incurred before the effective date cited in a fully executed loan agreement unless those expenditures are approved in the LoanSTAR Technical Guidebook. Commitment of funding to applicants will take place upon execution of the MOU. Those applicants must then submit a UAR or ISCR by the date identified in the MOU.

The SECO technical staff or its contractor will review the submitted UAR or ISCR. These documents must be approved before a LoanSTAR loan can be finalized. The technical staff may request additional information, calculations or cost backup if needed.

SECO will attempt to finalize a loan agreement with the apparent successful applicant. If a loan agreement cannot be successfully negotiated within a reasonable period of time, negotiations will be terminated. SECO may at any time, upon failure of negotiations, choose to reissue or withdraw the NOLFA/RFA rather than continue with negotiations.

After the final approval process has been completed, a LoanSTAR loan agreement is prepared and issued. The loan agreement is a document that authorizes the institution to proceed with the design of their project and includes guaranteed funding for the UCRMs stated in the approved UAR. Once the loan agreement has been executed, the institution can then begin the process of designing and implementing the measures identified in the report. This process includes several milestones:

1. Selecting a design engineer or ESCO
2. Preparing the design documents
3. Bidding the work
4. Installing the project
5. Closing out the project
6. Requesting a loan repayment schedule from SECO
7. Repaying the loan

LOANSTAR REIMBURSEMENT PROCESS

As the borrower's contractor(s) completes the design and undertakes the construction installation activities, the contractor will submit invoices to the borrower in accordance with their contract requirements. The borrower will review these invoices and ensure all required documentation has been included in their submittal. At this point the borrower will prepare and submit a reimbursement request, in the prescribed format, to SECO for review and reimbursement. When SECO's review is completed and it is determined that the reimbursement request is valid and in the required format, the requested funding will be provided to the borrower. At this time, the LoanSTAR loan interest will start accruing on the disbursed funds.

LOANSTAR REPAYMENT PROCESS

When the project is complete and all appropriate documentation has been submitted to and accepted by SECO, SECO will forward a loan repayment schedule to the borrower. Loan payments will begin within 60 days of project completion. Loan payments are due quarterly, using the state's fiscal quarters. The amount of annual loan repayment is based on the energy cost savings projected in the utility assessment report. These projected savings are the basis for the loan. SECO does not guarantee these savings. Therefore, the dollar amount and the number of loan repayments are established in the promissory note and do not vary according to the actual savings. The typical borrower with a four-year payback is obligated to repay the loan in 16 quarterly installments over a four-year period.

The loan repayment schedule principal balance at the time of schedule preparation is equal to the contracted loan amount plus the interest accrued to date. The schedule details the straight line (linear) quarterly payments on the loan, as generated by an amortization calculator. The payments do not vary with actual facility utility savings. If the projected UAR savings have been accurately determined, the loan payments should not exceed the projected UAR savings.

Amortization, as referred to in the amortization calculator, is the process of paying off the loan over time through regular payments. A portion of each payment is credited for interest while the remaining portion of that corresponding payment is applied towards the principal balance. The exact amount of the payment that is applied to principal varies with each payment. Initially, a small amount of each payment is devoted to principal. As the loan matures, larger portions of each payment go towards paying down the principal.

Loan interest continues to accrue on the outstanding loan principal during the loan term. Should the borrower not make loan payments in a timely fashion, interest accrued during the late payment time period shall be paid on the last loan payment.

LOANSTAR MONITORING PROCESS

The LoanSTAR loan monitoring process is dependent on the type of design and construction contracting mechanisms: design-build (DB), design-bid-build (DBB), systems commissioning (SC), and energy savings performance contracts (ESPCs). LoanSTAR monitoring takes place during the design phase, construction phase and project closeout phase of the project.

DESIGN PHASE MONITORING FOR DB, DBB AND SC PROJECTS

To ensure that the design specifications match the measures identified in the UAR, SECO will typically require an in-progress design review and in some cases, a final design review (see LoanSTAR Design Review Report Format, Volume I, Appendix D). The in-progress design review will be completed when the design process is approximately 50 percent complete. This evaluation verifies that the design is proceeding in a direction that conforms with the approved UAR.

The final design review, which normally applies to DBB only, is completed when the 100 percent design documents and the design engineer certification have been received and approved. This evaluation verifies that the completed design conforms with the intent of the approved UAR, meets state energy codes and demonstrates generally accepted engineering practices. At this stage of the design process, the design reviewer also evaluates the proposed schedule and estimated project construction budget provided by the design engineer.

CONSTRUCTION PHASE MONITORING FOR DB, DBB, ESPC AND SC PROJECTS

The level of review and involvement by SECO on any loan will depend on the scope and complexity of the measures. To ensure that the work meets technical, state, and LoanSTAR requirements, SECO performs a construction monitoring visit at least once while the work is in progress. The typical monitoring reports will follow the construction monitoring report forms (progress and final) shown in Volume I, Appendix D. SECO appointed representatives will complete these reports.

The construction monitoring reports provide a general overview of construction site activities and address issues of budget, schedule and conformance of the work with the design documents. SECO representatives will highlight any concerns and/or make recommendations concerning any necessary changes in scope or budget.

In addition to general inspection requirements, the final construction monitoring report will also focus on the construction contractor's compliance with furnishing the "closeout" documentation required. The SECO representative will verify that guarantees, warrantees, releases, O&M manuals, training sessions required, etc. have been provided by the contractor. For SC projects, a final report (FSCR) will be required that addresses the initial report (ISCR) measures, documentation of added equipment, controls, changes in control strategies etc., along with operating and maintenance requirements. All findings are to be captured in this final monitoring report.

PROJECT CLOSEOUT FOR DB, DBB, ESPC AND SC PROJECTS

Upon completion of the project, the SECO representative will submit a 100 percent construction monitoring report and a final completion report to SECO (see Volume I, Appendix D).

SECTION II – GENERAL INSTRUCTIONS FOR PREPARING THE UTILITY ASSESSMENT REPORT (UAR)

COLLECTING UTILITY INFORMATION

Energy and water charges used in the LoanSTAR report shall be collected from existing utility bills unless it is known that a rate change will take place within the next six months. If it is known that a rate change will be in effect within the next six months, a copy of both the current and pending rate schedule and applicable riders shall be provided in the appendix to the UAR. In this case, the baseline profile may be adjusted with the updated utility rate. In either case, the actual rate schedule must be used in savings calculations. The baseline shall be a contiguous 12-month period of utility consumption occurring within a two-year period preceding the audit. Energy charges used to calculate energy savings must be the same for pre-UCRM activities (baseline) and post-UCRM activities.

COST OF ELECTRICITY

Energy charges on electric bills for electricity consumption are not always uniform. Some electricity contracts are structured with uniform energy charges while other contracts may have time-of-use charges and demand charges. In the time-of-use contract structure, energy charges are based on the marginal cost of providing the energy to different types of customers (customer class). Time-of-use charges are often called "tiered" or "block" pricing. The term "tiered" typically refers to a "block" type of rate structure where the energy unit price changes at preset consumption blocks for each billing period. The different rate structures for "tiered" or "block" construction may include single/uniform block, decreasing block and increasing block structures.

When calculating savings for facilities with "block" consumption charges, calculate the savings using the incremental cost per kWh; i.e., the cost applicable to the block into which the building's electrical consumption falls and in which savings are expected to occur. Add the average cost of fuel adjustment, over the most recent 12 months available, to the per kWh cost. An acceptable alternative is to use a forecast of the cost of fuel adjustment provided by the utility or other reliable sources such as the U.S. Energy Information Administration (**www.eia.gov/analysis/projection-data.cfm**).

Energy charges may also vary seasonally. When summer and winter energy rates differ, the calculated savings must take into account those differences. If the kWh savings accrue evenly throughout the year for the recommended UCRMs, an average annual cost per kWh may be applied. If the energy-efficiency savings accrue primarily during a certain part of the year, the applicable summer or winter energy rates must be used.

Another charge that must be considered for electricity consumption is demand. Utilities must have generating stations, transmission wires and substations on constant standby ready to meet the maximum amount of potential electricity that customers may require or, in other words, the "peak demand." The cost to ensure the equipment needed to respond to peak demand is expensive. While some commercial customers may need access to this energy only intermittently, others need it almost constantly. Most electricity customers fall somewhere in the middle. In order to distribute the costs associated with meeting peak demands, utilities apply differing charges for demand or apply time-of-use ratios.

Demand is the rate of electrical consumption measured over short increments of time (usually 15 or 30 minutes). It is measured in kilowatts (kW). Demand charges are billed for the peak kilowatt (kW) use averaged over these increments of time. Each month, when the meter is read, the demand indicator is reset to zero. A spike in the electric demand will result in additional costs on the utility bill. In some utility rate schedules, a spike in the electric demand may impact demand charges year round.

Sometimes there may be a difference between the recorded demand taken from the meter and the demand charges billed. This difference is due to a billing feature known as a "demand ratchet." The demand ratchet was created to maintain the infrastructure needed to handle the summer or winter peak demands.

A demand ratchet creates a minimum seasonal demand charge stating that the minimum billed demand for any of the summer months shall not be less than a specified percentage of the highest recorded demand during the previous three summer months. In the following example, assume the specified percentage is 85 percent.

Example:

> *June – The actual building peak demand is 120 kW. Thus, the lowest potential demand for the month of July will be at least 102 kW (85 percent of 120 kW).*
>
> *July – The actual building peak demand is 130 kW. This demand exceeds the 102 kW lowest potential demand, so the actual demand of 130 kW will be billed in July. The lowest potential demand for the month of August will be at least 110.5 kW (85% of 130 kW).*
>
> *August – Because of an unusually mild season, the actual building peak demand is 100 kW. This demand is less than the lowest potential demand of 110.5 kW. So the 110.5 kW demand will be billed in August. The highest of the lowest potential demands is still the 110.5 kW based on recorded demand in July. Thus, 110.5 kW will be the lowest potential demand for the month of September.*

Similarly, the billed demand process previously described is the same process that could be used for winter months.

On Jan. 1, 2002, deregulation of the electric utility industry occurred in Texas. With this deregulation, investor-owned utilities were unbundled into three separate affiliates: transmission and distribution utilities, power generation companies and retail electric providers. In addition, there was a push to make electric utility bills easier to understand.

Electric rate schedules are very difficult to develop in a way that is fair to the customer and just in tariff returns to the utilities' affiliates. To simplify utility bills, tabular specified charges, developed by the utilities and approved by the Public Utility Commission (PUC), are updated frequently and applied to bill tabulation. This makes it easier for the consumer to verify the authenticity of the charges on the bills, but in reality there are charges from three different utility affiliates instead of one, and the billing inputs are, to a large degree, controlled by the PUC. This makes it difficult to perform a meaningful billing audit. However, this generally makes it easier for an analyst to determine average incremental rates to use in electrical cost savings calculations based on billing charges.

AVOIDED ENERGY COST SAVINGS DETERMINATION

AVOIDED COSTS OF ELECTRICAL ENERGY AND DEMAND

When UCRMs are implemented within a project, the annual energy consumption (kWh/yr) will be reduced. This reduction in annual energy consumption will be multiplied by the energy charges ($/kWh) discussed earlier in this section. The resulting energy charges ($/kWh) are the avoided costs.

In addition, annual energy demand (kW/yr), over a short period of time, may also be reduced. This reduction in energy demand will be multiplied by the energy demand charges ($/kW) discussed earlier in this section. The resulting demand charges ($/kW) over a 12-month time period (baseline year) are the avoided costs.

The most accurate method of calculating avoided costs is to perform a series of monthly utility bill calculations for the pre-UCRM consumption, and then perform a series of equivalent monthly utility bill calculations assuming the UCRMs have been installed. Include the impact on individual UCRMs in descending dependencies in the calculations. The following process, using electricity as the energy source, can be used to calculate avoided costs. This same process can be used for other energy sources.

1. Sum the charges for all electric bills for one month of the past year:
2. Adjust the total to correct for changes in fuel cost, time-of-use, peak demand, as applicable, and rate changes, if a rate change will be in effect within the next six months.
3. Separately calculate the electricity consumption and electrical demand for the same month assuming the installation of the energy-efficiency retrofit has been completed.
4. Adjust the energy bill so that it includes any impacts on time-of-use (block) pricing and ratchets.
5. The avoided cost (cost savings) is the difference between the monthly energy cost totals in Step 2 and Step 4.
6. Repeat the process for each month of a 12-month period. Remember to adjust the energy bill for ratchet demands and time-of-use in this process.
7. Repeat the process for each UCRM that will be implemented in the project.

A simplified and conservative calculation for avoided cost of electricity in a block rate structure has been approved for use as follows: (1) calculate avoided electrical energy cost on a per kWh basis assuming the use is in the last block of actual consumption, and (2) calculate avoided electrical demand cost, if any, assuming a full-use, last-block basis. The last block is generally the lowest electrical cost rate. Applicable fuel and cost recovery costs are to be added. The last demand block is calculated with no ratchet or consumption limits on the block extension clauses.

Utility rate schedules employ a seemingly complex array of terms and charges to determine the total utility charges billed to the customer. An example of how to analyze two different utility rate schedules is provided in Volume I, Section IV – Technical Guidelines.

BORROWER-OWNED CENTRAL PLANTS

Avoided costs for borrower-owned central plants shall be based on the overall cost to operate the plant. The overall cost includes the utility and fuel costs, maintenance and operating costs and capital depreciation (based on actual expected lifetime of the equipment). If the central plant is a cogeneration plant, these costs shall be reasonably prorated between electrical and thermal energy output. If the central plant produces only a portion of the energy consumed at the borrower's facility and the remainder is purchased from a utility company, the cost of the purchased energy may be used to calculate UCRM savings, but only to the extent that they produce an actual reduction in cost of the purchased energy.

AVOIDED COSTS OF NATURAL GAS

The total avoided cost for natural gas is calculated by the following formula:

$$\text{Avoided Total Cost}\left(\frac{S}{MCF}\right) = \frac{\text{Total cost in the past 12 month period}\left(\frac{\$}{yr}\right)}{\text{Total consumption for the same 12 month period}\left(\frac{MCF}{yr}\right)}$$

Most natural gas utility bills show the natural gas charges in cost per unit of volume ($/MCF), although a few will use cost per energy unit ($/therm or $/MBTU). LoanSTAR QuickCalcs are written to use $/MCF (see Volume II). The following conversions can be used to convert the cost per energy unit ($/therm and $/MBTU) to a cost per unit of volume ($/MCF).

$/therm ➔ $/MCF divide by 0.103

$/million Btu ➔ $/MCF divide by 1.03

The total cost includes all charges for the natural gas including customer charge, transport, franchise tax, city tax, cost and delivery guarantee fees and final adjustment costs as applicable.

AVOIDED COSTS OF OIL

The total avoided cost for fuel oil, butane or propane is calculated as follows:

$$\text{Avoided Total Cost}\left(\frac{S}{Unit}\right) = \frac{\text{Total cost in the past 12 month period}\left(\frac{\$}{yr}\right)}{\text{Total consumption for the same 12 month period}\left(\frac{Unit}{yr}\right)}$$

Fuel oil, butane and propane are generally purchased prior to the beginning of the "season" and replenished as needed. Calculations for these fuels differ from those for electricity and natural gas because these fuels are generally purchased on a non-periodic basis. The volume of fuel on site and its value must be determined at the beginning of the 12-month period and again at the close of the 12-month period. The pro rata share of fuel and cost is added to those purchases made during the 12-month period, and the pro-rata share of fuel on hand at the end of the period is subtracted.

These fuel costs are generally stated in terms of dollars per gallon, pound or MCF and must be referenced to an energy density (Btu/lb. etc.). These fuels may be used in QuickCalc calculations if the relative conversion efficiencies and cost per unit energy are considered in the calculation process.

CLASSIFYING PROJECT TYPES

Financing for energy-efficiency projects may be approved for existing buildings, building renovations or systems commissioning of existing buildings.

RETROFIT PROJECT

This is a project with one or more UCRMs that is initiated by the analyst in an existing building with the purpose of the project being to save utility consumption or utility dollars. If the facility is owned by the state or a higher-education institution, the retrofit measures must meet or exceed the state energy code requirements. Projects funded by LoanSTAR in buildings not owned by the state must also meet state energy code requirements and all local and county building code requirements, as applicable.

MAJOR RENOVATION

A major renovation project involves one or more UCRMs and is defined as a building renovation or improvement where the implementation cost is $2 million or more, based on the initial cost estimate. Any project classified as a major renovation in a state-owned or public higher education facility is required to meet the current state energy code requirements, and a compliance certification must be filed with SECO. Projects funded by LoanSTAR in buildings not owned by the state must meet state energy code requirements and all local and county building code requirements, as applicable.

UCRMS

UCRMs are divided into three categories: I, II and III. Definitions for these categories are provided in the following pages. UCRM savings for these three categories are calculated at different levels of detail.

CATEGORY I UCRMS

Category I UCRMs are sometimes called "dipstick," "deemed" or "stipulated" savings UCRMs. Paybacks are stipulated for these UCRMs, and savings are calculated based on implementation cost. The annual cost savings are determined by dividing the total implementation cost by the stipulated payback. Table 2.1 contains a summary of those calculations.

TABLE 2.1 – PAYBACK CRITERIA FOR CATEGORY I UCRMS

UCRM	Payback (yrs.)
De-lamping	1
Repair Steam Traps	2
Photocells, Timeclocks or Energy Management System controls on Exterior Lights	3
Programmable Thermostats	3
Timeclock Shut Down of Equipment	3
Interior HID Lighting to LED (Lamp retrofit only – excludes new LED full-fixture replacement)	3
Incandescent to LED	1
Linear Fluorescent to LED (Type A, B or C only – excludes new LED full-fixture replacement)	5
LED Exit Signs	8
Exterior HID Parking Lot Lighting to LED (Fixture replacement only, excludes full pole replacement)	10
Exterior HID Wall Pack to LED	5

BTU SAVINGS CALCULATIONS

Annual source Btu savings for Category I UCRMs may be approximated by dividing annual cost savings by either electric utility rates, natural gas rates or both, if appropriate, then multiplying the results by either 11,600 Btu/kWh or 1,030,000 Btu/MCF, respectively.

