Susan Combs
Texas Comptroller of Public Accounts

Facility Preliminary Energy Assessments and Recommendations

Laredo ISD

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Laredo, Texas 78040

Prepared by:

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October 2011

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SECO
State Energy Conservation Office

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SECO - Schools & Local Government Energy Management Program
Laredo ISD
900 E. Lyon
Laredo, TX 78040
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1.0 EXECUTIVE SUMMARY

Laredo School District, now referred to as the District, requested that Texas Energy Engineering Services, Inc. (TEESI) perform a Preliminary Energy Assessment (PEA) of their facilities. This report documents that analysis.

This service is provided at no cost to the District through the Schools Energy Management and Technical Assistance Program as administered by the Texas Comptroller of Public Accounts, State Energy Conservation Office (SECO). This program promotes and encourages an active partnership between SECO and Texas schools for the purpose of planning, funding, and implementing energy saving measures, which will ultimately reduce the District's annual energy costs.

The annual cost savings, implementation cost estimate and simple payback for all Utility Cost Reduction Measures (UCRM's) identified in this preliminary analysis are summarized below. Individual UCRM's are summarized in Section 11.0 of this report.

Est. Implementation Cost Estimate:	$792,140
Est. Annual Energy Saving (MMBTU/Yr):	3,537
Est. Annual Greenhouse Gas Emissions Reduction (Metric Tons CO_2e/Yr):	625
Est. Annual Energy Cost Savings:	$116,800
Simple Payback (Yrs):	6.8

This report includes a summary of the facilities surveyed along with energy consumption and costs, opportunities for energy savings, and information regarding energy management and options for funding retrofit projects. A follow-up visit to the District will be scheduled to address any questions pertaining to this report, or any other aspect of this program.

SECO is committed to providing whatever assistance the District may require in planning, funding and implementing the recommendations of this report. The District is encouraged to direct any questions or concerns to either of the following contact persons:

SECO / Mr. Stephen Ross
(512) 463-1770

TEESI / Saleem Khan
(512) 328-2533

2.0 FACILITY DESCRIPTIONS

This section provides a brief description of the facilities surveyed. The purpose of the onsite survey was to evaluate the major energy consuming equipment in each facility (i.e. Lighting, HVAC, and Controls Equipment). A description of each facility is provided below.

Buildings:	Joseph W. Nixon High School
Stories:	Two story
Area (estimated):	334,271 SF
Bldg. Components:	Brick building, built-up roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts High Intensity Discharge (HID) fixtures in gym
HVAC:	Split-DX units
Controls:	New additions: Energy Management System (EMS) – Manufacturer TAC Existing old campus: Start/stop controls (scheduled for redesign)

Buildings:	Raymond & Tirza Martin High School
Stories:	Two story
Area (estimated):	309,569 SF
Bldg. Components:	Brick building, built up roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts High Intensity Discharge (HID) fixtures in gym
HVAC:	Split-DX units, Packaged Units, Air-cooled Chiller Chilled Water Systems
Controls:	Energy Management System (EMS) – Manufacturer TAC

Buildings:	Leonides G. Cigarroa High School
Stories:	Single story
Area (estimated):	330,000 SF
Bldg. Components:	Brick building, built up roof, slab on grade
Typical Lighting Fixtures:	T12 fluorescent fixtures with magnetic ballasts T8 fluorescent fixtures with electronic ballasts T5 fluorescent fixtures in gym
HVAC:	Split-DX units, Packaged Units
Controls:	Energy Management System (EMS) Manufacturer TAC, Programmable Thermostats

Buildings:	Alma A. Pierce Elementary School
Stories:	Single story
Area (estimated):	86,689 SF
Bldg. Components:	Brick building, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts High Intensity Discharge (HID) fixtures in gym
HVAC:	Split-DX units
Controls:	Energy Management System (EMS) – Manufacturer TAC

3.0 ENERGY CONSUMPTION AND PERFORMANCE

A site survey was conducted at several of the District's facilities. The facilities surveyed comprised a total gross area of approximately 1,137,092 square feet.

Annual electric invoices for the buildings surveyed were 1,692,688 for the 12-month period ending June 2011. A summary of annual utility costs is provided in **Appendix C**, Base Year Consumption History.

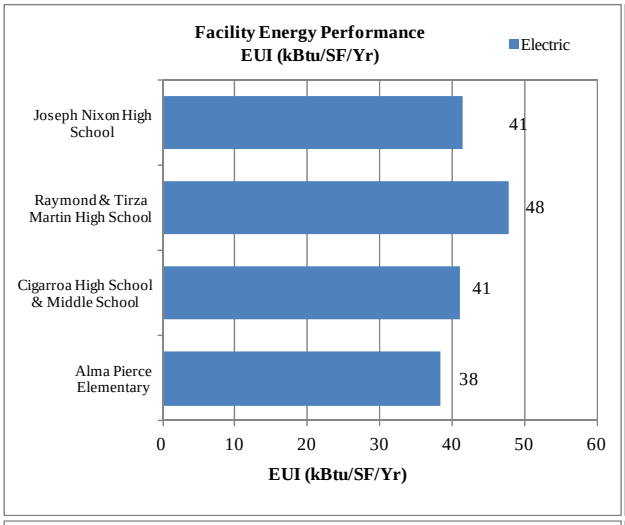
To help the District evaluate the overall energy performance of its facilities TEESI has calculated their Energy Utilization Index (EUI) and Energy Cost Index (ECI). The EUI represents a facility's annual energy usage per square foot; it is measured in thousands of BTUs per square foot per year (kBTU/SF/Year). Similarly, ECI is measured as cost per square foot per year ($/SF/Year). The EUI and ECI for selected facilities are listed below:

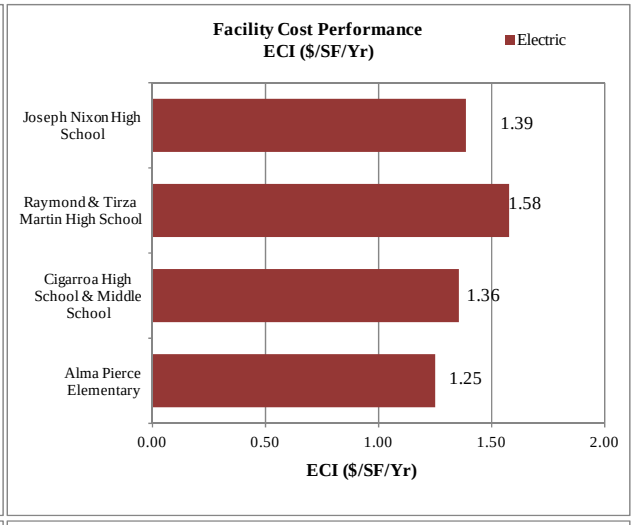
Energy Cost and Consumption Benchmarks									
		Electric				Total	EUI	ECI	
	Building	kWh/Yr	MMBTU/Yr	kWh/SF	$Cost/Yr	MMBTU/Yr	kBTU/SF/Yr	$/SF/Yr	SF
1	Joseph Nixon High School	4,052,132	13,830	12.12	464,064	13,830	41	1.39	334,271
2	Raymond & Tirza Martin High School	4,337,771	14,805	14.01	487,877	14,805	48	1.58	309,569
3	Cigarroa High School & Middle School*	5,606,754	19,136	12.03	632,284	19,136	41	1.36	466,000
4	Alma Pierce Elementary	975,000	3,328	11.25	108,463	3,328	38	1.25	86,689
		kWh/Yr	MMBTU/Yr	kWh/SF	$Cost/Yr	MMBTU/Yr	kBTU/SF/Yr	$/SF/Yr	SF
		14,971,657	51,098	12.51	1,692,688	51,098	43	1.41	1,196,529

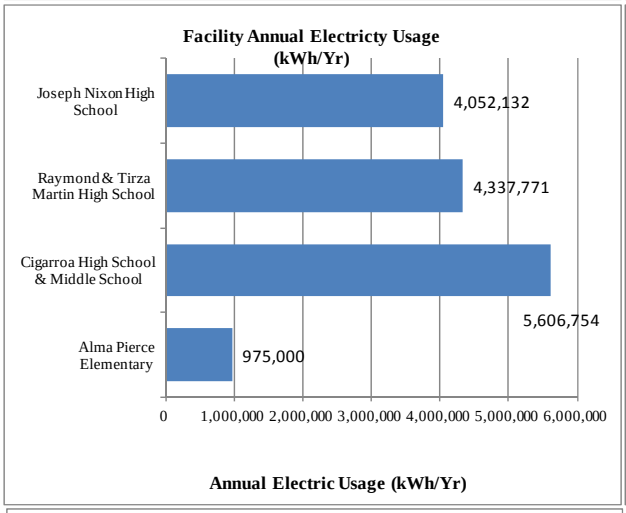
*Cigarroa High School and Middle School utility data is not separated because the schools utilize multiple meters, including one that serves both campuses. Only Cigarroa High School was analyzed for this report, but the Middle School is included here for benchmarking purposes.