Example: Install Programmable Thermostats
Estimated project cost = $25,000
Simple payback (from Table 1) = 3 years
Annual cost savings = $25,000/3 years = $8,333/yr.
$8,333/yr. x 80% = $6,667/yr. (approximate electric utility savings)
$8,333/yr. x 20% = $1,666/yr. (approximate natural gas utility savings)
$6,667/yr. ÷ $0.08/kWh = 83,333 (kWh/yr.)
$1,666/yr. ÷ $4.50/MCF = 370 (MCF/yr.)
83,333 (kWh/yr) x 11.600(Btu/kWh) = 967 x 106 (Btu/yr)
370 (MCF/yr) x 1,030,000(Btu/MCF) = 381 x 106 (Btu/yr)
Total annual savings = 381 x 106 (Btu/yr)

CATEGORY II UCRMS

Category II UCRMs can be analyzed through use of calculation methods provided in Volume II of this publication (QuickCalc – simplified manual or spreadsheet calculation forms). These simplified methods are provided to decrease the time and cost traditionally invested in analyzing well established, relatively uncomplicated measures. Analysts are encouraged to use QuickCalc for the following types of measures:

Temperature Control

- Temperature control (electric cooling and electric or gas heating)

HVAC Schedule/Control

- Timeclock control of air conditioning/heating units (electric cooling and electric or gas heating)
- Timeclock control of motor loads (non-air-conditioned space)

Ventilation Control

- Ventilation control (electric cooling and gas heating)
- Ventilation control (electric cooling and heating)

Economizer Upgrades

- Dry bulb airside economizer (electric cooling)
- Dry bulb airside economizer (gas cooling)

Lighting Adjustments

- Lighting conversion (replacement of lamp and ballast)
- Interior fixture re-lamping/replacing (electric cooling and heating)
- Interior fixture re-lamping/replacing (electric cooling and gas heating)
- Interior fixture re-lamping/replacing (gas cooling and heating)
- Street/security lighting conversion

Lighting Schedule

- Exterior lighting controls
- Interior lighting controls (electric cooling and gas heating)
- Interior lighting controls (electric cooling and heating)

Equipment Upgrades

- Conversion to dedicated computer room cooling unit (electric to electric)
- DHW heater conversion (electric to gas)
- Electric efficiency motor replacement (non-air-conditioned space)
- Replacement of low-efficiency DHW heater units (gas to gas)
- Replacement of low-efficiency gas Heating (gas to gas)
- Replacement of low-efficiency HVAC units (converting from electric cooling and gas heating to heat pumps)
- Replacement of low-efficiency HVAC units (converting from electric cooling and heating to electric cooling and gas heating)
- Replacement of low-efficiency HVAC units (converting from electric cooling and heating to gas cooling and heating)
- Replacement of low-efficiency HVAC units (converting from electric cooling and heating to heat pumps)
- Replacement of low-efficiency HVAC units (electric cooling - EER and gas heating)
- Replacement of low-efficiency HVAC units (electric cooling - kW/ton and gas heating)

Custom Measures

- Attic/ceiling insulation (electric cooling and gas heating)
- Attic/ceiling insulation (electric cooling and heating)
- Infiltration reduction (electric cooling and gas heating)
- Infiltration reduction (electric cooling and heating)
- Programmable thermostats (electric cooling and electric or gas heating)
- Wall insulation (electric cooling and gas heating)
- Wall insulation (electric cooling and heating)
- Window solar gain control for clear, unshaded windows (electric cooling and electric or gas heating)

QuickCalc forms for these measures are included in Volume II of this publication. These manual forms and automated spreadsheets, which can be downloaded from the SECO website, utilize the same analysis techniques as the original SimpCalc software, which is no longer supported, and produce results of comparable precision.

CATEGORY III UCRMS

If a retrofit measure is not, for calculation purposes, identified as a Category I or Category II UCRM, it must be treated as a Category III UCRM. Category III UCRM analyses may be more complex and require detailed utility cost savings calculations and documentation. Examples of Category III UCRMs include energy management systems, cooling towers, and thermal energy storage.

PROJECT SELECTION PROCEDURES

It is the technical analyst's responsibility to identify the most cost-effective measures in existing buildings that will qualify for LoanSTAR funding. To accomplish this task, the following process should be followed:

1. Meet with administrative personnel to collect annual cost and consumption of utilities and to consider their ideas of what could be done in their facilities to reduce utility costs.
2. Meet with maintenance personnel to hear their ideas for reducing utility costs.
3. Conduct a field survey on the building(s).
    a. Look for operations and maintenance (O&M) process changes that will result in a reduction of consumption.
    b. Look for "standard" retrofit measures that will, with utility cost savings, with a global payback within 10 years (15 for 50 percent or more HVAC, controls and/or renewables) and which can be handled as Category I or Category II UCRMs.
    c. Look for additional measures that will, with utility cost savings, normally pay back within the allowable payback periods but will not be Category I or Category II UCRMs.
    d. Look for other measures that are unique to these facilities. These will be calculated as Category III UCRMs but may, with utility cost savings, have paybacks longer than the allowable payback periods but shorter than the estimated useful life of the UCRM.
    e. Make a quick assessment of the expected cost and savings associated with UCRMs identified in the steps above by reviewing typical paybacks for measures selected.
    f. If the combined payback for all UCRMs meets the 15-year maximum payback requirement, complete data collection for Category I and Category II UCRMs on-site and select measures for Category III UCRMs.
    g. If the combined payback for all UCRMs does not meet the maximum payback requirements, confer with the borrower and determine if there is a better combination of UCRMs that will meet the maximum paybacks or if the borrower would be interested in "buying down" the combined project payback. Then complete data collection for Category I and II UCRMs on site, select measures for Category III UCRMs and compute expected composite cost (after buydown).

ESTIMATING COSTS TO BE USED IN PAYBACK DETERMINATION

Costs included in payback determination include implementation costs and existing debt on equipment that will be removed from the site. Implementation costs include design, demolition and construction activities. Since debt on existing equipment removed from the site must be included in the payback determination, it is the analyst's responsibility to determine if there is any remaining debt on existing equipment.

As a general rule, operations and maintenance (O&M) activities cannot be included as a part of the funded project. However, there may be specific situations where it is appropriate to create a UCRM to replace an O&M activity or where resulting O&M hard cost savings can be included in the UCRM savings. Additional information is provided on this topic in the following paragraphs.

DESIGN

The UCRM design costs include associated labor, materials, overhead, profit and insurance for the design of the specific UCRM. Sometimes these costs may also include the costs associated with engineering site visits and subsequent monitoring and report preparation during construction activities.

CONSTRUCTION

The construction phase of a retrofit measure generally includes both demolition and construction elements. During demolition there are labor and material costs associated with the removal and disposal of any existing equipment.

The borrower and the contractor must decide who will own the equipment once it is placed out of service. The borrower may elect to retain ownership and have the equipment relocated to specified areas on the site. The borrower may also elect to have the contractor sell the equipment and apply a portion of the proceeds to the UCRM for cost reduction. The borrower may also elect not to retain equipment ownership. If ownership is not retained, it is the responsibility of the contractor to remove and properly dispose of the equipment. Any proceeds from removed equipment sales would thus belong to the contractor.

After the existing equipment has been removed from the site, construction activities proceed with the installation of new equipment. There are labor, equipment and material costs associated with these construction activities. Construction phase costs also include overhead, profit, bonding, insurance and operating costs such as project manager (PM)/construction manager (CM), field office, utility services for field office, storage areas etc.

EXISTING DEBT ON EQUIPMENT TO BE REMOVED

There may be an occasion where the equipment that is being replaced is still being paid for through a bond or other financing mechanism. It is incumbent upon the technical analyst to determine if there is debt that exists on the equipment. If debt does exist on the equipment, the outstanding balance of the debt must be included in the payback calculations.

NON-FUNDABLE OPERATIONS AND MAINTENANCE

Operations and maintenance (O&M) activities are not candidates to be considered as part of a UCRM or as a stand-alone UCRM. One helpful way to differentiate whether or not the task is a UCRM is to ask the following question: "Is the recommended action something that the building staff should be doing ordinarily as a regular part of their duties?" If the answer is yes, the recommended action will usually be an O&M and should not be included in UCRM cost determination.

However, UAR recommendations that involve turning machines on/off, for example, illustrate borderline cases. Obviously, a maintenance staff that is performing its duties will turn off all equipment after normal building occupancy hours if use of the equipment is unnecessary. However, this kind of manual on/off control is the exception rather than the rule. In cases like this consider:

- Does the maintenance staff have the workforce to comfortably perform the required operation manually?
- Can the staff reasonably be expected to perform this duty in a reliable manner?

If the answer to either question is no, then recommend investment in automatic control equipment (i.e., time clocks, energy management systems etc.) and classify the measure as a UCRM, rather than recommending manual performance of these tasks as an O&M.

Analysts are encouraged to include non-funded but recommended O&M items in an appendix of the UAR. Volume I, Appendix B of this guidebook provides additional information and case studies on O&Ms.

FUNDABLE HARD COST OPERATIONS AND MAINTENANCE

Implementation of a UCRM may result in hard cost O&M savings. Use the following bullet list to determine if the hard cost savings are eligible savings and to quantify the magnitude of savings:

- Use a reasonableness test on O&M hard cost savings. Either provide copies of work orders (12 to 24 months), illustrating actual maintenance costs for the equipment being replaced, or use industry-acceptable maintenance cost estimations, such as R.S. Means "Facilities Maintenance & Repair Cost Data," to document estimated savings. If the service has been provided on a contract basis, provide contract cost documentation to document estimated savings.
- O&M hard cost savings should be secondary and not primary. Annual O&M hard cost savings should never exceed the annual energy dollar savings for the measure associated with the O&M costs.
- The duration of operational savings should not exceed the remaining average useful life of the equipment in place.
- Operational savings costs used in the baseline year will remain in place for the duration of the savings. No inflation factors will be included in the costs.
- The operational savings will not be reduced by upcoming operational costs associated with the newly installed equipment.

ESTIMATING IMPLEMENTATION COSTS

Implementation costs must be estimated and documented in sufficient detail to meet LoanSTAR Program requirements. In general, these costs should be estimated as close as possible to the costs that can be realistically expected so that the adding of a small escalation to these costs will virtually assure a final actual cost that is less than or equal to the estimated cost.

A detailed budget for the installation of each retrofit must be included. Implementation cost estimates should be as detailed as practicable and conform to the acceptable documentation discussed below. The budget must include a work breakdown structure (WBS) including each major element required to install the retrofit. The WBS should list:

- one-time credits (i.e., salvage value, rebates, grants etc.)
- borrower management fees
- escalation allowance
- total costs
- additional design/engineering/administration cost
- financing cost
- insurance costs
- contractor costs
- profit margins
- subcontractor costs
- labor cost
- materials cost
- equipment cost

For state agencies, the materials and equipment identification and pricing may be taken from the automated state contract whenever these items are available. Copies of the automated contracts covering the specific items of interest can be obtained by contacting the Texas Comptroller Statewide Procurement Division. If a particular item of equipment or material is not included on the state contract list, it should be identified by specified type, size, capacity or other required attributes in order to describe the required purchase. It can be identified by the equipment cut sheet, specific manufacturer's model number, description etc., as long as it is understood that other manufacturers' equivalent items can be substituted.

The implementation costs must include a budget for the removal and proper disposal of materials and equipment to be replaced under this program. These materials would include, but not be limited to, items such as light bulbs, ballasts, switches, controls, HVAC equipment, refrigerants, pumps, fans, blowers, piping, valves, conduit, wiring and boilers. Special care should be taken to budget sufficient funds to properly dispose of materials that are hazardous to the environment.

If a UCRM installation estimate equals or exceeds $100,000 (labor, construction equipment and contractor's overhead and profit), the technical analyst should obtain and include at least one written estimate from a reputable regional contractor if possible (see acceptable alternate below). If labor is to be performed by the borrower's staff, their hourly rate for the trade required should be included, but not any mark-up (profit).

If a UCRM installation estimate is less than $100,000, the technical analyst may estimate by subtotaling equipment, materials and labor costs for each UCRM requiring the services of an installation contractor and adding 20-30 percent for the contractor's indirect cost, overhead and profit.

Examples of alternate acceptable implementation cost documentation are provided in the following list:

- A recent quotation from a regional contractor for furnishing labor, materials, supplies and equipment to implement the retrofit. This should be referenced in the implementation portion of the report, and the quotation document should appear in the UCRM (or the appendix if voluminous).
- In the absence of a quotation from a contractor for the installation of the UCRM, a quotation from suppliers or the price from the state contract list for furnishing the equipment or materials required in the implementation of the savings is satisfactory, if accompanied by a labor estimate and the contractor's overhead and profit based on generally accepted construction cost data (see below). This should be referenced in the implementation portion of the report, and the backup or justification documentation should appear in the UCRM (or in the appendix if voluminous).
- Where quotes from contractors or suppliers are not available or cannot be obtained for the costs of materials, supplies and equipment or for the productivity and cost of labor, this information can be obtained from a recognized construction cost database such as those produced by the R. S. Means Company. This information should be referenced in the implementation portion of the report listing the source (including the year) and the specific line item quoted, so that the information can be reviewed for correctness. This should include an analysis of labor productivity as outlined by the database used. However, the pay rates used and the material costs should be indexed to reflect the costs of the locale in which the buildings studied are located, if there is any significant variation.
- Where in-house personnel are used to implement projects, a referenced statement from an administrator of the borrower to justify the rates used will be acceptable. In this case, the base pay rate plus applicable burden should be used.

For retrofit measures in detailed reports that require additional design/engineering/administration where the analyst does not normally perform these functions, a letter quote must be obtained from a consulting A/E firm or an engineering firm that does perform these functions. If the technical analyst also provides design and engineering services of the type required in the retrofit measures, they may provide the estimate for this work. This should be included in the implementation portion of the report and should appear in the UCRM cost. This estimate should contain, as a minimum, the total dollars necessary to complete the plans and specifications and to provide sufficient quality control to ensure that the project is installed as designed.

An escalation allowance may be included in the cost buildup at the technical analyst's discretion, using up to 15 percent of the total estimated project cost in order to assure that sufficient loan funds are available to complete the retrofit.

CHANGE IN SCOPE

The LoanSTAR loan award is based on the utility assessment report (UAR) submitted with the loan application. Sometimes during the design phase or implementation of the retrofit measure(s), it may become necessary to deviate from the approved UAR. Proposed changes in project scope will be documented in the LoanSTAR Change in Scope Review prepared by a SECO representative during the design review or construction monitoring visit (See Volume I, Appendix D). Calculations will be required if there is reason to believe that net savings will decrease or costs increase as a result of implementing the change.

The LoanSTAR Change in Scope Review prepared by a SECO representative will be submitted to SECO for further consideration. If SECO concurs with the recommended change(s), SECO will prepare and issue a loan contract amendment.

SECTION III – SPECIAL INSTRUCTIONS

USE OF COMPUTER PROGRAMS FOR ENERGY SAVINGS CALCULATIONS

Analysts are encouraged to calculate utility savings manually, wherever practical, using simplified energy calculation methods based upon accepted engineering procedures, such as those recommended by ASHRAE and IES. Carefully prepared, concise calculations based on simplified utility cost-saving calculation procedures are generally sufficiently accurate to meet the basic objective of a UAR. These calculations should be presented in a concise, logical sequence. Utilizing the simplified utility cost-saving calculation procedures also expedites the technical review process.

The technical analyst may, in some cases, find it necessary to utilize a computer program to analyze a complex UCRM. Should the analyst elect to use a computer program or spreadsheet to calculate energy savings, energy calculation methods must be identified, and the printouts and solutions should be clearly marked and self-explanatory. The analyst may submit calculated savings obtained from computer programs if the calculation procedures and formulae used are clearly identified and the following guidelines are followed:

- The energy calculation procedures and equations and the calculations/assumptions that provide the documentation for claimed energy savings must be included in the report. If spreadsheets are used, key tabulated numbers and column headings must be clearly identified, and formulae used and sample calculations must be provided that correlate with values shown in the spreadsheet.
- The name of commercial computer programs and their origin or vendor should be clearly indicated. In the case of computerized heat gain/loss calculations, detailed calculation procedures need not be documented as long as the load calculation method (i.e., ASHRAE transfer function method, bin method etc.) is specified. All pertinent input and output data should be shown, with key values highlighted or underlined. Approved energy use simulation programs must comply with ASHRAE Standard 140-I (most current adopted version), Standard Method of Test for the Evaluation of Building Energy Analysis. Computer programs like Carrier E20-II, Trane Trace and DOE-2 currently meet this requirement.
- "Black box" computer programs which do not show formulae used or assumptions made and calculate the final results with very little input information are not acceptable, unless clear explanations of calculations can be provided along with documentation of successful results on five or more recent projects through measurement and verification activity.

Annual consumption predicted by computer simulation models must be within 5 percent of actual utility data (for each energy type). Monthly consumption variations may not be more than 15 percent in any case. If the baseline must be adjusted due to special circumstances, the justification for the adjustment, along with both the actual and proposed utility data (for each energy type), must be supplied with the calculations.

QuickCalc procedures found in Volume II may be used according to the directions provided.

EQUIPMENT SELECTION

MINIMUM EQUIPMENT ENERGY EFFICIENCY

All recommended equipment must meet or exceed state and local codes and must meet or exceed the equipment efficiency standards as embodied within the current version of the Texas Design Standard (based on ANSI/ASHRAE/IESNA Standard 90.1, or 2015 IECC for state-funded commercial buildings and major renovations at state agencies).

ENVIRONMENTAL CONCERNS

A concern for future equipment selection arises from the mandates of the Clean Air Act of 1990, Title VI - Stratospheric Ozone Protection. Title VI specifies a schedule for phase-out of the use and manufacture of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) that are currently used in air conditioning and refrigeration systems, and in other devices. Many chillers and building air conditioning units continue to use CFC-11, CFC-12 and HCFC-22 refrigerants (also known as R-11, R-12 and R-22, respectively).

The Clean Air Act specifies that all CFCs, such as R-11 and R-12, will not be manufactured after Jan. 1, 1996. The currently available alternative for R-11 is HCFC-123 and for R-12 a hydrofluorocarbon HFC-134a. HCFC-123 manufacture will cease Jan. 1, 2030 by the current mandates. HFC-134a has no ozone depletion potential and is not subject to the current regulations. The originally mandated end of production of R-22 was Jan. 1, 2030, but that date was moved up to Jan. 1, 2020. The production and importation of R-22 decreased steadily between 2015 and 2019, ceasing altogether on Jan. 1, 2020. Many businesses have started to transition to alternative refrigerants. In deciding when to convert (or retrofit) to an alternative refrigerant, one must consider the amount of time that will be needed to finish all phases of the conversion. During the transition period, there are three basic choices: (1) convert the existing system, (2) buy a new system or (3) continue to operate the existing system. If converting the existing system, one must confirm with the equipment supplier that the system can be retrofitted to use an ozone-friendly refrigerant and that all components are compatible with the new refrigerant. Buying a new, more efficient system may require more money initially but may reduce the electricity bill and save money over time. If the decision is made to continue operating the existing system, one must ensure that a process is in place to quickly repair any leaks.

The EPA ENERGY STAR Buildings Manual provides some approximate guidelines dealing with chiller retrofit/replacement options as a result of the refrigerant phase-out. Chillers that are less than 10 years old are recommended for retrofits compatible with the new refrigerants. These retrofits will involve installing new gaskets and seals, replacing or rewinding the existing motor and modifying the impellers. The retrofit is recommended to occur at the same time as major overhauls of the equipment to minimize overall costs. If the chiller is more than 10 years old, replacement may be the better option from the standpoint of increased operational efficiency. The original equipment manufacturers can be consulted concerning the efficiency of the current unit, how the unit will perform with the new refrigerants and how newer units would be expected to operate. For chillers that are closer to 20 years old, the replacement option becomes the recommended choice considering the estimated useful life of the equipment.

EQUIPMENT LOADING

A common error encountered in LoanSTAR reports is assuming that equipment is fully loaded. Frequently, chillers, boilers and pumps were oversized to provide a margin for future growth or unknowns in sizing. Also, loads often change after equipment is installed. The technical analyst must make a judgment as to the loading of the equipment as utilized. One way to verify use is to record the power drawn under appropriate environmental conditions. Another verification method for pumps and fans is to measure pump head or fan static pressure, as applicable, and apply these data to pump and fan curves. The following problems have been observed in LoanSTAR audits:

- A school administration area originally designed as office space was converted to cool dry food storage. Later, the area was partitioned to make two offices. A single thermostat not located in an office controlled all spaces.
- It was decided that one suite of offices at a school was not receiving enough cooling, so approximately 800 cfm was ducted in from an adjacent rooftop unit. No control changes were made.
- A rooftop package unit served three classrooms, one of which was converted to storage without changes to the system or single control.

The rationale for the loads used in LoanSTAR analyses should be noted in the report.

EQUIPMENT EFFICIENCY

Knowledge of equipment efficiency is necessary for adequate analysis of potential UCRMs. Two areas for concern are efficiency decay and inaccurate conversion between performance measures. The efficiency of a 10-year-old residential/commercial HVAC unit is generally less than when the system was placed in service. A typical unit with an energy efficiency ratio (EER) of 9 may exhibit a current EER of 7.5-8. A natural gas furnace with an original efficiency of 80 percent may now have efficiency in the 70-75 percent range, depending on maintenance and use. One approach to determining efficiency is to obtain data from the manufacturer for that model and decrease the efficiency by some reasonable amount; e.g., 5 to 10 percent. Any adjustment to performance characteristics should be noted and rationalized.

CURRENT OPERATING EFFICIENCY OF AGED AIR COOLED UNITS CALCULATION

The Texas Department of Housing and Community Affairs published a white paper entitled "Best Practice – SEER and EER Determination" in January 2017. The paper illustrates a mathematical process for determining the existing EER or SEER of certain types of HVAC equipment when the exact performance of the existing equipment is unknown and cannot be measured. The formula includes an assessment of the base EER or SEER, which is then degraded based on an assessment of the unit's maintenance factor and its age:

$$\text{EER} = (\text{new condition EER}) * (1 - \text{Maintenance Factor})^{\text{age}}$$

The paper recommends using a maintenance factor of 0.01 or 0.02 depending upon the maintenance history of residential units. The SECO LoanSTAR guidelines have historically allowed poor-condition, air-cooled 3-25-ton air conditioning units that have reached the end of their useful life expectancy to be modeled with current operating efficiencies as low as 6.6 EER, or 1.8 kW/ton. ASHRAE indicates that these types of units have reached the end of their useful life expectancy when they are 15 years old. In 2005, (15 years ago as of this writing), typical manufacturer catalog data indicates the new-condition EER for these types of units was approximately 9.

By reverse calculating the maintenance factor that results in an energy efficiency approximating 6.6 EER after the useful life expectancy of 15 years has passed, it is determined that the most appropriate commercially applied maintenance factor to be used in the formula is 0.02.

$$\text{Current Operating EER, 3-25 ton air cooled air conditioners} = (9) * (1-0.02)^{15} = 6.6471$$

As a test, the text above indicates a 10 year old, EER 9 split system should exhibit a current operating efficiency of 7.5 to 8:

$$\text{Current Operating EER, 3-25-ton air-cooled air conditioners} = (9) * (1-0.02)^{10} = 7.3537$$

This formula, adjusted for the current age of the specific unit to be replaced and a maintenance factor of 0.02, may be used to estimate the current operating efficiency for 3-25-ton split systems or rooftop units to be replaced in LoanSTAR projects when direct measurement techniques are not possible.

Conversion of one performance measurement to another frequently leads to error. The use of EER and SEER interchangeably is an example. EER is a measure of the performance of a cooling system based on the BTUs of cooling produced by one watt of electric power. Typical values range from 10-14 Btu/W. Performance is measured at 95°F ambient condenser temperature and 80°F dry bulb/67°F wet bulb temperature entering air conditions. Fan motor heat is included in the load.

SEER is defined as the amount of cooling performed during a cooling season divided by the total electrical power expended to produce the cooling effect. Cooling measurements are given in BTUs and power consumption in watts. Actual certification is performed in a laboratory under controlled conditions. EER and SEER are not interchangeable. Contact the manufacturer for values with suitable units. (Systems rated at 60,000 Btu/hr and less are generally specified in SEER units). In the absence of definitive information, note that the conversion factor for EER to SEER is dependent on the unit and can range from 0.69 to 0.93.

A third measure of cooling performance is the integrated part-load value (IPLV). IPLV is used for larger water chilling equipment that is capable of significant unloading. The larger water chilling equipment is placed in an application where load and condensing temperatures vary during the cooling season. Data are collected at four load levels (100, 75, 50 and 25 percent) and specified condenser conditions; a weighted average is then calculated. Results are usually provided in kW/Ton but sometimes in EER or COP. IPLV is not directly interchangeable with SEER.

A fourth measure of cooling performance is the non-standard part-load value (NPLV). It is similar to IPLV, but efficiency is determined under conditions other than IPLV conditions. NPLV and IPLV are not interchangeable.

LIGHT LEVELS

The analyst must use caution to ensure that UCRMs which reduce light output will still meet or exceed the lighting levels recommended by the current Illuminating Engineering Society (IES) standards. In addition, the lighting power allowance must meet the standards of the current version of ANSI/ASHRAE/IESNA Standard 90.1 or 2015 IECC for state-funded commercial buildings and major renovations at state agencies as applicable (primarily Section 9). Data should be provided in the UAR that show the measured existing light output in typical areas affected by the UCRM, the proposed light output subsequent to the retrofit and recommended minimum values. In the event that lighting levels are increased, a simple statement to that effect giving the light output of old and new lamps and the source of the data will be sufficient.

Cleaning is not sufficient to justify light output level increases unless it is to be part of a new, regular ongoing maintenance program described in the report that did not exist before.

SECTION IV – TECHNICAL GUIDELINES

GENERAL INFORMATION

The primary objective of the utility assessment report is the installation of sound retrofits that have an established payback track record. It is essential that paybacks be as accurate as possible because borrowers will be using the utility savings achieved by the projects to repay their loan principals and interest. In performing payback analyses, analysts should err on the conservative side.

Calculation methodologies shall be consistent with industry norms; it is suggested that the current ANSI/ASHRAE/IESNA Standard 90.1 be followed as a preferred methodology. Common methods employed in the calculation process allow for a uniform and swift review of the submitted reports.

In calculating the total utility consumption and utility cost savings expected from the acquisition or installation of all energy conservation reduction measures, the analyst must take into account the (possible) interaction between the "applied for" measures (see calculation methodology below). This is required because, due to dependency effects, the total energy savings which result from the combination of several UCRMs may be less than the sum of the independent energy savings of each measure.

It is also the responsibility of the technical analyst to carefully document all assumptions made with regard to estimated implementation cost and cost savings. These assumptions must be clearly identified to assist the borrower and the reviewer in determining the validity of the individual UCRMs. For example, if the retrofit work requires disruption to an occupied space, the analyst should state that the cost estimate is based on the work performed after hours or on weekends at a premium rate. If the analyst assumes that the borrower will vacate a given area for the retrofit work to be done, this should be clearly noted. In the case of school retrofits, if the analyst assumes that all retrofit work will be performed during the summer months, this should be clearly stated so that the borrower will be able to anticipate any scheduling conflicts. The same is true for assumptions made with regard to equipment run time when calculating potential energy savings. All of the assumed run times, setbacks, 24-hour operations etc. should be summarized to call attention to the fact that important decisions are based upon the validity of this information.

It is recommended that each UCRM be calculated as if all UCRMs have been completed in the following order: (1) building load reductions, (2) distribution system modifications, (3) primary equipment modification/replacements and (4) energy management system installations (see example in calculation methodology of this section).

UCRMs should generally be grouped with like measures. For example, including multiple motor retrofit calculations in one UCRM is appropriate. If multiple HVAC upgrades (boiler replacement, pumping modifications, controls upgrades etc.) are grouped in one measure labeled "HVAC Retrofits" (for example), the analyst must show very clearly how the effects of dependency have been taken into account in the calculated savings.

CALCULATION METHODOLOGY EXAMPLES

INTERACTION OF MEASURES

A common mistake made by technical analysts is overlooking the interaction between a load reduction measure (such as adding insulation) and an equipment change (such as changing to a higher efficiency cooling system). Often the sum of the independent savings leads to an overly optimistic payback period. The correct way to handle these two dependent measures is illustrated in the following examples.

For example, consider a school building that spends $8,000 per year for cooling energy only. Calculations based upon energy consumption records and manufacturer's data for the central air conditioning system indicate an annual consumption for an average weather year of about 160,000 kWh at 5¢/kWh. A technical analyst develops two measures to reduce total cooling costs. UCRM-1 is a measure to upgrade the ceiling insulation to R-30. Calculations show that this measure will reduce the annual cooling load by 25 percent. A second measure, UCRM-2, is developed to replace the old cooling system (EER = 5) with a new high-efficiency system (EER = 10). Determine the energy saved by this combination of two measures.

Review of Independent Savings (each UCRM reaches full savings potential)

UCRM-1 Savings – New ceiling insulation with existing cooling system

Installed insulation will save 25 percent on cooling load. Based upon detailed calculations shown in UCRM-1 data. Therefore, URCM 1 Savings = 25% × 160,000(kWh/yr) = 40 (kWh/yr).

UCRM-2 Savings – New cooling system with no new insulation

The high-efficiency cooling system will save:

UCRM 2 Savings = 160,000 (kWh/yr) × (5 EER/ 10 EER) = 80,000 (kWh/yr)

UCRM-1 and UCRM-2 Savings (UCRMs both reach full savings potential)

Combined Savings = 40,000 (kWh/yr) + 80,000 (kWh/yr) = 120,000 (kWh/yr)

Combined Savings (with dependency)

Original Heat Load = 160,000 (kWh/yr) × 5(Btu/hr/Wh) × 1,000(Wh/kWh) = 800x106(Btu/hr/yr)

Modified Heat Load = (1-25%) × 800 x 106 (Btu/hr/yr) = 600 × 106 (Btu/hr/yr)

Operating Energy for new cooling system = 600 × 106 (Btu/hr/yr)/ 10(Btu/hr/Wh) × 1,000(Wh/kWh) = 60,000(kwh/yr)

Combined savings of UCRM-1 and UCRM-2 are:

Savings = kWh/yr (before) – kWh/yr (after)

= 160,000 (kWh/yr) – 60,000 (kWh/yr)

= 100,000 (kWh/yr)

For the preceding example, the utility assessment report will show a sequential implementation of measures; therefore, UCRM-1 savings = 40,000 kWh and UCRM-2 savings = 100,000 – 40,000 kWh.

NOTE: The combined savings of 100,000 kWh/yr. is less than the sum of the independent savings of 120,000 kWh/yr.

VARIABLE SPEED DRIVE

Variable speed drive (VSD) installations have been a commonly recommended retrofit in recent years. Variation in the savings calculation methods has led to confusion and slowed the review of the submitted reports. The ANSI/ASHRAE/IESNA Standard 90.1 presents two recommended methods for determining the savings from VSD installations on fan systems. These two methods are taken from ANSI/ASHRAE/IESNA Standard 90.1-2010, Table G3.1.3.15, and are shown and discussed below.

METHOD 1 – PART-LOAN POWER DATA

Fan Part-Load Ratio	Fraction of Full-Load Power
0.	0.00
0.	0.03
0.	0.07
0.	0.13
0.	0.21
0.	0.30
0.	0.41
0.	0.54
0.	0.68
0.	0.83
1.	1.00

METHOD 2 – PART-LOAN FAN POWER EQUATION

$$P_{fan} = 0.0013 - 0.1470 \text{ x } PLR_{fan} - 0.9506 \text{ x } (PLR_{fan})^2 - 0.0998 \text{ x } (PLR_{fan})^3$$

where,

$$P_{fan} = \textit{fraction of full load fan power}$$

$$PLR_{fan} = \textit{fan part load ratio (current cfm/design cfm)}$$

Close inspection of these two methods to determine fan power reveals that they are better described as two different approaches using the same method. The table, Method 1, is intended to be used as a quick reference and lists eleven evenly spaced fan part-load ratios and their resulting fractions of full-load fan power. Method 2 is provided so that specific fan part-load ratios and their resulting fractions of full-load power can be calculated.

It is important to note that these two methods offer theoretical reductions in fan power, but they do not consider the effect of the associated motor and drive. Furthermore, when the speed (RPM) of a motor is reduced beyond a certain point, no more energy savings accrue because the motor efficiency declines and, ultimately, the inherent motor and friction losses prevail.

The two methods provided above are useful when the current cfm and design cfm are provided, but often in a retrofit measure the motor is being replaced to match actual loads, or a VFD is being added to reduce motor RPMs to meet variable load requirements. When applying VFD control, it is practical to use the standard fan laws found in the ASHRAE Handbook – HVAC Systems and Equipment. The following equation is a commonly used simplification of these laws and may be used for VFD measures:

$$hp_{Current} = \left(\frac{RPM_{Current}}{RPM_{Original}}\right)^3 \text{ x } hp_{Original}$$

SAMPLE ELECTRICAL RATE CALCULATIONS FOR COST AVOIDANCE

The method of determining the avoided costs of electrical consumption and demand will be illustrated by the following example using a hypothetical electric rate schedule. The following examples are included only as an illustration of how to calculate avoided electrical costs; each electric provider may have a different rate structure.

The examples use historical and modern rate schedules and are intended to illustrate a broad range of variables that must be considered in cost avoidance calculations. The analyst must use current rate schedules or those that will be in place within six months after the UAR is produced.

The first example is used to illustrate what happens with a more complex historical rate schedule. This rate schedule uses variable-size electrical consumption blocks and other charges that must be included to calculate avoided costs of electrical energy and demand. It also depicts how demand has an implicit impact on the avoided cost of energy when the energy consumption block sizes are dependent upon demand. A "ratchet" clause is explained in the discussion of this example.

EXAMPLE 1 – CITY OF REWOP (HYPOTHETICAL) – GENERAL SERVICE (SECONDARY)

This example illustrates a determination of the avoided costs of electrical energy and demand for a consumer using the City of Rewop Energy Electric Rate Schedule. A copy of the schedule is provided at the end of these calculations. Specific references will be made to portions of this schedule during the following discussion.

In the section labeled "Monthly Rate," the components of the utility costs are given. The consumption-based charges consist of an energy charge, a fuel charge, a power cost charge, and a cost-of-service charge. Other charges are a customer charge and a demand charge. The customer charge is not a consumption-based charge and does not affect the avoided costs of electrical energy or demand in any way. This facility pays no sales taxes on its utilities.

The City of Rewop Energy General Service (Secondary) Schedule does not have different energy charges for the summer and winter periods. However, the determination of billed demand illustrates an important rate schedule feature.

The following is excerpted from the "Demand Determination" section of the rate schedule:

a) Billed demand is the smaller of:
   - current month kW
   - on-peak kW plus 25 percent of the current month kW in excess of the on-peak kW

b) But is not less than the highest of:

- 80 percent of the on-peak kW
- 50 percent of the contract kW
- 50 percent of the annual kW

The City of Rewop Energy's definitions of these demand terms are provided within the rate schedule. The minimum demand to be charged will be one of the three options listed above. This is a prime example of the "ratchet" clause that is included within some utility rate schedules. Typically, the minimum billed demand is 80 percent of the on-peak demand, which will trigger the ratchet. Therefore, during the off-peak period, the minimum demand that a facility will be billed for is usually equal to 80 percent of the maximum metered demand during the previous 11 months in the on-peak period.

Table 4.1 shows the electrical consumption of a facility within the City of Rewop energy service area that is on the General Services (Secondary) Rate Schedule. Refer to the columns for the actual and billed demands in the months of October and April. Notice that the billed demand is larger than the actual demand in those months. The 80 percent ratchet was triggered in those months because the actual demands were less than the value of 80 percent of the on-peak during the previous June-September on-peak season. The billed demand of 554 kW in October allows us to calculate that the on-peak demand set during that period was:

$$\begin{aligned} \text{Demand} &= 554(\text{kW}) \div 80\% \\ &= 693(\text{kW}) \end{aligned}$$

AVOIDED COST OF ELECTRICAL ENERGY

The avoided cost of electrical energy will be composed of the energy charge, fuel charge, power cost charge and a fuel refund. The fuel refund has been returned monthly by the City of Rewop Energy instead of in a lump sum. The power cost charge also changes every month.

Energy Charge. Table 4.1 shows the electrical energy and demand usage by the facility that is the basis for this example. This facility is solidly in the third block of energy consumption. Therefore, the avoided energy charge is: = $0.007/kWh

Fuel Charge. The fuel charge from Rider FC is the avoided fuel charge: = $0.018926/kWh

Purchased Power Cost Charge. The power cost charge changes monthly, so an average of the amounts from the last 12 monthly bills (not included in this document) will be used to calculate the avoided cost:

= [$0.000382/kWh + $0.000426/kWh +$0.000382/kWh + $0.000468/kWh + $0.000496/kWh + $0.000530/kWh + $0.000537/kWh +$0.000510/kWh + $0.000415/kWh + $0.000412/kWh + $0.000153/kWh + $0.000163/kWh] ÷ 12

= $0.000406/kWh

TABLE 4.1 — SUMMARY OF ELECTRICAL CONSUMPTION AND DEMAND, CITY OF REWOP ENERGY GENERAL SERVICE (SECONDARY) RATE SCHEDULE

Billing Dates	Month	Days in Period	Plant Energy Consumption (kWh)	Guard Light Consumption (kWh)	Consumed in Block 1 (kWh)	Consumed in Block 2 (kWh)	Consumed in Block 3 (kWh)	Actual Demand (kW)	Billed Demand (kW)
09/21-10/20	Oct	30	215,376	1,350	2,500	95,980	116,896	399	554
10/20-11/18	Nov	30	258,240	1,350	2,500	111,620	144,120	646	646
11/18-12/18	Dec	30	226,368	1,350	2,500	109,070	114,798	631	631
12/18-01/20	Jan	33	327,840	1,350	2,500	118,930	206,410	689	689
01/20-02/17	Feb	28	199,248	1,350	2,500	117,060	79,688	678	678
02/17-03/18	Mar	30	190,272	1,350	2,500	111,620	76,152	646	646
03/18-04/12	Apr	25	183,216	1,125	2,500	95,980	84,736	504	554
04/12-05/11	May	29	229,488	1,350	2,500	95,980	131,008	544	554
05/11-06/10	Jun	30	260,784	1,350	2,500	91,050	167,234	525	525
06/10-07/12	Jul	32	230,256	1,350	2,500	104,650	123,106	605	605
07/12-08/10	Aug	29	249,312	1,350	2,500	121,105	125,707	557	557
08/10-09/09	Sep	30	241,776	1,350	2,500	119,600	119,676	550	550
		TOTALS	**2,812,176**	**15,975**	**30,000**	**1,292,645**	**1,489,531**	**6,974**	**7,189**
		AVERAGES	**234,348**	**1,331**	**2,500**	**107,720**	**124,128**	**581**	**599**

Fuel Refund. Fuel refunds are provided monthly to account for the variation in the price of fuel the utility purchases to produce electricity. The average of the amounts from the last 12 monthly bills (not included in this document) will be used to calculate the avoided cost.

= [\$0.000240/kWh + \$0.000486/kWh + \$0.000464/kWh + \$0.000439/kWh + \$0.000479/kWh + \$0.000521/kWh + \$0.000496/kWh + \$0.000476/kWh + \$0.000401/kWh + \$0.000405/kWh + \$0.000379/kWh + \$0.000349/kWh] ÷ 12

= \$0.000406/kWh

Avoided Cost of Electrical Energy.