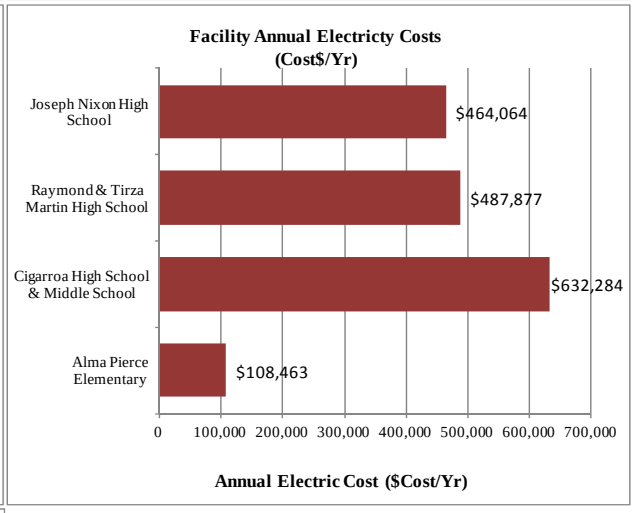
Knowing the EUI and ECI of each facility is useful to help determine the District's overall energy performance. In addition, the District's EUI was compared to TEESI's database of Texas schools. See **Appendix D** to determine how the EUIs of these facilities compared to those of other schools in Texas.

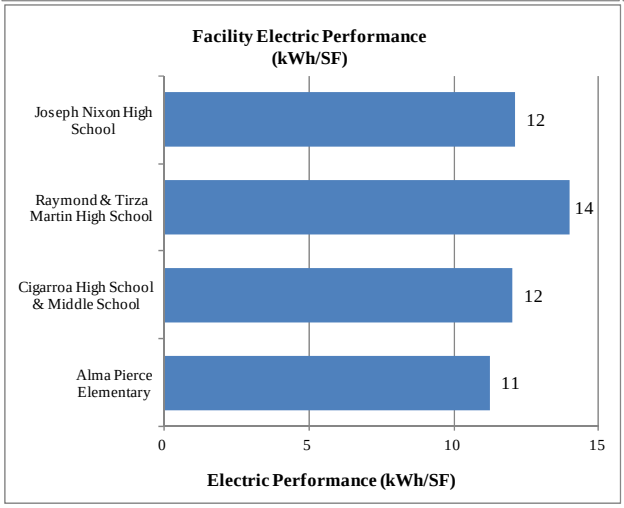
The following charts summarize the data presented in the previous table. See **Appendix C** for further detail.



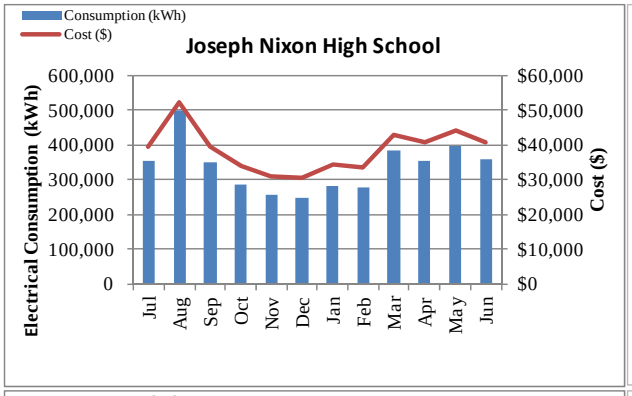




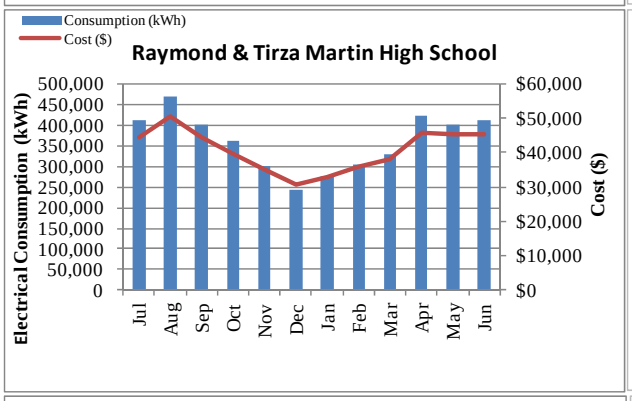




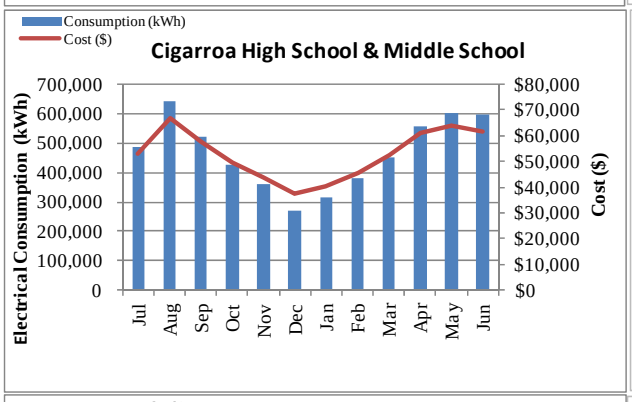
The following charts summarize each campus monthly electric data (natural gas service is not present at the campuses). See **Appendix C** for further detail.



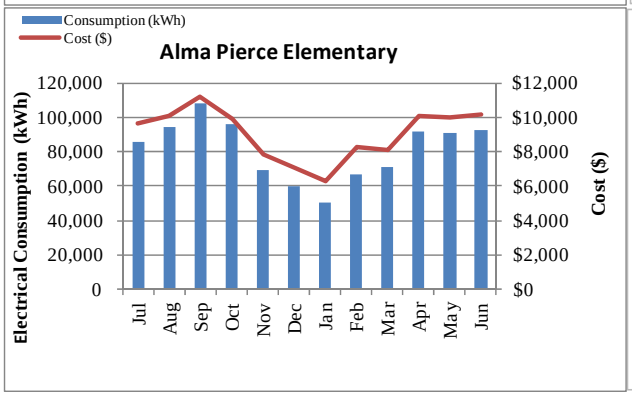
NATURAL GAS N/A



NATURAL GAS N/A

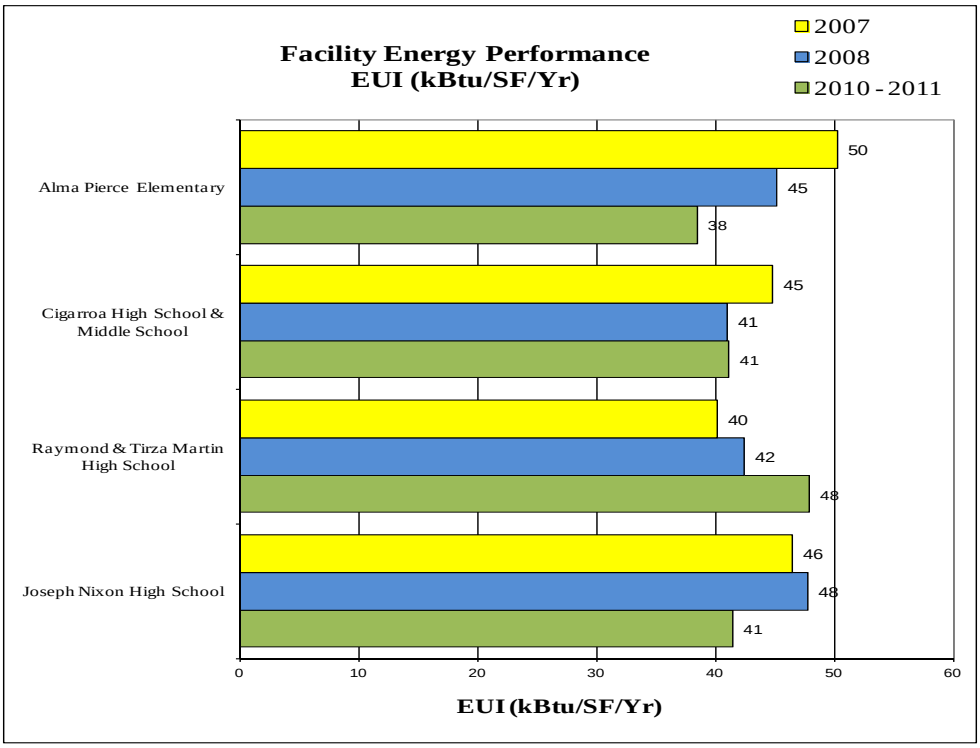


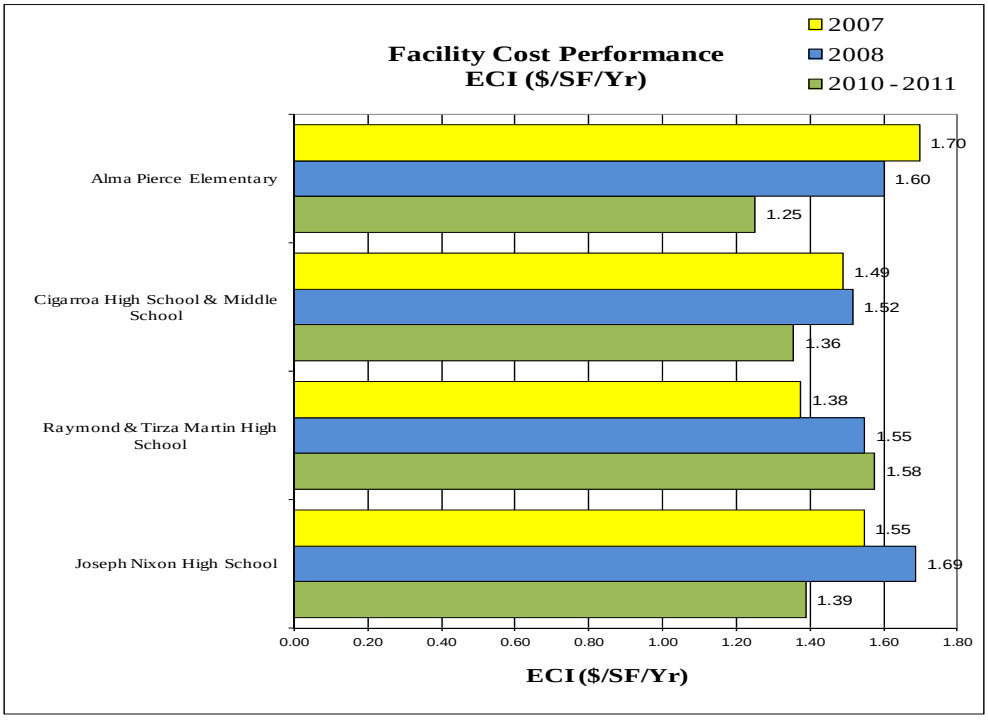
NATURAL GAS N/A

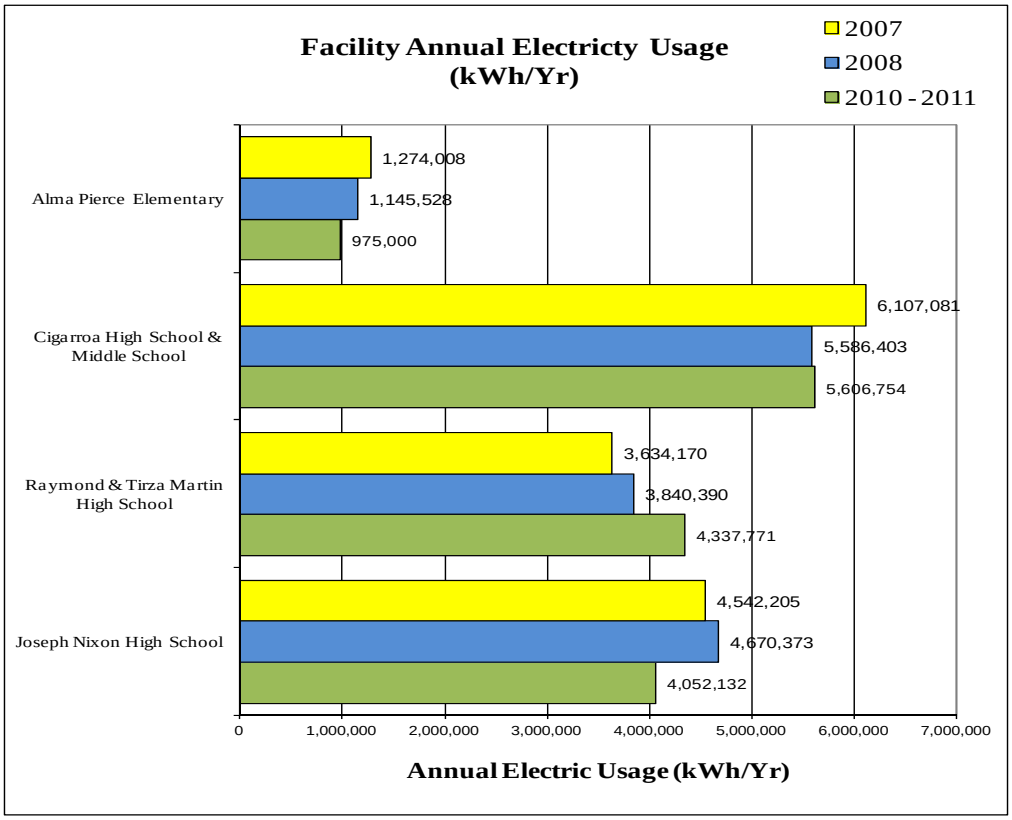


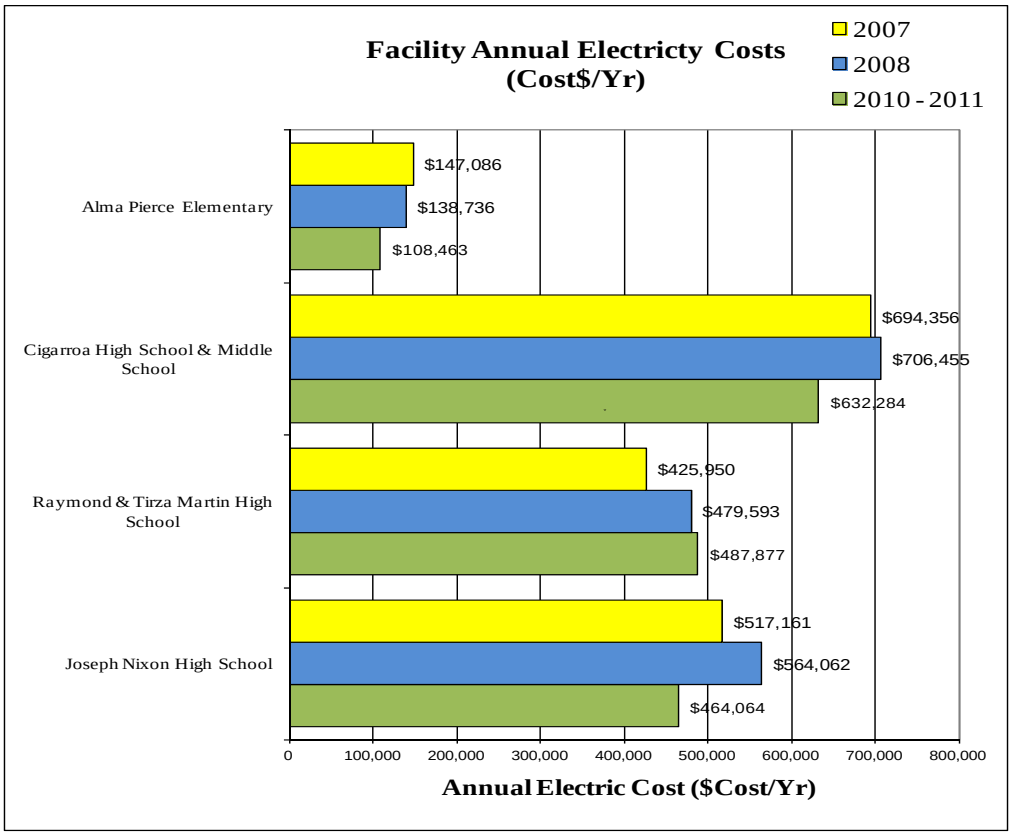
NATURAL GAS N/A

The following charts compare consumption and cost data for the schools surveyed, based on current utility data as well as past utility data. This information is useful in order to see overall facility energy consumption increases or decreases. Please note the following charts utilized utility data from January – December 2007, January – December 2008, and July 2010 – June 2011.






Facility Annual Electricty Usage
(kWh/Yr)
2007
2008
2010 - 2011
Alma Pierce Elementary
1,274,008
1,145,528
975,000
Cigarroa High School & Middle School
6,107,081
5,586,403
5,606,754
Raymond & Tirza Martin High School
3,634,170
3,840,390
4,337,771
Joseph Nixon High School
4,542,205
4,670,373
4,052,132
0
1,000,000
2,000,000
3,000,000
4,000,000
5,000,000
6,000,000
7,000,000
Annual Electric Usage (kWh/Yr)


Facility Annual Electricty Costs
(Cost$/Yr)
2007
2008
2010 - 2011
Alma Pierce Elementary
$147,086
$138,736
$108,463
Cigarroa High School & Middle School
$694,356
$706,455
$632,284
Raymond & Tirza Martin High School
$425,950
$479,593
$487,877
Joseph Nixon High School
$517,161
$564,062
$464,064
0
100,000
200,000
300,000
400,000
500,000
600,000
700,000
800,000
Annual Electric Cost ($Cost/Yr)

4.0 ENERGY STAR PORTFOLIO MANAGER

The District's energy baseline can be developed in ENERGY STAR's Portfolio Manager. One of the key reasons for using ENERGY STAR Portfolio Manager is its ability to normalize the District's baseline according to several key factors (i.e. Weather, Square Feet, Hours of Operation, Number of Computers, etc.). It is also a free online resource available to all registered users, and is a user-friendly web-based tool.

ENERGY STAR is a joint program of the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE). ENERGY STAR has developed Portfolio Manager, an innovative online energy management tool, designed to help organizations track and assess energy and water consumption of their facilities. Portfolio Manager helps organizations set investment priorities, identify under-performing buildings, verify efficiency improvements, and receive EPA recognition for superior energy performance.