= Energy Charge(\$/kWh) + Fuel Charge(\$/kWh) + Power Cost Charge(\$/kWh) - Fuel Refund(\$/kWh)

= \$0.007/kWh + \$0.018926/kWh + \$0.000406/kWh - \$0.000428/kWh

= \$0.0259/kWh

AVOIDED COST OF ELECTRICAL DEMAND

The avoided cost of electrical demand is the fixed demand charge given in the rate schedule, plus a block extender charge that is implicit in the variable energy consumption block that is dependent upon the demand.

Demand Charge. The fixed demand charge in the General Services (Secondary) Rate Schedule is \$9.01/kW of billed demand in excess of 10 kW. Therefore, the fixed demand charge is .

Block Extender Charge. The first energy consumption block is fixed at 2,500 kWh, but the second block is extended by a multiplier of 215 kWh per kW of billed demand. The avoided demand associated with the second block is the block extender charge. If the electrical demand were reduced, the size of the second block would decrease. Since actual consumption does not change, this will cause more of the consumption to be charged at the lower-priced third block rate. This amounts to savings on energy consumption due to the reduction in the demand. This is termed the "block extender charge" and is computed as shown below:

D2 = [2nd block price - 3rd block price (\$/kWh)] × 2nd block extender (kWh/kW)
= [0.0325/kWh-\$0.007/kW] × 215(kWh/kW)

D2 = \$5.48/kWh

Avoided Cost of Electrical Demand:

D = D_1 + D_2
= Fixed demand charge ($/kWh) + block extender charge ($/kW)
D = $9.01/kW + $5.48/kW
D = $14.49/kW

Simplified Electrical Avoided Cost. The simplified electrical avoided cost is essentially the same except that ratchets are not considered as a detriment to demand calculations. The actual demand is used in determining the avoided cost.

CITY OF REWOP ELECTRIC RATE SCHEDULE – GENERAL SERVICE (SECONDARY)

Application. Applicable to any customer for all of the electric service supplied at one point of delivery and measured through one meter at secondary voltage. Each point of delivery is metered and billed separately, and a demand meter is required when the expected maximum kW is 10kW or higher.

Applicable to temporary, construction power or warning siren service in conjunction with the appropriate rider. Not applicable to resale service, shared service or where delivery voltage is other than secondary voltage.

Type of Service. Single- or three-phase, 60 hertz at any one of the company's available standard secondary service voltages as required by the customer. Where service of the type desired by the customer is not already available at the point of delivery, additional charges and special contract arrangements between the company and the customer may be required prior to its being furnished.

MONTHLY RATE

Charge			Amount
Customer			$15.00
Demand	Demand in excess of 10 kW		$9.01/kW
	Each current month kW in excess of the contract kW		$1.00/kW
Energy	Customer without metered	First 2,500 kWh	$0.0670/kWh
	Demand	All additional kWh	$0.0325/kWh
	Customer with metered	First 2,500 kWh	$0.0670/kWh
	Demand	Next 3,500 kWh*	$0.0325/kWh
		All additional kWh	$0.0070/kWh
***Add 215 kWh per kW of demand in excess of 10 kW**			

Fuel Cost. Plus an amount for fuel cost calculated in accordance with Rider FC.

Power Cost. Plus an amount for purchased power cost calculated in accordance with Rider PCR.

Payment. Bills are due when rendered and become past due if not paid within 16 days thereafter. Bills are increased by 5 percent if not paid within 20 days after being rendered.

Demand Determination. Demand for calculation of the monthly bill is determined in accordance with the following provisions:

a) Demand is the smaller of:

1) current month kW

2) on-peak kW plus 25 percent of the current month kW in excess of the on-peak kW. This provision applies only if the customer has a stable, recurring, annual use pattern of use and at least one full month of actual on-peak history, or an estimate thereof, which is representative of such annual use pattern.

b) But is not less than the highest of:

1) 80 percent of on-peak kW
2) 50 percent of contract kW
3) 50 percent of annual kW

Definitions

- Current month kW is the highest 15-minute kW recorded at the point of delivery during the current month.
- On-peak kW is the highest 15-minute kW recorded during the billing months of June through September in the 12-month period ended with the current month. For a customer contracting for new service, on-peak kW is the current month kW until the customer establishes such demand through on-peak use, unless, in the company's sole judgment, sufficient data exists for the company to estimate on- peak kW until Customer establishes on-peak history through actual use. Premise history may be used to estimate on-peak kW.
- Contract kW is the maximum kW specified in the agreement for electric service.
- Annual kW is the highest 15-minute kW recorded at the point of delivery in the 12-month period ended with the current month.

Time-of-Day Option. At customer's option and after completion of necessary contract arrangements and installation of necessary metering equipment, the on-peak kW used in determining a billing demand is based upon the highest 15-minute kW recorded during the Company's on-peak hours in the 12-month period ended with the current month. On-peak hours are the eight hours between 12 noon and 8 p.m. each weekday (Monday-Friday), excluding July 4 and Labor Day, during the calendar months of June through September.

An additional monthly charge of $10 is made when the customer selects time-of-day option. On-peak kW must be established by actual use during the company's on-peak hours before billing under time-of-day option becomes effective. Service hereunder may be commenced only on the first regularly scheduled meter reading date after June 1, July 1 or August 1 containing at least 5 on-peak days. Company reserves the right to discontinue this option to additional customers if, in the company's judgment, system load characteristics no longer warrant such option.

Special Conditions. Where the customer has another source of power which is connected, either electrically or mechanically, to equipment which may be concurrently operated by service provided by the company, the customer must install and maintain, at the customer's expense, such devices as may be necessary to protect the customer's and the company's equipment and service.

Agreement. An agreement for electric service with a term of not less than one year is required for customers having or expected to have maximum electrical loads of 500 kW or more, when special contract arrangements are involved, and may be required for loads under 500 kW. When the customer has a source of power available, not held solely for emergency use, for which the company's service may be substituted, either directly or indirectly, or used as a standby, supplementary or maintenance power supply, an agreement for electric service is required. The maximum electrical load specified in the agreement for electric service may not be less than the sum of the customer's normal load plus the load which may be carried all or part of the time by the customer's generator or prime mover or other source of energy.

Notice. Service hereunder is subject to the orders of regulatory bodies having jurisdiction and to the company's tariff for electric service.

CITY OF REWOP ELECTRIC RATE SCHEDULE – FUEL COST RIDER (FC FACTOR)

Application. The Rider FC is applicable to all rate schedules that provide for inclusion of fuel cost hereunder. The fuel cost factor is added to the amount due from charges of the rate schedules under which electric service is provided. The fuel cost factor is billed in proportion to the number of kWh used.

Net Monthly Bill. The fuel cost factor for each of the company's rate schedules is as follows:

Major Rate Class	Rate Schedules	Fuel Component
Residential service	R, RLU, RTU	$0.018926/kWh
General service (secondary)	GS, OL (including all riders)	$0.018926/kWh
General service (primary)	GP, SSC-T (including all riders)	$0.018402/kWh
General service (transmission)	HV (including all riders)	$0.018093/kWh
Municipal service (secondary)	MP-SEC, MS-SEC, SL-SEC	$0.018926/kWh
Municipal service (primary)	MP-PRI, MS-PRI, SL-PRI	$0.018402/kWh
Wholesale power service (primary)	WP-PRI	$0.018402/kWh
Wholesale power service (transmission)	WP-TRAN	$0.018093/kWh

The amount to be billed is determined by multiplying the kWh used by the appropriate fuel cost factor and is rounded to the nearest cent.

EXAMPLE 2 – TYPICAL RATE SCHEDULE FOR A DEREGULATED MARKET (HYPOTHETICAL)

This example illustrates a determination of the avoided cost of electric energy and demand for a consumer using a typical deregulated rate schedule. Below is a brief overview of the calculation procedures and following that is a sample monthly bill with calculated avoided costs.

AVOIDED CHARGES CALCULATIONS EXPLAINED

Annual Avoided Energy Charge. A typical consumer's electricity contract will state the current energy charge, but, based on the contract, that charge may change with time or quantity of electricity used by the consumer. In the sample bill shown below, only data from one month is provided to illustrate the proper calculation procedures for determining annual avoidance energy and demand charges. Utility bills vary so there may be more than one energy charge each month. If this is the case, to calculate the monthly energy rate requires only to sum these separate $/kWh rates. Then, to calculate the annual avoided energy charge, rates from 12 consecutive months must be averaged as shown in the equation below:

$$\frac{\sum_{Jan}^{Dec}\left[Monthly\ Rate\ \left(\frac{\$}{kWh}\right)\right]}{12\ Months} = Annual\ Avoided\ Energy\ Charge\ \left(\frac{\$}{kWh}\right)$$

Equation 1. Annual Avoided Energy Charge

Annual Avoided Demand Charge. Calculating the annual avoided demand charge is accomplished in a similar fashion; i.e., it requires that the sum of each of the monthly demand charges are added together and then divided by the billed demand. Then these monthly demand charges are totaled and averaged for 12 months as shown in the equation below:

$$\frac{\sum_{Jan}^{Dec}[Monthly\ Avoided\ Demand\ Charge\ (\frac{\$}{kW})]}{12\ Months} = Annual\ Avoided\ Energy\ Charge\ (\frac{\$}{kWh})$$

Equation 2. Annual Avoided Demand Charge

Sample Electric Bill. The following is a sample monthly electric bill that shows some typical charges. Using the data in this sample bill and applying the equations described above, the monthly demand and monthly energy charges can be determined. Because data from only one month is displayed, the annual values are not determined in this example. However, all that has to be done is to repeat the process shown for an additional 11 contiguous months and divide the results by 12.

There are a number of flat-rate charges that appear in electric bills. These charges vary by electric utility supplier, but it is important to remember they do not factor into the avoided costs because they are not dependent on energy or demand.

ELECTRIC BILL			
Electric Usage Detail			
Demand	3,095 kW		
Load factor	63%		
Current Electric Charges Detail (30-day billing period)			
State Power Program – Monthly Gas Index			
Actual consumption x price		1,402,866 kWh @$0.065110/kWh	$91,340.61
Base charge			$10.00
Line loss charge			$6,836.75
Aggregator fee			$533.74
TDSP Pass-Through Charges			
Non-standard service equip inspect		1 @ $58.000000/ea	$58.00
Energy efficiency recovery charge			$2.48
TDSP customer charge			$24.90
Delivery point charge			$16.65
Nuclear decommissioning (NDF)		3,391 kW @ $0.044000/kW	$149.20
System Benefit Fund (SBF)		1,402,866 kWh @$0.000655/kWh	$918.88
Transmission charge (TUOS)		2,212 kW @ $1.470000/kW	$3,251.64
Transition charge (TC1)		3,391 kW @ $0.289000/kW	$980.00
Transition charge (TC2)		3,391 kW @ $0.161000/kW	$545.95
Transmission cost recovery factor (TCRF)		2,212 kW @ $0.840573/kW	$1,859.35
Distribution charge (DUOS)		3,391 kW @ $3.550000/kW	$12,038.05
Total TDSP Pass-Through Charges			**$19,845.10**
Total Current Charges			**$118,566.20**

Calculating the Avoided Energy Charge. In the bill above, there are two lines that obviously involve kWh charges. The first is the energy price, and the second is the System Benefit Fund (SBF). In addition to these two charges, there is a third energy charge that is less obvious, the line loss charge. The line loss charge is not a typical charge, but it is representative of the obscure charges that may appear on a bill and must be considered. Generally, the Public Utility Commission (PUC), the regional electric provider (REP) or the transmission and distribution service provider (TDSP) will have to be contacted in order to understand how these obscure charges are calculated. To understand line loss charge in this example, it is necessary to go beyond any of these entities and contact the aggregator. Simply put, it may require persistence to track down the actual calculation methods. For the line loss charge in this example, the calculation method is as follows:

$$\text{metered kWh} \times \text{loss factor} \times \text{energy rate} = \text{line loss charge}$$

The loss factor is the unknown variable in this equation, but it can easily be calculated for this specific month by dividing the line loss charge by the actual consumption charge. The avoided energy charge can then be calculated using the loss factor. However, the avoided energy charge can be calculated simply by dividing the line loss charge by the metered kWh as shown.

With the energy rate for the line loss charge calculated, all that needs to be done to determine the avoided energy charge for this month is to add the three energy rates together.

$$\frac{\$6{,}836.75}{1{,}402{,}866\ kWh} = \$0.004873/kWh$$

$$\frac{\$0.065110}{kWh} + \frac{\$0.000655}{kWh} + \frac{\$0.004873}{kWh} = \$0.070638/kWh$$

If the annual avoided energy charge needed to be calculated, then 12 consecutive months' worth of data would have to be collected and averaged.

Calculating the Avoided Demand Charges

The sample bill provided does not show a comprehensive list of possible demand charges, but this is typical of a utility bill.* This sample bill has six lines containing demand rates: nuclear decommissioning (NDF), transmission charge (TUOS), transition charges (TC1 & TC2), transmission cost recovery factor (TCRF) and distribution charge (DUOS). To calculate the monthly demand charge, the final dollar values of each charge must be added and then divided by that month's actual demand.

$$\frac{\$149.20 + \$3{,}251.64 + \$980.00 + \$545.95 \div \$1{,}859.35 + \$12{,}038.05}{3{,}095kW} = \$6.082129/kW$$

Then, using Equation 2 from above, the data from 12 consecutive months can be used to calculate the annual avoided demand charge.

*The PUC approves demand charges and provides a comprehensive list of the electric providers and their approved charges on its website.

SECTION V – PRELIMINARY ENERGY AUDIT FORMAT

The guidelines contained in this guidebook must be used for utility cost reduction measures (UCRMs) funded through the LoanSTAR Program, which finances the following types of contracting mechanisms: design-bid-build (DBB), design-build (DB), systems commissioning (SC) and energy savings performance contracting (ESPC).

It is possible for a state agency to utilize a different source of funding for their utility savings retrofit. However, the state agency is still required to utilize the guidelines contained in this guidebook.

ESPC projects must follow the performance contracting process described in the **Performance Contracting Guidelines**.

The funding process described in Volume I, Section I, LoanSTAR Funding Process provides for submission of a preliminary energy audit (PEA) to obtain a memorandum of understanding (MOU) from SECO, which reserves funds during a specified time to prepare a utility assessment report (UAR). This MOU is not a loan agreement but rather reserves funds until a UAR can be submitted for approval. Following UAR approval, the reserved funds can then be committed to fund a loan contract agreement.

PRELIMINARY ENERGY AUDIT (PEA)

1.0 Introduction

[Provide name and description of affected facilities, building(s), and their locations. Provide name, address and telephone number of the owner's contact and PE analyst.]

2.0 Executive Summary

(Include UCRM names, costs, savings and paybacks; total project cost, savings and payback and describe needed and expected benefits and planned method of implementation: DB, DBB or ESCO.)

3.0 Energy Assessment Procedure

(Identify procedures that were used to identify potential M&Os and UCRMs.)

4.0 Facility Description

[Describe building(s) construction, square footage (conditioned and unconditioned), age, condition, operating hours, HVAC, DWH, lighting and controls. List of previous energy upgrades.]

5.0 Energy Performance Indicators

[Include calculated energy cost index (ECI) – $/sq. ft. and comparisons to other similar buildings.]

6.0 Utility Rate Schedule Analyses

(Provide analyses resulting in avoided cost rates for electric, gas and water savings, as applicable.)

7.0 Recommendations

A. Maintenance and operations measures

B. Capital expense measures. (List UCRMs for which funding is being sought and show savings calculations, or method of estimating savings, for each UCRM. Also show estimated costs which should include development of UAR, all costs associated with design and construction and expected payback.)

APPENDICES

I. Summary of Funding and Procurement Options

II. Electric Utility Rate Schedule and Recent 12-Month Billings Summary

III. Natural Gas Utility Rate Schedule and Recent 12-Month Billings Summary

IV. Energy Policy (Existing)

SECTION VI –UTILITY ASSESSMENT REPORT FORMAT

Utility assessment reports for design-bid-build (DBB), design-build (DB) and systems commissioning (SC) (as applicable) projects must be prepared in the format provided in the following pages of this guidebook. The prescribed format is intended to speed the review process as well as the report writing process. All numbers, titles etc. should be in the location indicated in the format.

Equipment and material descriptions should be sufficiently complete and clear for reviewers to verify the reasonableness of claimed UCRM costs. For simple measures (lighting retrofits, for example) which could possibly be implemented by the borrower's personnel, sufficient detail about equipment, material and locations of the proposed installations should be given so that the borrower could accomplish the measure based on information contained in the assessment report alone. Recommendations for additional design/engineering should be clearly indicated as a project cost as indicated in Volume I, Section II, Estimating Implementation Costs.

Final report copies must be bound on the left-hand side in three-ring binders with the title and date of the report on the spine. Final reports must be signed and sealed by a professional engineer licensed in the State of Texas (see required qualifications in Volume I, Section I, The Utility Assessment Report and Initial Systems Commissioning Report). Three copies of the utility assessment report must be submitted with the loan application.

It is possible for a state agency to utilize a different source of funding for its utility savings retrofit. However, the agency is still required to follow the guidelines contained in this guidebook.

TEXAS LOANSTAR PROGRAM

UTILITY ASSESSMENT REPORT

For:

(Name of Facility)

(Address)

(Agency # if applicable)

ORIGINAL DATE OF REPORT

SUBSEQUENT REVISION DATES OF REPORT, AS APPLICABLE

Conducted by:

(Name of Firm)

(Address)

(Phone Number)

Number of Buildings:

Total Gross Square Footage:

TABLE OF CONTENTS

PREFACE

BACKGROUND

(Provide a brief narrative description of this program, note the location/description of the facilities studied, and address any significant circumstances concerning the facilities that have a bearing on utility consumption.)

SUMMARY NARRATIVE

This study was performed under the Texas LoanSTAR Technical Guidebook as administered by the State Energy Conservation Office. The purpose is to identify utility cost reduction measures (UCRMs) which, when implemented, will result in significant utility cost savings for (the borrower). The savings calculations are made using sound, accepted fundamentals of engineering and current utility rate schedules.

ACKNOWLEDGMENTS

The staff of __________________ would like to extend its thanks and appreciation to (the borrower) and its staff for assistance on the procurement of building data and operation schedules. Special thanks to (names and titles) for devoting time, insight and resources. Further thanks are extended to other operations and maintenance personnel for their support and helpfulness. (Note helpful individuals and mention areas where the borrower's personnel are doing a good job in existing energy management and projects.)

UTILITY ASSESSMENT REPORT

(Name of Borrower)
(Address)
Contact Person: (Project Manager, Title)
Phone Number:

EXECUTIVE SUMMARY

BUILDINGS/FACILITIES ANALYZED

[Identify name(s) of building(s)/facilities analyzed and their use, type of construction and total square footage.]

COMPOSITE PROJECT SUMMARY

(Provide a summary listing of all recommended UCRMs, along with the buildings to which they apply.)

SUMMARY OF PROJECT

(including limited and simplified calculation measures)

Savings/Cost Reduction	Cat. I	Cat. II	Cat. III	Unit of Measure
kWh Savings				kWh/yr
Demand savings				kW/yr
Gas savings				MCF/yr
Btu savings[2]				MMBtu/yr
Water savings				kgal/yr
Total cost savings				$/yr
Base year cost reduction				%
Implementation cost				$
Simple payback				yrs

1 Building O&M savings identified in the appendix should not be included in the total.

2 Btu savings should be calculated on the basis of source BTUs (11,600 BTU/kWh and 1,030,000 BTU/MCF). See Volume I, Section II, UCRMs, Btu Savings Calculations for a sample Btu savings calculation for Category I measures.

This report identifies capital-intensive projects, which, if implemented in the form recommended, will result in the savings and costs summarized above. The savings for the recommended composite project listed above account for interdependence of savings of individual UCRMs. Costs for the project likewise account for savings that accrue from installing several UCRMs at once and for utility rebates that will lower project cost.

SPECIAL CONSIDERATIONS

(Provide a description of any special considerations for the borrower's benefit, including possible utility rebates. Also, detail actions and costs the borrower will likely incur in operating and maintaining all UCRMs included in the report.)

UCRM IDENTIFICATION

SECO has standardized the assignment of identifying numbers to UCRMs in a LoanSTAR project. The author of the report will use the following numbering system:

Note: UCRM numbering will not necessarily be sequential; numerical gaps between UCRMs are anticipated and expected.

LoanSTAR UCRM Numbering Assignments	
UCRM #	**Description**
1.0	Lighting
1.1	Lighting Controls
1.2	Lighting Controls
2.0	HVAC
2.1	HVAC Only Renovation/Replacement
2.2	HVAC Controls
2.3	HVAC and Controls Renovation
2.4	HVAC Therma Storage
2.5	HVAC Boiler Plant/Chiller Plant
2.6	HVAC Airside Renovation (Duct Repair/Replacement, Duct Insulation, New AHU/Motor, Installation of VFD's on Pumps, replacing inoperable control valves/operators, Text and Balance)
2.7	HVAC Water Distribution Systems (Piping/Repair/Replacement, Piping Insulation, New Pump, Installation of VFD's on Pumps, replacing inoperable control valves/operators, Test and Balance
3.0	Commissioning
4.0	Electrical
4.1	Power Factor Improvement
4.2	Energy/Power Management
4.3	Electrical (other)
5.0	Water Conservation
5.1	Water Use/Distribution
5.2	Water and Sewer Conservation
5.3	Domestic Hot Water Renovation/Replacement
5.4	Irrigation System Renovation and Controls
5.5	Portable Water Efficiency Measures
6.0	Water and WW Treatment Plant
6.1	Water Treatment and Processing
6.2	Pumps/Motors
7.0	Building Loan Reduction
7.1	Window Renovation (Replacement/Enclosure)
7.2	Envelope Insulation (Roof/Attic/Exterior Walls)
8.0	Renewable Energy
9.0	Other UCRM
10.0	Other UCRM
11.0	Other Loan Project Costs
12.0	Engineering Audit Expense
13.0	Contingency Allowance

TABLE 1 — SUMMARY OF INDIVIDUAL ENERGY COST-REDUCTION MEASURES (USE THIS TABLE ON DESIGN-BID AND DESIGN-BID-BUILD PROJECTS.)

UCRM Number	UCRM Title	Average Annual Savings	Average Annual Savings						UCRM Cost, Est. ($)	Payback, Est. (yrs.)	UCRM Lifetime, Est. (yrs.)
		Electric Energy (kWh/yr)	Demand (kW/yr)	Electric ($/yr)	Natural Gas (MCF/yr)	Natural Gas ($/yr)	Water (kgal/yr)	Water ($/yr)			
1											
2											
3											
4											
5											
6											
7											
8											
Total Project Area (sq. ft.)											
Utility Assessment Report Cost											
Construction Bonding Cost											
Owner's Administration, Management, Training & Other Costs											
Implementation Costs (simple payback)											
On-going Monitoring Service Cost											
Rebate savings											
Financing cost											
TOTAL (project payback)											

TABLE: SUMMARY OF CONSUMPTION AND UTILITY DOLLAR SAVINGS PER FACILITY, ALL MEASURES									
Facility or Campus	Base Year Total kWh	Base Year Utility $	UCRM	UCRM	UCRM	Total kWh Served ALL UCRMs	% Base Year kWh Saved	TOTAL $ Saved ALL UCRMs	% Base Year $ Saved
A	1,381,775	$ 176,066	Yes or No	Yes or No	Yes or No	232,736	17%	$ 29,655	17%
B	927,757	$ 123,791	Yes or No	Yes or No	Yes or No	183,274	20%	$ 24,454	20%
C	430,420	$ 60,332	Yes or No	Yes or No	Yes or No	76,179	18%	$ 10,678	18%
D	37,700	$ 5,639	Yes or No	Yes or No	Yes or No	5,410	14%	$ 809	14%
E	869,280	$ 115,988	Yes or No	Yes or No	Yes or No	157,322	18%	$ 11,207	10%
F	117,840	$ 15,408	Yes or No	Yes or No	Yes or No	9,485	8%	$ 1,240	8%
TOTALS	**3,764,772**	**$ 497,223**				**664,406**	**17.65%**	**$78,044**	**16%**

Note: Values in the Table are Example Data Points to illustrate the purpose of the Table.

HVAC UCRM SAVINGS DEGREDATION

Average annual savings is the nominal annual savings less degradation. Annual savings calculations must factor in degradation for HVAC-related UCRMs. Average annual savings for non-HVAC UCRMs is equal to the measure's nominal savings. HVAC nominal annual savings should be degraded by ¾ percent on a simple (non-compounding) dollar basis. Borrowers may include a supplemental degraded savings table (example below) with the project UAR. A verifiable degradation method should be used to calculate median monthly annual savings, which in turn should be used as the UCRM average annual savings when calculating project simple payback.

UCRM No.	UCRM Title	Average Annual Savings						UCRM Cost, Est. ($)	Payback, Est. (yrs.)	UCRM Lifetime, Est. (yrs.)
		Nominal Electric ($/yr)	Average Electric ($/yr)	Nominal Natural Gas ($/yr)	Natural Gas ($/yr)	Nominal Water ($/yr)	Average Water ($/yr)			
1	HVAC	$1,100.00	$1,073.53[a]	$0	$0	$0	$0	$5,250	4.89	5
2	Lighting	$1,200.00	$1,200.00	$0	$0	$0	$0	$9,180	7.65	8.5
3	Water	$0	$0	$0	$0	$400	$400	$4,200	10.5	12
4										
5										

[a]Average savings for HVAC UCRMs are equal to the median value of the distribution when the nominal savings value is degraded for each month of the estimated UCRM lifetime.

TABLE 1 (ALTERNATE) — SUMMARY OF INDIVIDUAL ENERGY COST-REDUCTION MEASURES
(Use this table on ESPC projects.)

			Annual Energy Savings											
Ucrm No.	Utility Cost Reduction Measures (UCRM) Title		Electric Energy (kWh/yr)	Demand (kW/yr)	Electric ($/yr)	Natural Gas (Mcf/yr)	Natural Gas ($/yr)	Water (kGal/yr)	Water ($/yr)	Project Cost ($)	Annual Projected Savings ($/yr) (P)	Payback (yrs.)	Estimated Project Lifetime (yrs.) (S)
1											$ -	#DIV/0!	
2											$ -	#DIV/0!	
3											$ -	#DIV/0!	
4											$ -	#DIV/0!	
5													
6													
7													
8													
		Subtotal	0	0	$ -	0	$ -	0	$ -	0	0	#DIV/0!	0.0

Ratios	
Costs (I/J)	#DIV/0!
Total M&V Fees as a percent of Total Project Costs (I/J)	#DIV/0!
Total Guaranteed Savings over Loan Amount (M/Q)***	#DIV/0!
Ratios with One-Time Savings and Rebates added to Total Guaranteed Savings	
Total Guaranteed Savings over Total Project Costs (M'/J)	#DIV/0!
Total Guaranteed Savings over Loan Amount (M'/Q)	#DIV/0!

Savings	
(K) Annual Guaranteed Savings Over Contract Term ($/yr)	
(K') One-time third party rebates, used as savings and paid directly to ESCO	
(L) Contract Terms (yrs)	
(M) Total Guaranteed Savings over the Total Contract Term (K*L)	$ -
(M') Total Guaranteed Savings with Rebates and one time savings over the Total Contract Term ((K*L)+K'+K'')	$ -
(N) Estimated Projected Savings over the Contract Term (P*L)	$ -
(O) Total Excess Guaranteed Savings over Total Project Costs (M-J)	$ -

Financing Terms (Please attatch a debt service schedule)

Interest Rate	Loan Amount	Total Interest	Total Debt Servicer	Contract Term (yrs)
%		$-	$-	

	Contract Provisions for Guaranteed Savings (check all that apply)
	Contractor will pay shortfall if guarantee is not met
	Contractor cannot recoup savings in excess of guaranteed savings
	Contractor payment not limited to amount of debt service or guaranteed savings, whichever is less
	Contract does not allow excess savings to carry forward from year to year
	Contractor cannot recoup shortfall payments in subsequent years
	Implementation period savings - covers debt service
	Implementation period savings - added to first year guarantee

Project Cost Summary	
(A) Total Costs of UCRM's ($)	$0
(B) Total Utility Assessment Report ($)	
(C) Total Payment, Construction and Performance Bond Costs ($)	
(D) Total Third Party Review Costs paid by the agency ($)	
(E) Owner's Administration, Management, Training & Other Costs ($)	
(F) Total Implementation Costs (A+B+C+D+E) ($)	**$0**
(G) Total Interest Cost ($)	
(H) Upfront Costs paid by the Owner	
(I) Total Measurement & Verification Fees ($) (M&V Fees)	
(J) Total Project Costs* (F+G+H+I) ($)	**$0**
Less: Costs not part of the contract price between the ESCO and the Issuer:	
For Example: Total Third Party Review Costs paid by the agency ($) Owner's Administration, Management, Training & Other Costs ($)	
Contract Price**	**$0**
Less: One-Time Guaranteed Savings used to reduce the loan amount (i.e. installation savings)	
Less: One-time third party rebates used to reduce the loan amount	
(Q) Loan Amount	**$0**

Payback (yrs)	
Actually Simple (F/P)	#DIV/0!
Total (J/K)	#DIV/0!

Notes:
* Total Project Costs includes all costs that must be covered by savings under statute.
**Contract Price amount agreed upon between the ESCO and Issuer.
***May consider one-time savings and rebates that reduce loan amount)

Name of Agency Contact Responsible for Completing this Form

Name: ______________________________

Title: ______________________________

Agency: ______________________________

Phone #: ______________________________

E-maile: ______________________________

TABLE 2 – BASE YEAR UTILITY CONSUMPTION DATA

Building ID:

Gross Square Footage:

EUI:

ECI:

For prior 12-month period beginning________________ ,_______ and ending ________________

	Electrical							Natural Gas		Water or Other	
Month	Consumption (kWh)	Demand Metered (kW or kVA)	Demand Charged (kW or kVA)	Power Factor	Fuel Adjustment ($/kWh)	PCRF or Cogeneration ($/kWh)	Total Cost ($)	Consumption (MCF)	Cost ($)	Consumption Unit	Cost ($)
January											
February											
March											
April											
May											
June											
July											
August											
September											
October											
November											
December											
TOTAL											

	Electricity	Natural Gas	Water or Other
Company Name			
Company Rate Schedule			

METERING INFORMATION

TABLE 3 – METER DATA

Electric

Meter Number	Area Served

Natural Gas

Meter Number	Area Served

Water and Waste Water

Meter Number	Area Served

UTILITY RATE SCHEDULE ANALYSIS

Electric Utility Rate Schedule Analysis
Name of utility/provider:
Rate schedule analyzed:
Summary of billing component charges:
Avoided cost of energy to be used in calculations:
Avoided cost of demand to be used in calculations:
Comments:

Gas Utility Rate Schedule Analysis
Name of utility/provider:
Rate schedule analyzed:
Summary of billing component charges:
Avoided cost of energy to be used in calculations:
Avoided cost of demand to be used in calculations:
Comments:

Water and Other Utility Rate Schedule Analysis
Name of utility/provider:
Rate schedule analyzed:
Summary of billing component charges:
Avoided cost of energy to be used in calculations:
Comments:

FACILITY DESCRIPTIONS

FACILITY DESCRIPTION

(Provide a limited description of the facility including its size and use. Include a suitable facility map indicating the location of buildings analyzed. A copy of an 8 ½-x-11 layout obtained from facility personnel should be used or adapted. In the absence of such a layout, a sketch should be used.)

BUILDING DESCRIPTIONS

(List the name and/or number of each building and under the listing provide the following information:
Building construction description: foundation, structure, walls, windows, roof, insulation, physical condition etc.

1. Building use general functions, operating hours etc.
2. Building energy and water-using systems – types, sizes and present condition of equipment such as boilers, hot water systems, chillers, cooling towers, air handling units, heat pumps, DX units, lighting, kitchen equipment, laboratory equipment, irrigation systems etc.
3. Building energy and water-using system controls – manual practices and/or condition and type of automatic controls including thermostats (with setpoints), hot water setpoints, boiler pressures and controls, chilled water setpoints, lighting controls, ventilation controls, calibration conditions and practices etc.

For similar buildings provide the listing and under the listing indicate to which building it is similar and only provide exceptions to the similarity. Tables 4 and 5 should be used for compiling this information.)

TABLE 4 – BUILDING DATA

Required for buildings housing Category III UCRMs. **Optional** for buildings housing only Category I or II UCRMs.

Building Name	Function	Conditioned Area (SF)	Gross Area (SF)	Number of Stories	Wall Construction Type	Roof Construction Type	Year of Construction	Texas Historical Commission Necessary?	Estimated Remaining Life (Years)	Physical Condition

TABLE 5 – EQUIPMENT LIST

Required for buildings housing Category III UCRMs; optional for buildings housing only categories I or II UCRMs. **Include only the equipment that affects the calculations in the utility assessment report.**

Building Name:____

Equipment Name	Quantity	Nameplate Data	Field Measurements	Efficiency	Load Factor	Annual Operation Hours	Area Served & Sq. Ft.

E = estimated, M = measured, D = from manufacturer's data. (Use E, M or D as a suffix where needed, particularly to indicate estimated load factors or efficiencies where no other data exist.

TECHNICAL ANALYSIS

UTILITY COST REDUCTION MEASURES (UCRMS)

CATEGORY I UCRMS – LIMITED CALCULATIONS

UCRM NO.:
UCRM NAME:
SUMMARY:
DATA:

See Volume I, Section II, UCRMs (Category I UCRMs) and Volume I, Appendix C for guidance.

kWh savings:	$ ________________	kWh/yr
Gas savings:	$ ________________	MCF/yr
Cost savings:	$ ________________	/yr
Implementation cost:	$ ________________	
Simple payback:	________________	yrs.

UCRM DESCRIPTION

(Provide a narrative stating what the UCRM will accomplish, what buildings it applies to and how it is to be implemented. ***This description must be provided in detail****. The operating hours, load on the equipment, methods of control, size and location of equipment etc. must also be described. The analyst should keep in mind that the reviewer must be able to read the UCRM description and understand the logic of the measure, and the borrower must be able to implement the UCRM without additional design documents if he so desires. Include clarifying sketches as necessary.)*

ASSUMPTIONS

(Summarize all assumptions which affect implementation, cost estimates and cost savings. These assumptions will include, but not be limited to, the availability of the building for UCRM completion, equipment run times and setbacks and any extended hours of building operation. See Volume I, Section II – General Instructions.)

IMPLEMENTATION COSTS

Use the following format and refer to Volume I, Section II, Estimating Implementation Costs. These costs should be based on the amount of equipment to be replaced, modified or removed.

Equipment:	$____________
Materials:	$____________
Labor:	$____________
Contractor markup:	$____________
Additional design/engineering/administration:	$____________
Escalation (15% maximum):	$____________
TOTAL	$____________

COST SAVINGS

(Estimate the annual cost savings for Category I UCRMs by dividing the implementation cost obtained above by the simple payback. Paybacks for Category I UCRMs are found in Volume I, Section II, UCRMs (Category I UCRMs).)

CATEGORY II UCRMS SIMPLIFIED CALCULATIONS

UCRM NO.:
UCRM NAME:
SUMMARY:

kWh savings:	________________	kWh/yr.
Demand savings:	________________	kW/yr.
Gas savings:	________________	MCF/yr.
Cost savings:	$ ______________	/yr.
Implementation cost:	$ ______________	
Simple payback:	________________	yrs.
Estimated useful life:	________________	yrs.

UCRM DESCRIPTION

*(Provide a narrative stating what the UCRM will accomplish, what buildings it applies to and how it is to be implemented. **This description must be provided in detail**. The operating hours, load on the equipment, methods of control, size and location of equipment etc. must also be described. The analyst should keep in mind that the reviewer and the future design engineer must be able to read the UCRM description and understand the logic of the measure. Include clarifying sketches as necessary.)*

ASSUMPTIONS

(Summarize all assumptions which affect implementation, cost estimates and cost savings. These assumptions will include, but not be limited to, the availability of the building for UCRM completion, equipment run times and setbacks and any extended hours of building operation. See Volume I, Section II – General Instructions.)

IMPLEMENTATION COSTS

(Use the following format and refer to Volume I, Section II, Estimating Implementation Costs for more details. These costs should be based on the amount of equipment to be replaced, modified or removed.)

Equipment:	$___________
Materials:	$___________
Labor:	$___________
Contractor markup:	$___________
Additional design/engineering/administration:	$___________
Escalation (15% maximum):	$___________
TOTAL	$___________

COST SAVINGS

(Include the QuickCalc printouts and forms used (see Volume II of these Technical Guidelines). Any supplemental calculations for which software has not been provided should also be included in this section.)

QUICKCALC/SIMPCALC UCRM FORMS

(Include supporting data, calculations, costs and simple payback.)

CATEGORY III UCRMS – DETAILED CALCULATIONS

UCRM NO.:
UCRM NAME:

SUMMARY DATA (DEPENDENT)

(All measures are to be analyzed in the dependent mode and in the following sequence: building loads, distribution systems, primary equipment and energy management systems. All simplified calculation UCRMs are assumed to be installed for dependency purposes.)

kWh savings:	________________	kWh/yr.
Demand savings:	________________	kW/yr.
Gas savings:	________________	MCF/yr.
Water savings:	________________	kgal/yr.
Cost savings:	$ ______________	/yr.
Implementation cost:	$ ______________	
Simple payback:	________________	yrs.
Estimated useful life:	________________	yrs.

UCRM DESCRIPTION

(Provide a narrative stating what the UCRM will accomplish, what buildings it applies to and how it is to be implemented. ***This description must be provided in detail****. The operating hours, load on the equipment, methods of control, size and location of equipment etc. must also be described. The analyst should keep in mind that the reviewer must be able to read the UCRM description and understand the logic of the measure. Include clarifying sketches as necessary.)*

ASSUMPTIONS

(Summarize all assumptions which affect implementation, cost estimates and cost savings. These assumptions will include, but not be limited to, the availability of the building for UCRM completion, equipment run times and setbacks and any extended hours of building operation; see Volume I, Section II – General Instructions.)