Portfolio Manger is an energy performance benchmarking tool. Portfolio Manager rates a building's energy performance on a scale of 1–100 relative to similar buildings nationwide. The rating system is based on a statistically representative model utilizing a national survey conducted by the Department of Energy's Energy Information Administration. This national survey, known as the Commercial Building Energy Consumption Survey (CBECS), is conducted every four years, and gathers data on building characteristics and energy use from thousands of buildings across the United States. A rating of 50 indicates that the building, from an energy consumption standpoint, performs better than 50% of all similar-use buildings nationwide, while a rating of 75 indicates that the building performs better than 75% of all similar-use buildings nationwide.

In addition, Portfolio Manager is used to generate a Statement of Energy Performance (SEP) for each building, summarizing key energy information such as site and source energy intensity, greenhouse gas emission, energy reduction targets and energy cost. The Statement of Energy Performance can help in applying for an ENERGY STAR Building label or satisfying LEED for Existing Buildings (LEED-EB) requirements. For example, one of the requirements to receive an ENERGY STAR Building Label is to achieve a minimum CBECS rating of **75**. A requirement to receive LEED-EB certification is an ENERGY STAR rating of **69**.

To develop the District's baseline, 12 months of utility consumption, cost data, and Building Space Use information will be required. The table on the following page is a sample of the Building Space Use data required by Portfolio Manager to generate the Energy Performance Rating. These inputs are critical and can significantly influence how Portfolio Manager computes the ENERGY STAR Rating. Many of these key inputs may vary over time and could influence the rating. If an ENERGY STAR Label is pursued, these key inputs will need to be verified and certified by a Professional Engineer. Verification of this information is required when submitting the Statement of Energy Performance for ENERGY STAR's review.

ENERGY STAR Portfolio Manager Example Space Use Data

Facility Type: K-12 School

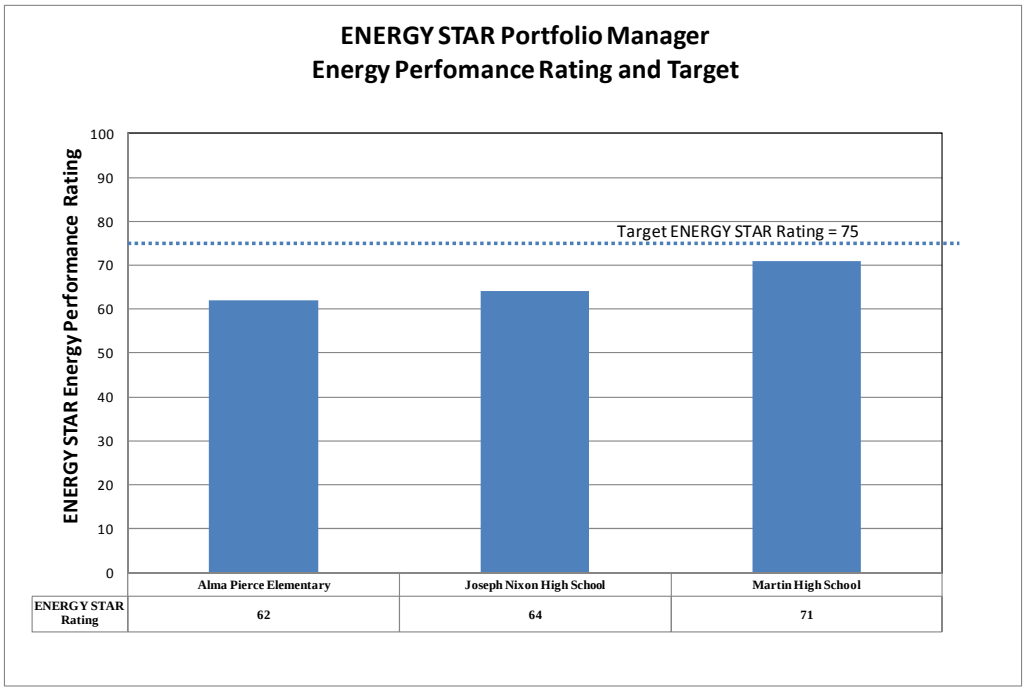
- 12 Months of Electric
- Gross Floor Area
- Open Weekends (Y/N)
- # of PCs
- # of Walk in refrigerators/freezers units
- Presence of cooking facilities
- Percent Cooled
- Percent Heated
- Months Open per Year
- High School (Y/N)

Each facility at the District was analyzed through the ENERGY STAR Portfolio Manager. **Default** values were used for the data in the table above except for utility bills and gross floor areas. It is recommended the District update these to correct values for each facility in order to achieve appropriate ENERGY STAR ratings. The table below summarizes the preliminary results based on some default values.