EQUIPMENT AND ENVIRONMENTAL DESCRIPTIONS

(Provide narrative and/or listings of all pertinent existing conditions including, as applicable, items such as equipment/efficiency changes, light level readings, amperage readings, temperature readings, equipment efficiencies, operating hours, existing controls and/or operating procedures, estimated loads, estimated duty cycles etc. In other words, back up equation inputs and provide assurance that codes, standards and comfort will not be violated by implementation of this UCRM.)

COST SAVINGS CALCULATIONS

(Show detailed utility cost savings calculations. Show all formulas, conversion factors and equations used to determine savings. All calculations must include units. Clearly state any assumptions. Use proper utility rates. If computer programs are used, refer to Volume I, Section III, Use of Computer Programs for Energy Savings Calculations.)

IMPLEMENTATION COSTS

(Use the following format.)

Design and administration:		$______________
Material:		$______________
Equipment:		$______________
Labor:		$______________
Contractor mark-up:		$______________
Escalation (15% maximum):		$______________
	TOTAL	$______________

COST BACKUP

(Provide unit pricing on all major pieces of equipment and material. Provide contractor estimates on all major installations that clearly break out material, equipment and labor. Where contractor estimates are not available, use recent bid prices or a reputable pricing source such as Means. Include all reasonable markups. Provide hours and rates for all labor not included in contractor estimates. Use state contract pricing of materials where applicable. Refer to Volume I, Section II, Estimating Implementation Costs.)

SIMPLE PAYBACK

(Provide simple payback calculation.)

APPENDIX

SUPPORTING DOCUMENTATION

(Include supporting documentation, equipment cut sheets, pricing backup, utility rate schedules, lighting readings etc.)

OPERATIONS AND MAINTENANCE RECOMMENDATIONS

[Refer to Volume I, Section II, Estimating Costs to be Used in Payback Determination (Non-fundable Operations and Maintenance Recommendations) and Appendix B for further instructions.]

ANALYST CERTIFICATION

The undersigned certifies that this report has been conducted in accordance with the Texas LoanSTAR Technical Guidebook requirements as administered by the State Energy Conservation Office. The undersigned also certifies that the data and the cost reduction estimates presented are factual, accurate, reasonable and in accordance with generally accepted engineering practices to the best of the analyst's knowledge, and that this knowledge is based on the analyst's on-site investigation of the facilities involved. The undersigned further certifies that the analyst has no undisclosed, conflicting financial interest in the recommendations of this report.

The undersigned also agrees that if a recommendation of this or any other report generated under this program is implemented, that no company or association that the analyst owns or has a financial interest in will provide products or construction for this project.

Analyst's Signature

Date

Title

Texas P.E. Registration Number

(Affix Official P.E. Seal)

APPENDIX A –EXAMPLES OF EFFICIENCY IMPROVEMENT OPPORTUNITIES DISCOVERED THROUGH SYSTEMS COMMISSIONING

TEMPERATURE CONTROLS AND SET POINTS

1. Hot and cold deck temperature set points are not correct. Units are typically not in calibration. Numerous times cold deck temperatures below 55°F and hot deck temperatures above 110°F waste energy.

2. When there is an outside air or zone reset on the decks, they must be operating properly. Many times when the outside temperature is quite warm, hot deck temperatures have been discovered that are still too high. If there are no reset schedules, they can be added.

3. The room temperature set points are typically not where they are scheduled. Typical EMS measures call for summer temperatures of 75°F and winter temperatures of 72°F. These are usually adjusted by the occupants or the EMS operator in a way that consumes more energy.

4. Vent cycle operation on double-duct units with a single fan are typically a problem. The energy savings associated with the free cooling (mixed air temperature of 55°F) causes a higher heating penalty. This occurs because the amount of hot deck air is usually higher than the cold deck air in these weather conditions. The heat required to raise 55°F air to 100°F is greater than with 75°F return (mixed air).

5. Timed on-and-off schedules may be defeated since operators have found that they have trouble cooling down or warming up a space. Rather than spending time to adjust schedules, the schedules drop out of place. In some cases it is easier to set the fans to a slow roll condition (if they have a variable frequency drive) so that air is provided at all times, and the fans can be set to speed up if the space temperatures rise above or below a fixed set point. The fan would then slow back down when the space temperature drops back to within limits.

6. There are many locations where damper or valve actuators are not operating. Damper actuators that have turned on the rod do not control properly. Actuators with bad diaphragms will not operate to their full capability. Dampers also are frequently discovered that are frozen in place and do not move. Multizone dampers are especially problematic.

AIR AND WATER (CHILLED OR HOT) FLOW

1. There are some occasions when air handling units are oversized and there is excess air. Many times sheaves and motors should be changed before installing VFDs for variable flow control. There are also cases where air handling units have been changed to variable volume, and the fans do not operate at greater than 80 percent speed at full-load conditions.

2. When air handlers are changed to variable volume, there are many instances where the controls do not operate properly. The controls are not in calibration so the fans are operating at a greater speed than is really required.

3. Chilled water and hot water pumps typically do not operate at the proper head. Sometimes pumps are grossly over designed and cannot operate efficiently at actual head. When this happens, the pumps operate on the far side of the pump curve and deliver higher flow than is required. This causes lower differential temperatures since as the flow increases the differential temperature drops at the same tonnage requirements. Sometimes this can be adjusted through partial valve closures or trimming the pump impeller.

4. Return fans usually cause problems with air infiltration into a building if the fan is oversized. If the return fans have a VFD for variable flow and building pressure control, the controls have to stay in calibration and set points maintained to keep building over pressurization and infiltration to a minimum.

OUTSIDE AIR CONTROL

1. There have been many instances where the outside air dampers are inoperable or closed by the maintenance crews due to other problems. If the outside air damper is closed too far and there are exhaust fans in the building, there could be infiltration problems. Exhaust air flow is sometimes greater than that required for the people load, and the building can be negatively pressurized. This is usually a good candidate for CO2 or timed outside and exhaust air control when there are a limited number of people in the building. However, the outside air must be kept slightly greater than the exhaust air.

2. Kitchens cause some interesting problems of their own since the kitchen exhaust hoods operate on a limited basis. When these fans are operating, the outside air must match these as well. Many times the building outside air volume does not take these units into account.

3. There are many areas where there are high amounts of infiltration air because of leaks around doors and windows, in wall and roof lines where the ceiling plenum is the return air plenum, and excess outside air enters the building. These need to be sealed because the outside air, as needed, should enter air handling units for filtration and dehumidification control.

APPENDIX B – OPERATIONS AND MAINTENANCE PRACTICES

INTRODUCTION

Enormous amounts of energy are wasted in existing buildings through improper and unnecessary operation of the building and its energy-consuming equipment. Operations and maintenance recommendations (O&Ms) are relatively inexpensive (low cost or no cost) measures that can improve campus or building efficiency without substantial modifications. Often O&Ms save hundreds and even thousands of dollars' worth of utilities after implementation. A detailed program to identify, implement and maintain all the applicable and reasonable O&Ms is described below. O&Ms are not eligible for LoanSTAR funding.

An O&M program must have long-term commitment from both management and maintenance staff to produce a lasting increase in energy efficiency and cost savings. Frequently, periodic actions are required to maintain savings. A one-time effort, without establishing a continuing program, produces only small, temporary improvements. Many O&Ms should be included in the staff's preventive maintenance program because they aid in not only increased efficiency but also in prolonging equipment life and reducing the amount of major capital expenditures spent on equipment and system failures. The O&M program should be a part of the staff's regular, overall maintenance program.

The quality of operations and maintenance is a key factor in influencing a building's energy costs. Historically, O&M energy conservation has focused on (1) fixing damaged parts, (2) reducing excessive operating hours and (3) making appropriate nighttime setbacks. These traditional O&M measures can substantially reduce building energy consumption in poorly operated and maintained buildings and energy systems. However, building energy consumption can be further reduced even after these traditional O&M measures are applied. Extended O&M measures involve such things as optimal adjustment of the HVAC system by adjusting cold deck and hot deck settings according to the ambient temperature and controlling parameters like space temperature and humidity. The cold deck and hot deck settings can be adjusted continuously by an energy management control system (EMCS) without additional investment. The optimized cold deck settings can be implemented manually or by an EMCS. These O&M measures reduce or even eliminate reheat by optimizing the whole system performance according to current weather conditions.

Traditionally, O&M strategies have been studied and discussed frequently, but in many instances, O&Ms have not been implemented to any large extent. Building facilities' staff is usually too busy "putting out fires" and has little time to study and implement O&M measures that will save energy.

The intent of these guidelines is to provide either the technical analyst or the facilities manager with a list of traditional O&Ms along with a methodology that can be applied to survey, identify and implement extended O&M measures at their particular site. Several case studies of O&Ms identified through prior LoanSTAR studies are presented in order to illustrate the benefits in terms of energy savings.

IDENTIFICATION OF O&MS

Some of the activities which analysts should do in order to identify O&M measures are listed below:

1. Daytime walk-throughs to determine:
   a. Number of PCs, printers, copiers
   b. Sample wattage of office machines
   c. Lighting
      - Foot-candle readings
      - Fixture counts
      - Controls
   d. Survey mechanical systems
      - System types and description
      - Record nameplate data
      - Temperature measurements (e.g., supply air registers to detect simultaneous heating and cooling)
      - Verify controls operation
   e. Condition of the building envelope
2. Interview building operators to determine/obtain data on:
   a. Building operating hours – tenants
   b. Custodial operating hours
   c. Uninterruptible loads
   d. Current energy conservation practices
   e. Operating parameters – setpoints, sequences disabled, hard points entered etc.
   f. Energy consumption history – utility bills
3. Nighttime walk-throughs to determine:
   a. Number of office machines left on
   b. Number of lights left on
   c. Number of air handlers left on
   d. Space temperature and humidity measurements
   e. Verify controls operation
4. Short-term measurements
   a. Lighting levels
   b. Hot deck temperatures
   c. Cold deck temperatures
   d. Space temperatures
   e. Return air temperatures

TYPICAL O&MS

For commercial/office and institutional buildings, O&Ms can be separated into eight categories. They are:

1. Heating and Cooling Systems
   a. Turn off steam/hot water valves during summer or survey periodically for valve leak-by.
   b. Turn off or set back domestic hot water temperature.
   c. Isolate off-line boilers and keep on-line boilers tuned.
   d. Use low-temperature condenser water to increase chiller efficiency.
   e. Replace faulty steam traps.
   f. Insulate steam, hot water and chilled water lines.
   g. Ensure that pneumatic lines are not leaking and remain waterproof.
   h. Ensure that compressed air systems are maintained and operated properly.
   i. Turn off fans and pumps when not in use.
   j. Reduce static pressure setpoints on VAV air handlers to satisfy most remote terminal boxes.

2. Interior Space Conditions
   a. Locate temperature and humidity sensing devices away from drafts, supply air diffusers, outside walls and direct sunlight. Consider purchasing wireless temperature sensors.
   b. Install locks on temperature and humidity sensing devices in areas where tampering is a problem.

3. HVAC Distribution System
   a. Check heating and cooling season setpoints to be sure that they are at design values.
   b. Install meters where cost effective to monitor trouble areas and document energy savings.
   c. Adjust temperature and humidity setpoints within comfort zones seasonally, higher in summer and lower in winter.
   d. Adjust thermostat settings based on occupancy (night setback).
   e. Adjust controls to prevent simultaneous operation of heating and cooling.
   f. Maintain proper shaft alignment on motors to reduce noise and vibration.
   g. Clean all system components (for example, ducts, humidifiers, condenser coil faces, chilled water and steam coils and fan blades).
   h. Clean or replace filters regularly.
   i. Replace inaccurate gauges and thermometers.
   j. Repair duct leaks.
   k. Ensure that dampers are tightly closed and repair dampers with loose or frozen linkages.
   l. Replace worn belts and bearings on fans and motors.
   m. Keep linkage and bearings lubricated.

4. Lighting System
   a. Adjust schedule so that lights are on only when necessary; install occupancy sensors.
   b. Take advantage of natural lighting where possible; use window films to reduce glare.
   c. Encourage the use of fluorescent desk lamps or table lamps where practical.
   d. Reduce outdoor, decorative and display lighting where possible.
   e. Schedule cleaning tasks for daylight hours. If this is not possible, instruct the custodial staff to use only necessary lighting, one room at a time, and to turn off lights after a room is cleaned.
   f. Clean lamps, luminaires, diffusers and interior surface of lighting fixtures on a regular schedule.
   g. De-lamp or reduce lighting levels.
   h. Replace incandescent bulbs with screw-in fluorescent lamps.
   i. Disconnect ballasts where de-lamping has occurred.

5. Building Envelope
   a. Weatherstrip, caulk or seal doors, windows, penetrations and other openings.
   b. Replace worn weatherstripping and missing putty or caulking around doors and window frames.
   c. Seal openings in walls for piping, electrical conduit, through-wall units and window frames.
   d. Replace or repair faulty door latches and adjust uneven doors.
   e. Maintain adequate insulation in walls, ceilings and roofing.
6. Power Systems
   a. Turn off elevators/escalators on weekends and after hours.
   b. Turn off equipment manually or through time clocks.
   c. Operate one boiler, chiller or compressor at 90 percent capacity instead of two at 45 percent capacity.
7. Controls
   a. Calibrate temperature and humidity sensing devices.
   b. Calibrate controls and ensure they operate as specified in the sequence of operation.
   c. Turn on/off energy consuming equipment through existing control system.
8. Water-side Equipment
   a. Clean or replace strainer screens in pumping systems periodically.
   b. Ensure that air separators are operating properly and that no air is entering the system.
   c. Flush system periodically.
   d. Use proper water treatment procedures to reduce fouling of transfer surfaces and potential biological growth.
   e. Clean coils, chillers, tubes, tanks, drain pans, heat exchanger surfaces, boilers and/or furnaces regularly.

These guidelines include some of the more important O&Ms as part of its recommendations. However, it is expected that the analyst will be able to identify additional O&Ms.

O&M CASE STUDIES AND METHODOLOGY

As mentioned earlier, extended O&Ms can help identify energy-saving measures that traditional O&Ms cannot do. This, however, requires more careful data gathering and analysis. If an EMCS exists at the facility and if it monitors energy and demand use data of the building, this dataset can be a very valuable source of information. If not, a certain amount of effort to gather such data is required.

In this section, a methodology for O&M identification is described and some case histories are presented.

1. Methodology

   During the daytime and nighttime site visits, the O&M opportunities are identified and necessary information for the O&M analysis is collected.

   - The feasibility of candidate O&M measures can be determined by examining the physical conditions of the HVAC systems, examining the capacity of the HVAC control system, and discussing candidate O&M measures with the operation and management staff of the borrower.
   - The possibility of de-lamping is determined by measuring the lighting levels at several selected places during a daytime walk-through. The potential savings in lighting and office equipment shut off is determined by a nighttime walk-through.

- The building envelope and occupancy information are collected by either visual assessment and examination or interviews with building operators, office workers and custodial staff. The building energy systems, such as AHUs and their control systems, are examined very carefully. The most important operation parameters and control methods, such as cold deck setting, total airflow rate and fraction of outside air intake, are inspected and measured if possible. Submeter data measured by the borrower, if available, are also collected. These measurements provide sufficient information for a detailed O&M analysis.

2. O&M Case Studies

Case Study 1

Building: Library, University of Texas at Austin
Floor area: 484,000 sq. ft.
Number of stories: six (6)
HVAC system type: single and dual-duct VAV system
O&M recommendations:

- Shut off steam valves for all the single-duct air handling units (summer).
- Shut off lights during unoccupied hours.

Measured energy savings:

- Steam: 5,300 MMBtu/yr
- Chilled: 5,000 MMBtu/yr
- Electricity: 1,162,500 kWh/yr

Measured annual savings in dollars: $121,000
Cost to implement: No implementation cost

Case Study 2

Building: Office, State Capitol Complex, Austin
Floor Area: 470,000 sq. ft.
Number of stories: eleven (11)
O&M Recommendations: Nighttime shutdown of some air-handling units.
Measured Energy Savings:

- Steam: 8,000 MMBtu/yr
- Chilled: 8,000 MMBtu/yr
- Electricity: 2,407,500 kWh/yr

Measured Annual Savings in Dollars: $122,000
Cost to Implement: No implementation cost

Case Study 3

Building: Middle School, Fort Worth ISD, Fort Worth
Floor Area: 92,900 sq. ft.
Number of stories: two (2)
O&M Recommendations: Nighttime shutdown of non-essential equipment.
Measured Energy Savings:

- Natural Gas: 320 MMBtu/yr
- Electricity: 337,000 kWh/yr

Measured Annual Savings in Dollars: $24,000
Cost to Implement: No implementation cost

Case Study 4

Building: Classrooms/Office, Texas A&M University, College Station
Floor Area: 342,000 sq. ft.
Number of stories: four (4)
O&M Recommendations: Hot water pump shutoff
Measured Energy Savings: Electricity: 97,000 kWh/yr
Measured Annual Savings in Dollars: $2,700
Cost to Implement: No implementation cost

Case Study 5

Building: Hospital/Office, UT Medical Branch, Galveston
Floor Area: 138,000 sq. ft.
Number of stories: seven (7)
O&M Recommendations: Change/optimize cold deck and hot deck schedules
Measured Energy Savings:

- Steam: 9,000 MMBtu/yr
- Chilled water: 10,500 MMBtu/yr

Measured Annual Savings in Dollars: $123,000
Cost to Implement: No implementation cost

APPENDIX C – UCRM CASE STUDIES

INTRODUCTION

Several utility cost reduction measures (UCRMs) are reviewed in this section as a comparison between utility assessment report estimated savings and actual measured savings. These case studies are summarized with respect to the UCRM implemented, site description, savings comparisons, potential reasons for the differences that exist between the estimated and measured savings and conclusions that suggest methods for improvement of the estimates.

CASE STUDIES

CASE STUDY 1: VAV RETROFIT

A UCRM for the University of Texas at Arlington Business Building was the conversion of the air handling units from constant volume to variable air volume (VAV). The dual-duct mixing boxes were replaced with VAV mixing boxes, and variable frequency drives (VFDs) were installed on fan motors. This retrofit was completed in July 1991.

Building Description

The Business Building is a two-section structure consisting of three floors in Area A and six floors in Area B. The building was constructed in 1976 and has a total area of 149,900 square feet. Area A houses classrooms, lecture halls and computer labs with regular hours of 8:00 a.m. to 6:00 p.m. Monday through Friday, although some classrooms and computer labs are used until midnight. Because of the computer labs, one of the three air handlers runs 24 hours a day, seven days a week.

Chilled water and steam are supplied to the building from the campus central plant. Auxiliary equipment includes a 30-hp chilled water pump and three air handlers in the building. Each air handler forms a dual-duct system that has been retrofitted with a VFD. Supply fan motor sizes are 100 hp, 50 hp and 40 hp, and each unit has a return air fan (one 10 hp and two 7-1/2 hp). The units are equipped with economizer cycles which, according to the building operators, are being used.

Savings Compared

The estimated annual savings by the audit were $70,278. Two years of monitored data shows that the total measured savings, $70,377, is 50 percent of the estimated annual savings. Some of the reasons for this difference are presented in the following section.

Differences Explained

A review of the original utility assessment report showed differences in the run time used and the actual building operating schedule. Another difference noted was between the estimated kW by the audit and the maximum measured kW. Adjusting these two items gives an estimated savings of $38,671 per year, which results in a measured savings that is 90 percent of the predicted value.