Facility Name	Current Rating (1-100)	Total Floor Space (Sq. Ft.)
Alma Pierce Elementary	62	86,689
Cigarroa High School & Middle School*	-	466,000
Joseph Nixon High School	64	274,834
Martin High School	71	309,569

*Cigarroa HS & MS are not rated because the buildings are metered together

The target for each of these schools is a rating of 75 or higher to qualify for ENERGY STAR. As previously noted, engineer verification is required to produce a Statement of Energy Performance (SEP) if applying for ENERGY STAR recognition. The following indicates the school's current energy performance ratings, ending in June 2011.



ENERGY STAR ratings for Laredo ISD

A benefit of using ENERGY STAR's Portfolio Manager is its ability to set goals for energy performance. It allows an energy performance target to be set and calculates the estimated savings per year to reach the goal. With a performance target of 75 set, the estimated yearly savings for each of the schools is indicated below.

	ENERGY STAR Rating			ENERGY STAR Rating Target			ENERGY STAR Rating Target		
	EXISTING RATING			TARGET RATING = 69			TARGET RATING = 75		
Facility	Current ENERGY STAR Rating	Current Utility Cost $/SF/yr	Greenhouse Gas Emissions ($MtCO_2e/yr$) / ($kgCO_2e/ft^2/yr$)	Target Utility Cost $/SF/yr	Potential Target Savings $/yr	Greenhouse Gas Emissions (MtCO2e/yr) / (kgCO2e/ft2/yr)	Target Utility Cost $/SF/yr	Potential Target Savings $/yr	Greenhouse Gas Emissions (MtCO2e/yr) / (kgCO2e/ft2/yr)
Joseph Nixon High School	64	$1.69	2311 / 8	$1.62	$18,603	2209 / 8	$1.51	$51,157	2066 / 7
Martin High School	71	$1.58	2474 / 8	$1.58	$0	-	$1.51	$19,515	2382 / 8
Alma Pierce Elementary	62	$1.25	556 / 6	$1.18	$6,508	523 / 6	$1.10	$13,016	490 / 5

5.0 ENERGY ACCOUNTING

UTILITY PROVIDERS

American Electric Power (AEP) & Just Energy provide electric service to the District.

MONITORING AND TRACKING

Currently, the District does not have an energy tracking software or spreadsheet in place. An effective energy tracking system is an essential tool by which an energy management program's activities are monitored. The system should be centralized and available for all engaged staff members to use in verifying progress toward established targets and milestones.

The District should consider consolidating the tracking and recording of all the District's utility accounts (i.e., Electricity, Natural Gas, Propane, Water, etc.) into an electronic spreadsheet similar to the chart shown on the following page. Along with total utility costs ($), utility consumption should be recorded as well (i.e., kWh, MCF, gallons, etc.). The District can use this data to track utility consumption patterns and budget utility expenses. **Preferably, the District should also consider an electronic database such as ENERGY STAR Portfolio Manager, which will provide a means of storing and tracking utility information. The District's baseline utility information has been entered into Portfolio Manager, as shown in the previous section. For more information on ENERGY STAR Portfolio Manager, please see Section 4.0.** Having this historical data improves the District's awareness of their energy performance and will help in tracking their energy reduction goals.

The steps below are essential for an effective energy management tracking system:

1. Perform regular updates. An effective system requires current and comprehensive data. Monthly updates should be strongly encouraged.

2. Conduct periodic reviews. Such reviews should focus on progress made, problems encountered, and potential rewards.

3. Identify necessary corrective actions. This step is essential for identifying if a specific activity is not meeting its expected performance and is in need of review.

In addition, having this historical utility data would facilitate **House** and **Senate Bill(s)** reporting requirements. Please see Section 7.0 for additional information regarding these requirements.

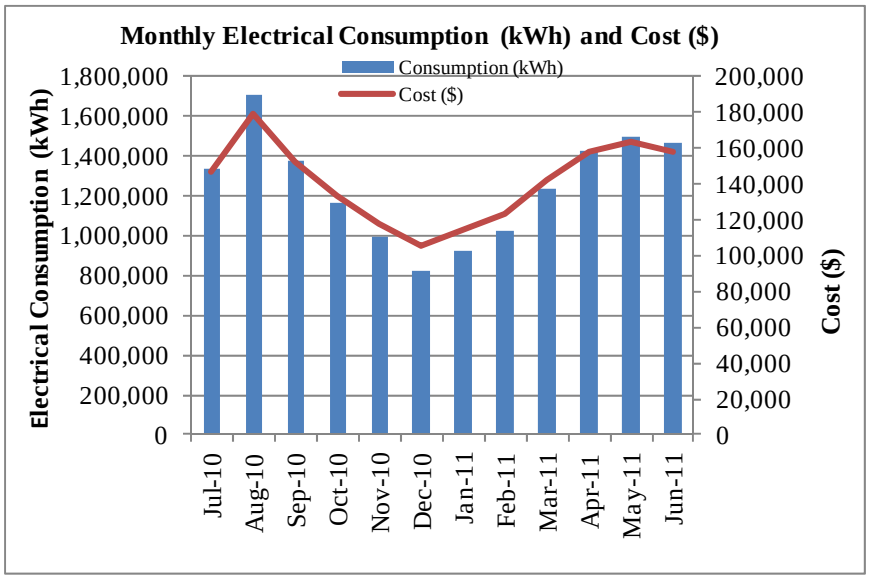
Furthermore, below is a sample format the District can customize to help summarize their overall utility usage and costs.

The data presented below is a summation of the data provided by the District. This data below includes only selected utility accounts and is for reference purposes only and does not represent the District's total utility data. See **Appendix C** for further detail regarding each utility account represented in the table below.

Laredo ISD - Sample Utility Input Form

MONTH	ELECTRICITY		
	KWH	COST $	Avg. Rate $/KWH
Jul-10	1,339,428	146,833	$0.1096
Aug-10	1,704,237	179,331	$0.1052
Sep-10	1,380,382	152,511	$0.1105
Oct-10	1,169,341	133,000	$0.1137
Nov-10	989,609	117,663	$0.1189
Dec-10	820,816	105,575	$0.1286
Jan-11	920,269	114,046	$0.1239
Feb-11	1,028,718	122,786	$0.1194
Mar-11	1,237,146	141,711	$0.1145
Apr-11	1,427,897	157,634	$0.1104
May-11	1,491,860	163,588	$0.1097
Jun-11	1,461,954	158,010	$0.1081
Total	14,971,657	$1,692,688	$0.1131

Gross Building Area:	1,196,529	SF



6.0 POWER METERING

At present, Cigarroa High School and Cigarroa Middle School share electric meters. This makes it difficult to account for the electrical consumption (kWh) or demand (kW) of the individual buildings. It is possible to perform analysis and/or simulations to develop baseline energy consumption profiles for unmetered buildings, but in order to support long-term energy efficient practices, separate Electric Meters should be installed to support energy conservation and facility planning needs.

The three primary benefits for metering are:

- Benchmarking and identifying areas of high energy use.
- Assist with measurement and verification of the implemented energy measures.
- Provide electric load profile data for future planning and renovations.

From an energy management perspective, access to the historical energy consumption data provides for better targeting of buildings for energy cost reduction measures. Where buildings have already undergone energy retrofits, metering helps with the measurement and verification process. In addition, a change in metered energy use can reveal a change in operating parameters, equipment efficiency, or control malfunction that may otherwise remain undetected.

From a facility management perspective, access to the historical peak power load will be available to planning and/or design teams. This will enable them to accurately determine if the existing power distribution equipment can accommodate a planned expansion or renovation or if new or additional equipment will be required.

For cost estimating purposes, metering locations are at the service entrance of the main electrical service at each campus (3 in total). **The budgetary cost estimate based on preliminary analysis for a comprehensive metering plan is approximately $10,000.** Please note that a detailed assessment & engineering survey should be conducted in conjunction with the scope of the Utility Cost Reduction Measures (UCRMs) to determine the exact scope and associated costs.

This metering and associated costs are based on a Revenue Grade Energy and Demand Meter. A suitable meter could be implemented that uses the EMS system at each campus for remote access of data and ease of use.

Another option that could be investigated is contacting the serving electric utility company and determining if they have a program to install energy meters for this purpose (non-billing). This could be a simpler as well as a less expensive solution but also may have monthly fees associated with it making it more expensive in the long-term.

7.0 ENERGY LEGISLATION OVERVIEW

In 2007, the 80th Texas Legislature passed Senate Bill 12 (**SB12**) which among other things extended the timeline set by Senate Bill 5 (**SB5**). SB5, commonly referred to as the Texas Emissions Reduction Plan, was adopted in 2001 by the 77th Texas Legislature to comply with the federal Clean Air Act standards. Also in 2007, the 80th Texas Legislature passed House Bill 3693 (**HB3693**) which amended provisions of several codes relating primarily to energy efficiency.

In 2009, the 81st Texas Legislature passed Senate Bill 300 (**SB300**). This bill specifically addressed the requirement for Texas Schools. This bill repealed the requirement in HB3693 that school districts must establish a goal of reducing electric consumption by 5% each year for six years starting Fiscal Year (FY) 2007. SB300 instead requires that school districts establish a long-range energy plan to reduce the overall electricity use by 5% beginning FY 2008. Besides this change, other requirements set forth in SB12 and HB3693 applicable to schools still apply.

Following are key requirements established by the above energy legislation:

- Establish a Long-Range Energy Plan (SB300) to reduce the District's electric consumption by five percent (5%) beginning with the 2008 state fiscal year and to consume electricity in subsequent fiscal years in accordance with the plan. The Long-Range Energy Plan should include strategies in the plan for achieving energy efficiency that result in net savings or that can be achieved without financial cost to the district. The Plan should account for the initial, short-term capital costs and lifetime costs and savings that may occur from implementation of the strategy. Each strategy should be evaluated based on the total net costs and savings that may occur over a seven-year period following implementation of the strategy.

- Record electric, water, and natural gas utility services (consumption and cost) in an electronic repository. The recorded information shall be on a publicly accessible Internet Web site with an interface designed for ease of navigation if available, or at another publicly accessible location. To help with the utility reporting process, a sample input form can be found in **Appendix B** of this report.

- Purchase commercially available light bulbs using the lowest wattages for the required illumination levels.

- Install energy saving devices in Vending Machines with non-perishable food products. **Not required of School Districts, but highly recommended.**

Summary descriptions of SB12, HB3693, and SB300 are available in **Appendix A.**

8.0 SAMPLE SCREENSHOTS OF ENERGY MANAGEMENT SYSTEM (EMS)

During the preliminary walk-through, several snap shots of the facilities' Energy Management System (EMS) frontend were taken. The EMS snap shots help provide a snapshot of the HVAC equipment settings (Temperature Setpoints, Equipment On/Off Status, etc.). Following are some comments based on quick review of EMS front end during the month of September 2011.

Martin High School:

1. Martin West/Band seems to have outside air temperature readings that are 5 to 6 degrees less than the rest of the campus.
2. AHU 1, 4, 6, and 17 seem to have the outside air damper at 100% with CO_2 of around 1700. Other AHUs have the outside air damper set to 25% with CO_2 in the hundreds. It is possible the District could fine-tune this to lower the outside air damper opening.

Alma Pierce Elementary School:

1. The minimum AHU outside air dampers seems to be 25% with the CO2 in the hundreds. The District could consider lowering the Outdoor Air (OA) opening for better control.
2. AHU #10 showed 82.8 % humidity, possibly resulting from a bad sensor. All other humidity sensors were around 50%.

Cigarroa High School:

1. The majority of AHUs have the OA damper set at 25%, which could possibly be lowered with room to accommodate the resulting change of CO_2.
2. AHU-10P has the auxiliary heat on.
3. AHU-2D has discharge temperature of 252, probably a bad sensor.
4. AHU-3Q has the two compressors on, but the fan is off.
5. The gym AHU-1BP has a discharge temperature of 217, probably a bad sensor.
6. The orchestra/art building has a humidity of 69% and 70%, but the EMS does not have any other readings on this building.

Nixon High School:

1. All existing campuses are scheduled for redesign and new construction. Half of the buildings will be demolished later this year or next year. There is only on/off controls at Nixon High.

On the following pages are examples illustrating the results of snap shots from the EMS listed above. While this information only provides a brief sample of the indoor conditions, this information is helpful in providing a general understanding of a facility's HVAC system operations. Since the HVAC system is the major energy consumer in most facilities, investigating these systems can help identify energy reduction opportunities. Please note the following images were obtained during the month of September 2011.

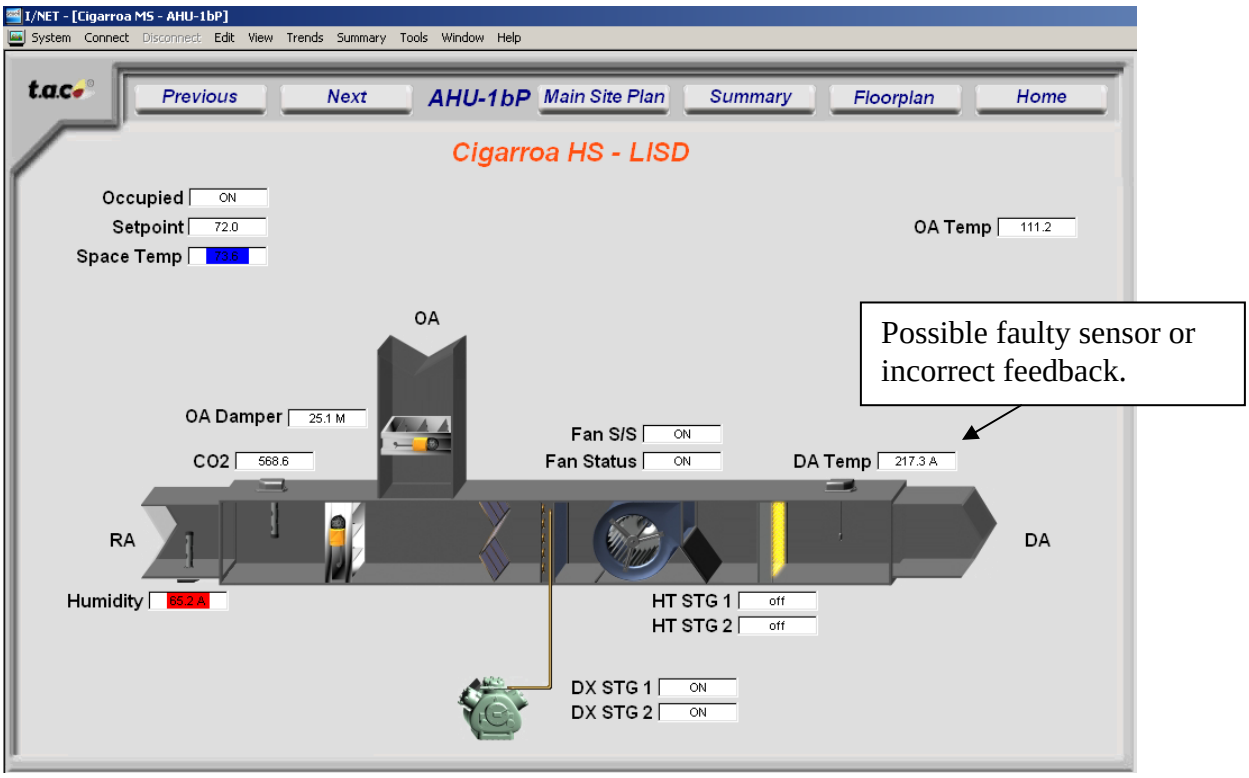


Figure 1: EMS Screenshot of Gym AHU at Cigarroa High School.