A table of the usage hours used in the original utility assessment report and the actual hours are shown in Table D.1. AHU #1 serves a computer lab that requires constant cooling, and the savings potential of a VAV is affected by the substantial increase in run time. AHU #2 and AHU #3 were specified to run 8,760 hrs./yr in the original utility assessment report. However, the actual usage hours are 5,268 hrs./yr., which represents 60 percent of the specified run time, thus decreasing the potential savings.

A comparison of the presumed air handler kW to the actual measured kW was made. In order to predict savings for each of the air-handling units in the building, the utility assessment report estimated a kW demand multiplied by usage hours to obtain kWh consumption. The building has been monitored since January 1991, and maximum kW demand for the monitored AHUs from January 1991 to June 1993 is less than the audit estimates. The results are summarized in Table D.2. When these kW differences are applied to the differences between utility assessment report estimated usage hours and scheduled usage hours, as presented in Table D.1, the resultant kWh consumption data is greatly affected. The reader should also note that AHUs #2 and #3 are displayed as a combination because the LoanSTAR metering combines them in the field.

TABLE C.1 – UTILITY ASSESSMENT REPORT ESTIMATED USAGE HOURS COMPARED WITH ACTUAL USAGE HOURS

Air Handler Number	Utility Assessment Report Estimated Usage Hours	Actual Usage Hours Pre- & Post-Retrofit	Actual/Utility Assessment Report Estimate (%)
AHU #1	Occupied 5,840	Occupied 8,760	150
	Unoccupied 2,920	Unoccupied -0-	—
AHU #2	Occupied 8,760	Occupied 5,268	60
	Unoccupied -0-	Unoccupied 3,492	—
AHU #3	Occupied 8,760	Occupied 5,268	60
	Unoccupied -0-	Unoccupied 3,492	—

TABLE C.2 – COMPARISON OF UTILITY ASSESSMENT REPORT ESTIMATED KW AND MAXIMUM MEASURED KW

Air Handler	Audit Assumed kW	Measured kW	Measured/Audit (%)
1	96	50	52
2 & 3	93	75	81

Based on the information presented in both Tables D.1 and D.2, an analysis was done to relate these kWh consumption differences to dollars saved per year. The adjusted estimated savings – $38,671 per year – results in a measured savings that is 90 percent of the predicted annual value.

Conclusions

The above problems could have been avoided by the following:

- Verify the occupancy hours with building personnel.
- Use measured values rather than nameplate data.

Verify the occupancy hours throughout the buildings noting which pieces of equipment serve that area so that appropriate run times are used in the calculations. A one-time measurement of the actual load would have indicated a difference between actual load and nameplate data.

CASE STUDY 2: DIVERSITY

A UCRM implemented in 1991 at Sims Elementary School and Dunbar Middle School in the Fort Worth Independent School District converted the fluorescent light fixtures from a 2´4 four-lamp to a 1´4 two-lamp configuration.

Building Descriptions

Sims Elementary School

Sims Elementary School is a one-story structure. Erected in 1989, the 62,400-square-foot building contains classrooms, offices and an auditorium-cafeteria. The building operates from 7:00 a.m. to 5:00 p.m., five days a week. Prior to the 1992-1993 school year, the school had a three-month summer break, but then went to a full-year schedule. Electricity is supplied to the building from a municipal power plant. The building has two 270,000 Btu/hr. hot water boilers.

Dunbar Middle School

Dunbar Middle School has a two-story main structure and a one-story activity building. The main building was erected in 1982, and the activity building was constructed in 1989. The 51,693-square-foot main building contains classrooms, offices, an auditorium, a cafeteria, a library and a gymnasium. The activity building is 6,128 square feet. The school operates from 6:30 a.m. to 7:00 p.m., five days a week. Prior to the 1992-1993 school year, the school had a three-month summer break but then went to a full-year schedule. Electricity is supplied to the building from a municipal power plant. The building has two 110-ton chillers, two 3,150,000 Btu/hr. hot water boilers and a variable volume chilled water pump.

Savings Compared

The estimated annual savings in the utility assessment report were $18,641. Twenty-nine months of monitored data show that the total measured savings are $32,859. The annualized amount is $13,600, which is 73 percent of the estimated annual savings. This difference is explained in the following section.

Differences Explained

A review of the original utility assessment report showed the diversity factor was assumed to be unity for the lighting fixtures. Several walk-throughs after the retrofit showed that the diversity was 0.75 resulting in a difference of 25 percent. When the corrected diversity factor is used to estimate savings, the estimated and measured savings are within 5 percent.

Conclusions

Several walk-throughs during the energy assessment process would give a reasonable diversity factor to be used in the utility assessment report calculations. This simple procedure would not overstate the estimated savings.

CASE STUDY 3: MOTOR SIZES

A UCRM at the University of Texas at Austin Education Building was the conversion of the air-handling units from constant volume to variable air volume. The dual-duct mixing boxes were replaced with VAV mixing boxes, and variable frequency drives were installed on fan motors. The original utility assessment report made no recommendation concerning changing the original motors. However, the motors were downsized to half the original horsepower (hp) in the retrofit completed in May 1991.

Building Description

The Education Building (EDB) is a five-story structure. Erected in 1973, the 251,161-square-foot building contains classrooms and administration offices. The building is primarily occupied Monday through Friday from 8:00 a.m. to 5:00 p.m. with some occupancy at other times. Air handlers are running 24 hours a day, seven days a week. Currently EDB has eight 50-hp, variable volume, dual-duct AHUs and three constant volume (7.5 hp, 7.5 hp and 5 hp) AHUs serving the building.

The retrofits implemented at the EDB were a variable volume, dual-duct air handling system, variable speed pumping and energy-efficient fluorescent lights. An economizer cycle has been added as a part of the retrofit. The retrofits were completed at the end of May 1991.

Savings Compared

The estimated annual energy savings for the VAV conversion were 1,195,530 kWh, resulting in an annual cost savings of $54,397. Three years of monitored data show that the average energy savings for the VAV conversion with the downsized motors were 1,665,049 kWh annually, which resulted in a cost savings of $75,760. The measured savings are 40 percent greater than the estimated savings. This difference is the result of the downsized motors.

Differences Explained

Originally the eight 100-hp (total 800 hp), dual-duct AHUs were included in the utility assessment report for VAV conversion without downsizing. However, measurements made prior to the retrofit by physical plant personnel indicated that motor loads never exceed 50 hp per motor. Therefore, smaller 50-hp motors were installed in the retrofit with variable frequency drives, resulting in greater savings.

Conclusions

Technical analysts should investigate the actual motor load for the equipment being considered for retrofit. A simple one-time clamp-on measurement would have identified that the actual load was different than the nameplate load. Using actual field measurements results in greater accuracy in the estimated savings.

CASE STUDY 4: COMPLETE VAV RETROFIT

A UCRM for the Perry-Castaneda Library at the University of Texas at Austin was the conversion of the air handling units from constant volume to variable air volume. The dual-duct mixing boxes were replaced with VAV mixing boxes, and variable frequency drives were installed on fan motors. The original utility assessment report considered only dual-duct units; however, physical plant personnel also included the single-duct units in the retrofit completed in December 1990.

Building Description

The Perry-Castaneda Library (PCL) is a six-story building with a floor area of 483,895 square feet. Constructed in 1977, the library contains an open-stack library, offices and computer facilities. The building is open seven days a week, Monday through Friday from 8 a.m. to 12 p.m., Saturday from 8 a.m. to 5 p.m. and Sunday from noon to 10 p.m. The air handling system runs 24 hours a day. There are eight 75-hp, variable volume, single-duct AHUs and four 100-hp, variable volume, dual-duct AHUs serving PCL.

The retrofits implemented at PCL were occupancy sensors (completed in November 1990), variable air volume air handling units (completed in December 1990) and variable speed pumping (completed in August 1990).

Savings Compared

The estimated annual energy savings in the utility assessment report for the dual-duct VAV conversion were 1,319,180 kWh, which results in a cost savings of $60,023. Three and one-half years of monitored data shows that the measured energy savings for the complete VAV conversion (both single and dual ducts) are 3,271,993 kWh annually, which results in a cost savings of $148,876. The measured annual savings are 2.5 times the estimated savings. This difference is the result of including all AHUs in the VAV conversion.

Differences Explained

A review of the original utility assessment report showed that only the dual ducts were considered for a VAV retrofit. The facility personnel decided to include all the AHU units in the building which resulted in higher savings.

Originally, the four 100-hp (total 400 hp) dual-duct AHUs were included in the utility assessment report for VAV conversion. The inclusion of eight additional 75-hp (total 600), single-duct AHUs increases the overall converted hp from 400 hp to 1,000 hp. This increase in horsepower of 2.5 times is reflected in a similar increase in estimated savings and was well worth the additional cost of this change in scope.

Conclusions

Technical analysts should consider both dual-duct and single-duct units in the utility assessment report for further consideration.

APPENDIX D – LOANSTAR REPORTING FORMS

SECO
State Energy Conservation Office

LOANSTAR DESIGN REVIEW REPORT

CHECK ONE:
___Progress Report – 50 percent
___Final Report – 100 percent

Review Date:____________________________________

This checklist serves as a guideline in reviewing the design plans and specifications to determine the progress and contractor/borrower's effectiveness and timeliness in implementing UCRMs as stated in the contract/loan agreement for all programs funded by SECO. The design review focuses on two specific areas: 1) conformance with UAR and 2) financial administration (as required).

Program Name: 201 LoanSTAR
Contract/Loan Number: CL
Number of Amendments:

Borrower:
Site Visit Location(s):
Contract Term:
Funding Amount(s):
Borrower Contact Name /Title:
Phone:
Email:
Address:

SECO Contact:
Email:
Phone:
Address:

ESCO/Design Consultant:
ESCO Contact Name:
Phone Number:
Email:
Address:

UCRMS

(Provide a description of all funded UCRMs including UCRM number., description, estimated cost, estimated savings and estimated payback. Note which UCRM designs have been reviewed and recommended during this review or previous reviews with an asterisk.)

Utility Assessment Report/Loan Agreement (dated________________)

UCRM No.	Description of UCRM	UCRM Cost ($)	Cost Savings/ Yr. ($)	Payback (Yrs.)

Change in Scope No. ____ (dated________________)

UCRM No.	Description of UCRM	UCRM Cost ($)	Cost Savings/ Yr. ($)	Payback (Yrs.)

DESIGN REVIEW

1. Which UCRM design reviews are included in this report?
2. Site visit (Reviewer shall obtain approval from SECO prior to site visit.)
3. In your opinion, if the installer follows these design documents will the installation meet applicable codes and good standard practice and meet the design concept given in the UAR or approved change in scope? If not, describe how the project is being implemented.
4. Expected Schedule:
   a. What is the proposed schedule for all remaining UCRM design submissions?
   b. What is the proposed schedule for the bid, 50 percent construction, final installation including O&M manuals, warrantees and as-built drawings?

FINANCIAL ADMINISTRATION

1. Project implementation costs (Document estimated project construction budget including UCRM costs, metering costs, administration costs and contingencies.)
2. Have there been any deviations from the contract/loan agreement design regarding the proposed expenditures of project funds? (Document scope changes, deletion of UCRMs, modification of UCRMs etc.)
3. Is the owner purchasing or installing any of the measures with their own funds or labor? (Document who will be performing measures and notes about whether this is part of a larger scope of work.)
4. Final comments, observations or recommendations concerning the overall design or administration for this project. (Include written recommendation for approval or rejection as required and attached a copy of the Design Engineer Certification with the 100 percent Design Review Report.)

Signature of SECO Representative	Date
Title	Approved Dated

SECO
State Energy
Conservation Office

LOANSTAR DESIGN ENGINEER CERTIFICATION

The Design Engineer selected to provide design services on projects can be the Engineer who prepared the UAR. However, there are several certifications the Design Engineer must attest to whether or not he/she is the same Engineer who prepared the UAR. By signing below, the Design Engineer certifies the following:

- The design has been conducted in accordance with the requirements of the Texas LoanSTAR Technical Guidebook as administered by SECO.
- The design meets generally accepted engineering practices, and the design is based on the design engineer's on-site investigation of the facilities involved.
- The design engineer will not receive additional financial remuneration (bonuses) beyond salary or fee based on design recommendations.
- Specifications or processes have not been developed in a manner that will result in only one potential supplier meeting those specification or process requirements.
- The design engineer has no undisclosed conflicting financial interest in the design recommendations.
- Equipment recommendations resulting from the design can be fulfilled by a minimum of two bidders for projects under $1,000,000 and three bidders for projects over $1,000,000.
- The design engineer will not influence a borrower to select any one of the recommended equipment manufacturers.

____
Signature of SECO Representative

____
Date

____
Title

____
Texas P.E. Registration Number

Affix Official P.E. Seal
(only if signed by an engineer)

LOANSTAR CONSTRUCTION MONITORING REPORT

CHECK ONE:
___Progress Report – 50 percent
___Final Report – 100 percent

Date of Site Visit: ______________________________

This checklist serves as a guideline in determining the progress and contractor/borrower's effectiveness and timeliness in implementing grant projects and/or UCRMs as stated in the contract or loan agreement for all programs funded by SECO. The monitoring visit focuses on two specific areas: 1) construction observations and 2) financial administration.

Program Name: 201 LoanSTAR CL
Contract/Loan Number:
Number of Amendments:

Borrower:
Site Visit Location(s):
Contract Term:
Funding Amount(s):

SECO Contact:
Email:
Phone:
Address:

ESCO/Design Consultant:
Address:
Contact:
Phone Number:

Construction Contractor:
Address:
Phone Number:
Contact:
Phone Number:

CONSTRUCTION OBSERVATIONS

1. Description of Work. Complete tables below as applicable.

Utility Assessment Report/Loan Agreement (dated_______________)

UCRM No.	Description of UCRM	UCRM Cost ($)	Cost Savings/ Yr ($)	Payback (Yrs.)

Change in Scope No. _____ (dated_______________)

UCRM No.	Description of UCRM	UCRM Cost ($)	Cost Savings/ Yr. ($)	Payback (Yrs.)

2. What is the current projected completion schedule for each UCRM?
3. What is the approximate percentage of completion of the contract/loan agreement?
4. Has the contract/loan agreement been implemented according to the approved scope of work?
   a. If not, describe how the project implementation has been changed.
      i. Changes in scope
      ii. Change order requests (includes field orders)
5. What internal management reporting systems has the borrower established to ensure that the contract/loan agreement's objectives are achieved?
6. Is someone in the borrower's organization assigned responsibility for reviewing reports and follow-up variance? If so, who?
7. Does the borrower have a written policy that establishes responsibility and also provides the procedures for periodic monitoring, verification and reporting of program progress and accomplishments?

8. Does the borrower have a method to recover lost data resulting from a disaster or system crash?

9. The following documents were reviewed to verify if the borrower has an orderly filing system for the administration of this contract/loan agreement.

a.	Complete, signed copy of contract or loan agreement	YES	NO	N/A
b.	Complete, signed copy of amendments	YES	NO	N/A
c.	Copies of monthly invoices	YES	NO	N/A
d.	Correspondence to/from SECO	YES	NO	N/A

10. Comments (UCRM observations):

FINANCIAL INFORMATION

1. Is there sufficient funding to complete the approved retrofit project?

2. Are there established procedures for the procurement of equipment and services purchased with project funds?

3. What is the borrower current financial status for this project?

Contract Amount:	$
Less funds received as of *(report date)* ________:	$ __________
Balance of funds as of this report:	$
Unpaid vouchers submitted *(dated)*__________:	$
Remaining unbilled funds:	$

4. Are budgeted amounts compared to actual amounts at least quarterly?

5. If applicable, can time and attendance reports be specifically traced back to the actual payroll?

6. Does the borrower have written policies and procedures for their budget process?
   If no, explain the contractor's budget process.

7. Comments (financial observations):

SUMMARY

Final comments, observations or recommendations concerning the overall administration of this project:

______________________________ ______________________________

Signature of SECO LoanSTAR Manager Date

SECO
State Energy Conservation Office

LOANSTAR FINAL COMPLETION REPORT

Loan: ____

Loan Amount: ________________________________

Borrower: ___________________________________

Note if the borrower has received the following items:

1. O&M Manuals/Record Drawings

   Has the borrower received all the required "as-built" drawings and O&M manuals on all equipment installed as a part of this project? (Yes/No) If no, explain why not:

2. Warranties/Guarantees

   Has the borrower received warranties and guarantees required by the specifications on all the equipment installed as a part of this project? (Yes/No) If no, explain why not:

SECO representative will sign and submit this "Final Completion Report" to the SECO LoanSTAR program administrator. At this point, the construction phase of the project is complete. The LoanSTAR program administrator will then prepare and send the borrower a loan repayment schedule.

______________________________________ ______________________________________

Signature of SECO LoanSTAR Manager Date

____

Name (Printed)

LOANSTAR CHANGE IN SCOPE REVIEW REPORT

Date of Site Visit:____________________

This form serves as a checklist for SECO review of proposed changes in scope. If there is a proposed change that will result in no elimination of approved UCRMs and no significant reduction of UCRM savings, SECO may grant approval of the change without additional calculations or documentation. However, if the proposed change is estimated to result in a significant reduction in savings (less than 10 percent) or any change in UCRMs or costs, the SECO representative must request and review full savings costs and payback calculations and forward the change request to the LoanSTAR administrator with appropriate recommendations. No cost increases of more than 10 percent will be considered for approval. This form will serve as documentation for a final decision by SECO. It must be completed by the SECO representative and forwarded to the LoanSTAR program administrator with any required supporting materials.

Program Name: 201 LoanSTAR
Contract/Loan Number: CL
Number of Amendments:

Borrower:
Site Visit Location(s):
Contract Term:
Funding Amount(s):
Borrower's Contact:

SECO Contact:
Email:
Phone Number:

ESCO/Design Consultant:
Address:
Contact:
Email:
Phone Number:

Construction Contractor:
Address:
Phone Number:
Contact:
Email:
Phone Number:

1. Provide description of change requested.
   [Provide detailed UCRM description(s) and change(s) requested.]
2. Provide change in scope effect on total project in table below:

Loan Agreement Attachment A (dated ________________)

UCRM No.	Description of UCRM	UCRM Cost ($)	Cost Savings/ Yr. ($)	Payback (Yrs.)

Change in Scope No. ____ (dated_______________)

UCRM No.	Description of UCRM	UCRM Cost ($)	Cost Savings/ Yr. ($)	Payback (Yrs.)

Attach cost and savings calculations backup if significant changes are proposed.