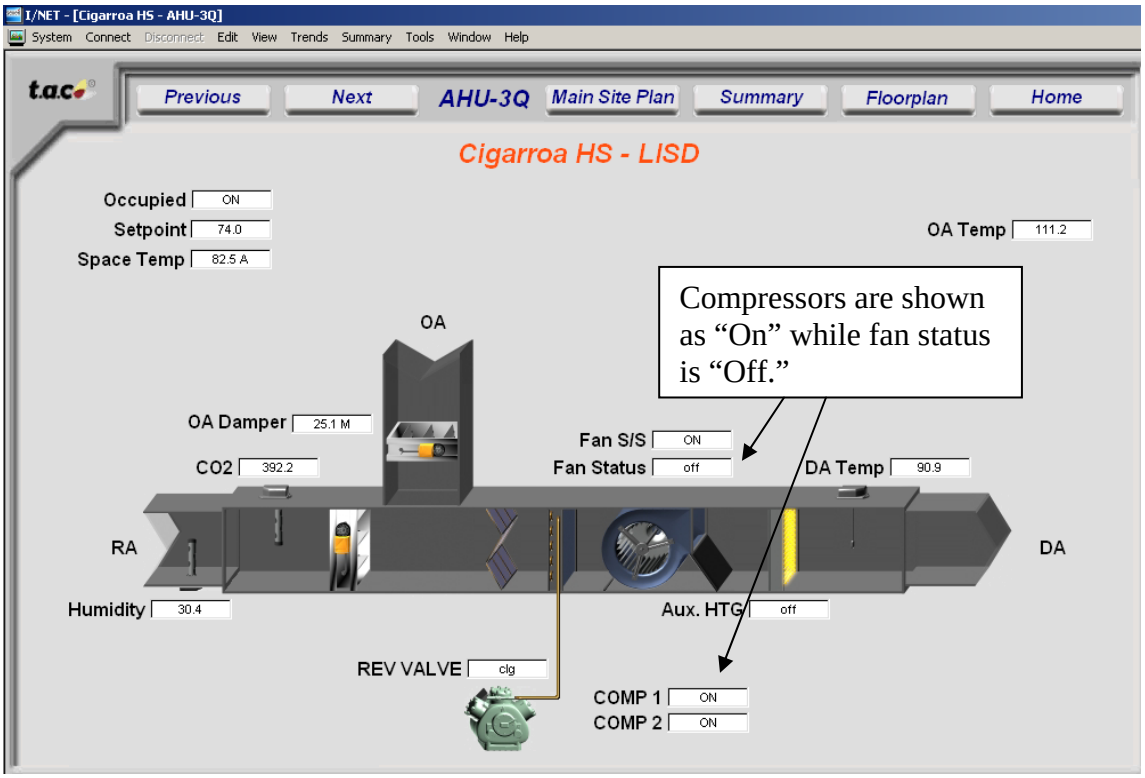


Figure 2: EMS screenshot of AHU at Cigarroa High School.

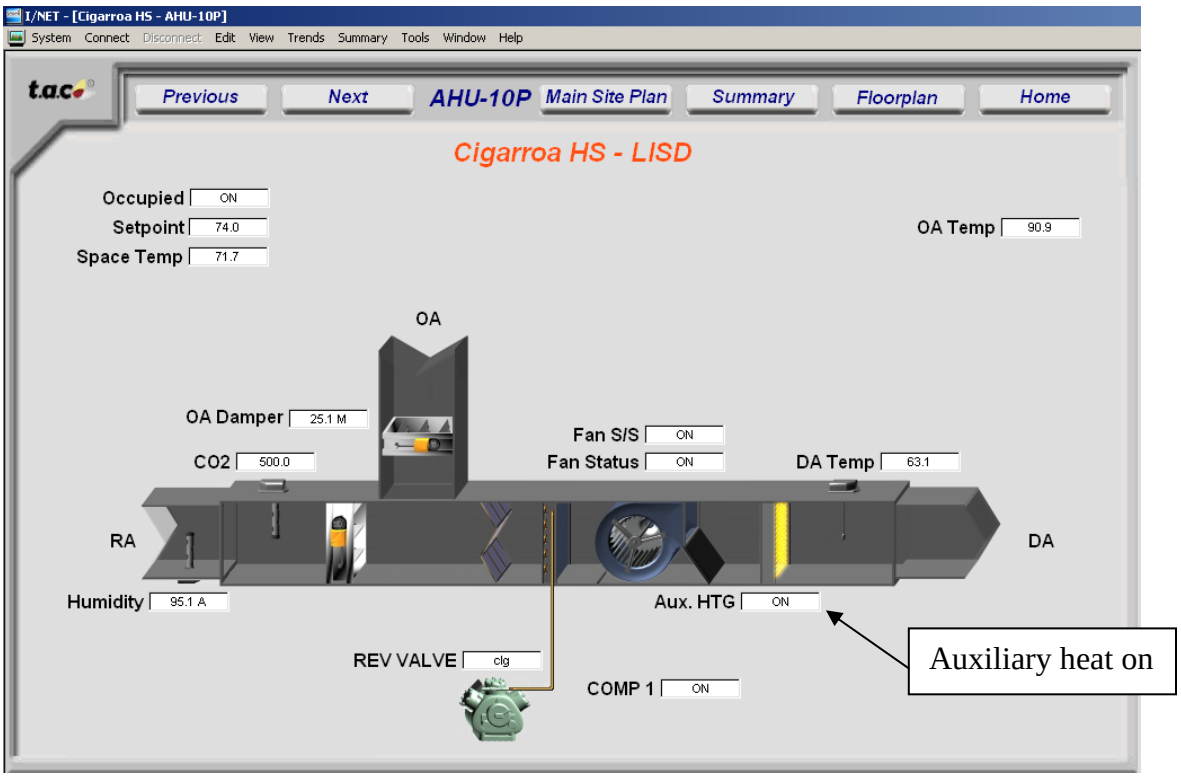


Figure 3: EMS Screenshot of AHU at Cigarroa High School.