CHECK ONE:
___Estimated
___Calculated

3. Recommendation regarding approval
   (Provide justification for any recommendations made.)

_______________________________ _______________________________

Signature of SECO Representative | Date

_______________________________ _______________________________

Name (printed) | Approved Date

APPENDIX E – LOANSTAR LOAN DISBURSEMENT (REIMBURSEMENT) REQUEST FORMS

TEXAS LOANSTAR REIMBURSEMENT REQUEST

GUIDELINES, FORMATS AND DOCUMENTS

LOANSTAR DISBURSEMENT REQUESTS

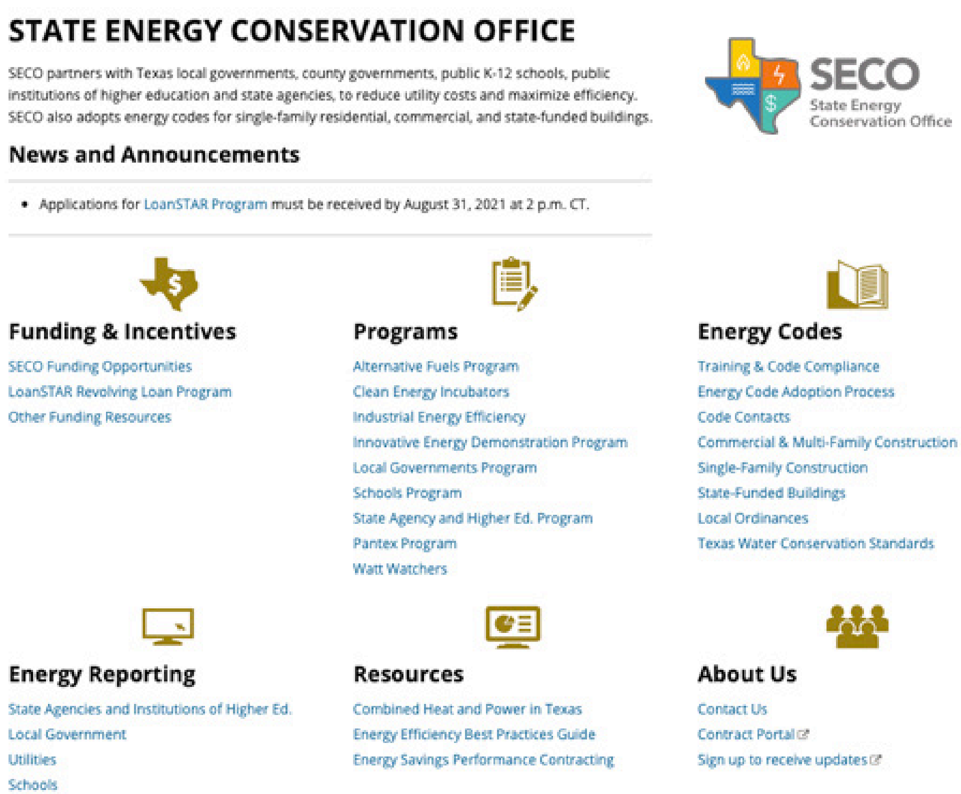
Comptroller of Public Accounts/State Energy Conservation Office

The LoanSTAR loan is styled as a line of credit, authorizing the borrower to implement specific energy conservation retrofit measures (ECRMs) and to receive loan funds up to the amount designated for each project. Article 6 of the loan agreement describes the disbursement of the loan. This article is pasted in bullet format below.

- The loan shall be disbursed in installments, no more frequently than monthly, following lender's receipt of borrower's requests for disbursement to pay the costs of goods purchased and services performed.
- Each request for disbursement shall be made on a form or voucher approved by lender and the State of Texas and supported by bills, statements or invoices for the goods or services to be paid and such other documentation that in lender's sole discretion allows for full substantiation of the costs incurred by borrower.
- Borrower's requests for disbursement must be received by lender not later than sixty (60) days after borrower pays for or authorizes payment for the goods and services, and lender shall have no obligation to make disbursements for the costs of goods and services if borrower fails to comply with this requirement.
- Notwithstanding any other provision of this agreement or any other document to the contrary, the total of all installments disbursed by lender to borrower shall not exceed the amount of the loan set forth in Section 2 of this agreement.

REQUEST FOR LOAN DISBURSEMENT FORMAT

1. Cover letter
2. LoanSTAR loan reimbursement checklist
3. Voucher information summary sheet. This sheet has to be completely filled out and signed by the appropriate authority.
4. LoanSTAR disbursement summary sheet, listing each utility cost reduction measure (UCRM) and its individual authorized loan amount, the current request for payment, total of all requests, retainage if applicable and the balance remaining for each UCRM. Columns should be totaled to show balances for the entire loan. (See attached example.)
5. Supporting documents, with signatures verifying that the goods and services have been delivered and that payment for them has been made by the borrower. Copies of summary bills (such as AIA Document G702/G703) signed by the contractor, plus copies of paid vouchers are normally sufficient.
6. Attachment I. Texas Historical Commission Project Review
7. Submit the reimbursement request via the SECO contract portal located on **seco.cpa.texas.gov**:



Allow a minimum of two weeks for your request to be processed.

1. COVER LETTER

2. LOANSTAR REIMBURSEMENT CHECKLIST

LoanSTAR Reimbursement Request Document Submittal Checklist

(Borrower to submit checklist and all of the following documents with each reimbursement request)

#	Document		Description/Details	Who Completes the Form?	Borrower Review	SECO Initials
A	**Cover Letter**		Signed cover letter	Borrower	☐	______
B	**VISS Form**		The VISS form must be completely filled out, signed and dated.			
		1	VISS form signed and dated	Borrower	☐	______
C	**LoanSTAR Disbursement Summary Spreadsheet**		The disbursement summary sheet must be completely filled out and signed by the appropriate authority.	Borrower	☐	______
D	**"AIA Application and Certification for Payment"**		The AIA document must be completely filled out, signed and dated.	"Contractor and Borrower"	☐	______
		1	Contractor Signature and Date		☐	______
		2	Contractor Notary (Stamp, Signature, and Date)		☐	______
		3	Borrower Certification Signature and Date		☐	______
E	**Invoice Support Documentation**		All invoices supporting the reimbursement amount must be submitted. The invoices must:	Contractor	☐	______
		1	Be on Contractor/Vendor letterhead		☐	______
		2	Be clearly itemized		☐	______
		3	Show amounts being billed/paid		☐	______
	The documents below are required to be submitted one time, with first reimbursement request.					
F	**Contract Attachment B-2**		Contractor must complete and sign Contract Attachment B-2 (Subcontractor Nondiscrimination).	Contractor	☐	______
G	**Texas Historical Commission**		If applicable, borrower must provide THC approval or exemption documentation. Not applicable ☐	THC	☐	______
			Borrower Checklist Review Signature and Date	______________________		
			SECO Checklist Review Signature and Date	______________________		

3. VOUCHER INFORMATION SUMMARY SHEET

VOUCHER INFORMATION SUMMARY SHEET

Contractor must fully complete, sign and submit with each claim.

BORROWER ____

SECO LOAN NUMBER______________________________________

BORROWER'S VENDOR I.D.# (11 DIGITS) ____________________________

BORROWER'S 3-DIGIT MAIL CODE ________________________________

PERIOD COVERED BY REIMBURSEMENT REQUEST ______________THRU ________

TOTAL AMOUNT OF THIS REIMBURSEMENT REQUEST $____________________

CERTIFICATION OF REIMBURSEMENT REQUEST

BORROWER'S CONTACT PRINTED NAME____________________

BORROWER'S CONTACT TITLE____________________

BORROWER'S CONTACT SIGNATURE ____________________

DATE____________________

4. LOANSTAR DISBURSEMENT SUMMARY PAGE

LOANSTAR DISBURSEMENT SUMMARY

				Billing date:				
				Billing period:				
Borrower:				Signature:				
Loan Number:				Phone:				
	U							
	C	Description of Utility	Approved	Current	Current	Cumulative	Cumulative	Remaining
	R	Conservation Retrofit Measure	UCRM Loan	Payment	Retainage	Payments	Retainage	Balance (c)
Building	M	(UCRM) (a)	Amount (b)	Request		(Incl. Current)	(Incl. Current)	
		TOTAL UCRM AMOUNTS						
		10% Contingency Allowance						
		Engineering Audit Expense						
		Metering Expense						
		TOTALS						
				Documentation for these				
				Figures is attached				
Comments:								

a) No UCRMs may be canceled after loan is granted without prior written lender approval.

b) Includes detailed engineering design, labor, and materials.

c) Cost of individual UCRM projects may not exceed UCRM Cost + Ten Percent of Total Loan Amount without amendment.

Any Individual variances exceeding this amount must receive prior written approval from lender.

5. LOANSTAR DISBURSEMENT SUMMARY EXAMPLE

LOANSTAR DISBURSEMENT SUMMARY

Billing date: May 25, 2016

Billing period: April 1, 2016 - Apil 30, 2016

Borrower:

Signature:

Loan Number:

Phone:

Building	ECRM	Description of Utility Conservation Retrofit Measure (ECRM) (a)	Approved ECRM Loan Amount (b)	Current Payment Request	Current Retainage	Cumulative Payments (Incl. Current)	Cumulative Retainage (Incl. Current)	Remaining Balance (c)
BUR	2	Dual Duct VAV	$ 122,966					$ 122,966
BUR	3	VAV Chilled Water Pumping	$ 11,993					$ 11,993
Com Bldg.	1	VAV Conversions	$ 404,874	$ 145,920	$ 8,105	$ 153,995	$ 8,530	$ 242,349
Com Bldg.	2	Variable Speed CW Pumping	$ 68,502					$ 68,502
Com Bldg.	3	Lghting Control	$ 4,111					$ 4,111
PCL	1	VAV Conversion	$ 706,764	$ 92,055	$ 5,345	$ 101,555	$ 5,845	$ 599,364
PCL	2	Occupancy Sensors	$ 3,250					$ 3,250
UTC	1	VAV Conversion	$ 328,820	$ 79,553	$ 4,412	$ 83,828	$ 4,637	$ 240,355
UTC	2	Install Three-Position Switches	$ 3,091					$ 3,091
WIN	3	VAV Chilled Water Pumping	$ 9,675					$ 9,675
		TOTAL UCRM AMOUNTS	$ 1,664,046	$ 317,528	$ 17,862	$ 339,378	$ 19,012	$ 1,305,656
		10% Contingency Allowance						
		Engineering Audit Expense	$ 35,000	$ 35,000	$ -	$ 35,000	$ -	$ -
		Metering Expense						
		TOTALS	$ 1,699,046	$ 352,528	$ 17,862	$ 374,378	$ 19,012	$ 1,305,656
				Documentation for these Figures is attached				

Comments:

a) No ECRMs may be canceled after loan is granted without prior written lender approval.

b) Includes detailed engineering design, labor, and materials.

c) Cost of individual UCRM projects may not exceed UCRM Cost + Ten Percent of Total Loan Amount without amendment.

Any Individual variances exceeding this amount must receive prior written approval from lender.

SECO State Energy Conservation Office

APPL: ION AND CERTIFICATE FOR PAYM T AIA DOCUMENT G702

One of [illegible] pages

SAMPLE

TO (Owner):

PROJECT: BOB'S

...IRACT FOR:

ATTENTION:

APPLICATION NO: 3

PERIOD FROM: 4/24/90
TO: 5/17/90

ARCHITECT'S PROJECT NO:

CONTRACT DATE: January 30, 1990

Distribution to:
- ☐ OWNER
- ☐ ARCHITECT
- ☐ CONTRACTOR
- ☐
- ☐

CONTRACTOR'S APPLICATION FOR PAYMENT

CHANGE ORDER SUMMARY		ADDITIONS	DEDUCTIONS
Change Orders approved in previous months by Owner	TOTAL		
Approved this Month			
Number	Date Approved		
	TOTALS		
Net change by Change Orders			

Application is made for Payment, as shown below, in connection with the Con
Continuation Sheet, AIA Document G703, is attached.

The present status of the account for this Contract is as follows:

ORIGINAL CONTRACT SUM	$ 1,010,000.00
Net change by Change Orders	$ -0-
CONTRACT SUM TO DATE	$ 1,010,000.00
TOTAL COMPLETED & STORED TO DATE (Col G on G703)	$ 324,280.00
RETAINAGE 5 % or total in Column I on G703	$ 16,214.00
TOTAL EARNED LESS RETAINAGE	$ 308,066.00
LESS PREVIOUS CERTIFICATES FOR PAYMENT	$ 185,383.00
CURRENT PAYMENT DUE	$ 122,683.00

The undersigned Contractor certifies that to the best of his knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by him for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR: [illegible], INC.

By: [illegible] Date: 5/17/90

State of: Texas County of: Travis
Subscribed and sworn to before me this 17th day of May, 1990
Notary Public: [illegible]
My Commission expires: 09/29/90

ARCHITECT'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising the above application, the Architect certifies to the Owner that the Work has progressed to the point indicated; that to the best of his knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents; and that the Contractor is entitled to payment of the AMOUNT

AMOUNT CERTIFIED $ 122,683
(Attach explanation if amount certified differs from the amount applied for.)

ARCHITECT:

By: [illegible] Date: 5/29/90

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice

SECO State Energy Conservation Office

CONTINUATION SHEET — AIA DOCUMENT G703 — PAGE _ OF 3 PAGES

SAMPLE

AIA Document G702, APPLICATION AND CERTIFICATE FOR PAYMENT, containing Contractor's signed Certification is attached.
In tabulations below, amounts are stated to the nearest dollar.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NUMBER: 3
APPLICATION DATE: May 17, 1990
PERIOD FROM: 4/24/90
TO: 5/17/90
ARCHITECT'S PROJECT NO:

A ITEM No.	B DESCRIPTION OF WORK		C SCHEDULED VALUE	D WORK COMPLETED Previous Applications	E This Application Work in Place	F Stored Materials (not in D or E)	G TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G÷C)	H BALANCE TO FINISH (C−G)	I RETAINAGE
1.	Bond, Ins. Submittal		6,000.00	4,500.00			4,500.00	75	1,500.00	225.0[illegible]
2.	VFD & Fans	M	126,259.00	70,000.00	31,000.00		101,000.00	80	25,259.00	5,050.[illegible]
		L	4,000.00						4,000.00	
3.	Insulation	M	1,500.00						1,500.00	
		L	2,700.00						2,700.00	
4.	Pipe, Valves, Ftgs.	M	1,000.00						1,000.00	
		L	1,800.00						1,800.00	
5.	Filters	M	3,000.00						3,000.00	
		L	1,000.00						1,000.00	
6.	Sheetmetal	M	12,000.00		1,200.00		1,200.00	10	10,800.00	60.0[illegible]
		L	18,000.00		1,800.00		1,800.00	10	16,200.00	90.[illegible]
7.	Temp. Controls	M	36,000.00	32,400.00			32,400.00	90	3,600.00	1,620.[illegible]
		L	54,000.00		5,400.00		5,400.00	10	48,600.00	270.0[illegible]
8.	Test & Balance	L	12,800.00						12,800.00	
9.	Electrical	M	19,377.00						19,377.00	
		L	29,064.00						29,064.00	
10.	Gen. Construction	M	2,600.00						2,600.00	
		L	3,900.00						3,900.00	
				[illegible],900.00	39,400.00		146,300.00	44	188,700.00	7,315.[illegible]

SAMPLE

SECO State Energy Conservation Office

LoanSTAR REIMBURSEMENT SUMMARY

BUILDING	ECM	Description	Loan Amount	Cumulative Payments (incl current pmt)	Cumulative Retainage 5% (incl current ret)	Current Payment	Current Retainage 5%	Remaining Balance
DUR	2	Dual Duct VAV	122,986.00					122,986.00
DUR	3	VAV Chilled Water Pumping	11,993.00					11,993.00
Comp. Bldg.	1	VAV Conversion	404,874.00	153,985.00	8,530.00	145,926.00	8,106.00	242,349.00
Comp. Bldg.	2	Variable Speed CW Pumping	88,502.00					88,502.00
Comp. Bldg.	3	Lighting Control	4,111.00					4,111.00
Comp. Bldg.	7	Two Speed AHU Motors/JC-40	88,278.00					88,278.00
EDB	1	Replace Incandescent Lighting	50,036.00					50,036.00
EDB	2	Occupancy Sensors	1,845.00					1,845.00
EDB	3	VAV Conversion	555,069.00					555,069.00
EDB	4	Variable Speed Pump Drive	30,021.00					30,021.00
GAR	1	FCMS Connection	19,184.00					19,184.00
GAR	4	Dual Duct VAV	59,979.00					59,979.00
GAR	5	VAV Chilled Water Pumping	8,313.00					8,313.00
GEA	2	Dual Duct VAV	134,818.00					134,818.00
GEA	3	VAV Chilled Water Pumping	10,843.00					10,843.00
NUR	2	Dual Duct VAV	181,842.00					181,842.00
NUR	3	VAV Chilled Water Pumping	10,674.00					10,674.00
PAI	3	Turn Off ACs 2, 3, & 4	4,768.00					4,768.00
PAI	5	Cold Deck Controls, AC-1	41,859.00					41,859.00
PAI	6	VAV Conversion AC-1	56,619.00					56,619.00
PAI	7	Replace AC-3 & 4	34,247.00					34,247.00
PAI	8	VAV Conversion AC-5	77,124.00					77,124.00
PAI	9	VAV Conversion AC-6	37,375.00					37,375.00
PCL	1	VAV Conversion	704,764.00	101,855.00	5,845.00	92,053.00	5,245.00	559,344.00
PCL	2	Occupancy Sensors	3,250.00					3,250.00
PCL	3	Variable Speed CWP	25,129.00					25,129.[illegible]
RAS	1	Hot and Cold Deck Reset	19,369.00					19,369.[illegible]
UTC	1	VAV Conversion	378,128.00	83,920.00	4,837.00	79,483.00	4,412.00	249,385[illegible]
UTC	2	Install Three-Position Switches	3,091.00					3,09[illegible]
UTC	4	Variable Speed CW Pumping	34,344.00					34,34[illegible]
WAG	2	Dual Duct VAV	86,852.00					86,8[illegible]
WCH	2	Replace Economizer Controls AC-1	2,790.00					2,[illegible]
WCH	4	Dual Duct VAV	84,700.00					84,[illegible]
WCH	5	VAV Chilled Water Pumping	8,878.00					[illegible]
WEL	1	VAV Conversion	734,725.00					72[illegible]
WEL	2	Replace Incandescent Lights	18,7[illegible]					[illegible]
WEL	3	CWP Variable Speed	[illegible]					[illegible]
WIN	2	Dual Duct VAV	[illegible]					[illegible]
WIN	3	VAV Chilled Water Pump[illegible]	[illegible]					[illegible]
Totals			[illegible]02.00	339,378.00	19,012.00	*317,528.00	*17,882.00	[illegible],00

* These figures refer to an attached voucher

SAMPLE

SAMPLE

6. ATTACHMENT I. TEXAS HISTORICAL COMMISSION PROJECT REVIEW

Attachment I: Texas Historical Commission Section Summary

Example Narrative

The scope of work associated with the (name of school) (contract #) project falls under (Category A, B or C) and does not require a THC consultation. The number of buildings that work was performed on in this project are (reason of category) (name of buildings); however, they **are not** listed in and **are not** eligible for listing in the National Register of Historic Places. They **are not** located in the National Register list or an eligible historic district or in a locally designated historic district. They **are not** state archeological landmarks.

Please see the following consultation list. The types of work being performed in this project in (Category A, B or C) are highlighted.

We have also included information that documents the building's age.

Where to Submit the Project Review

For detailed information on project reviews by the Texas Historical Commission, visit **https://www.thc.texas.gov/etrac-system** and **https://xapps.thc.state.tx.us/106Review/**.

SECO
State Energy
Conservation Office

111 East 17th Street
Austin, Texas 78701
www.seco.cpa.texas.gov