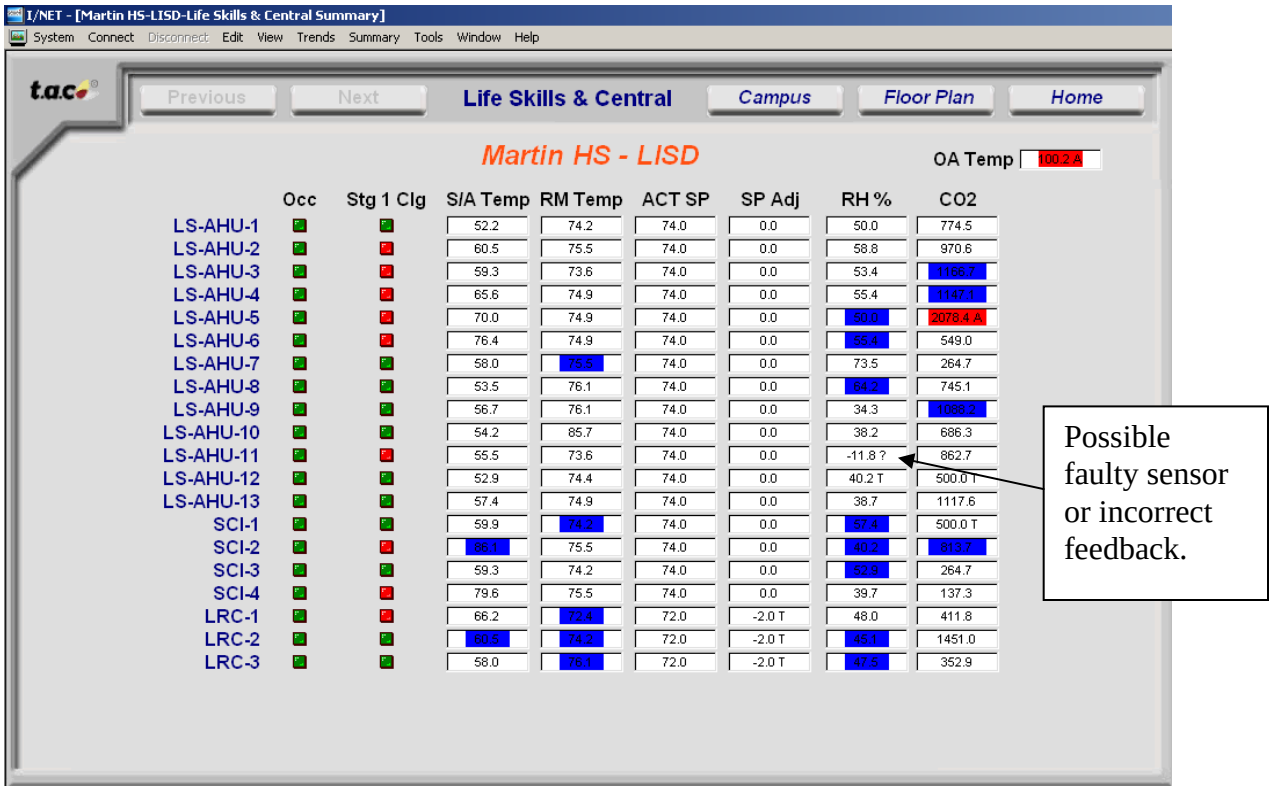
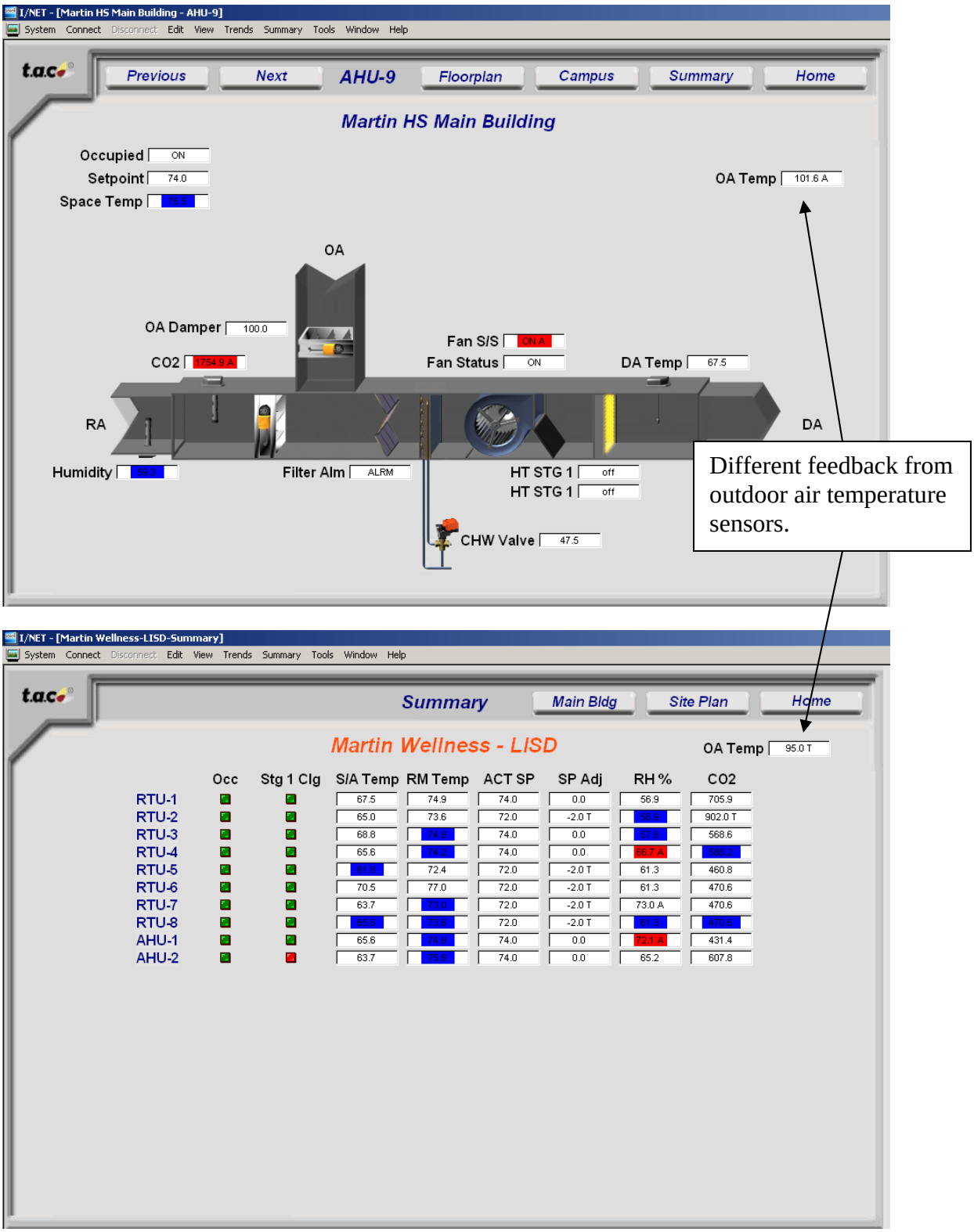


Figure 4: EMS Screenshot of Martin High School.



Figures 5 & 6: EMS Screenshots of Martin High School.

9.0 RECOMMENDED MAINTENANCE & OPERATION PROCEDURES

Good Maintenance and Operation procedures significantly improve operating economy, equipment life, and occupant comfort. Generally, maintenance and operation procedural improvements can be made with existing staff and budgetary levels. Below are typical maintenance and operations procedures that have energy savings benefits. The District may already be following some of the recommendations noted below. The following maintenance and operation procedures should be encouraged and continued to ensure sustainable energy savings.

PUBLICIZE ENERGY CONSERVATION

Promote energy awareness at regular staff meetings, on bulletin boards, and through organizational publications. Publicize energy cost reports showing uptrends and downtrends.

PERIODIC ENERGY MANAGEMENT SYSTEM (EMS) VERIFICATION

As previously discussed, the District should periodically verify the operating schedules and temperature setting of various HVAC units via the Energy Management Systems (EMS). Performing a general inspection and verification of the EMS will ensure the equipment is operating accordingly. In addition, properly setting and scheduling temperature setpoints can reduce energy consumption. For example, a one degree difference during occupied hours can result in 1% - 3% annual savings, and setting temperature settings back 10 to 15 degrees for eight hours a day (during unoccupied hours) can result in a 10% savings in cooling and heating costs.

MANAGE SMALL ELECTRICAL EQUIPMENT LOADS

Small electrical equipment loads consists of small appliances/devices such as portable heaters, microwaves, small refrigerators, coffee makers, stereos, cell phone chargers, desk lamps, etc. The District should establish a goal to reduce the number of small appliances and to limit their usage. For example, the use of small space heaters should be discouraged; hence, all space heating should be accomplished by the District's main heating system. In addition, many small devices such as radios, printers, and phone chargers can consume energy while not in use. To limit this "stand-by" power usage these devices should be unplugged or plugged into a power strip that can act as a central "turn off" point while not in use. With an effective energy awareness campaign to encourage participation, managing small electrical loads can achieve considerable energy savings.

ESTABLISH HVAC UNIT SERVICE SCHEDULES

Document schedules and review requirements for replacing filters, cleaning condensers, and cleaning evaporators. Include particulars such as filter sizes, crew scheduling, contract availability if needed, etc. Replace filters with standard efficiency pleated units. Generally, appropriate service frequencies are as follows -- filters: monthly; condensers: annually; evaporators: 5 years.

PRE-IDENTIFY PREMIUM EFFICIENCY MOTOR (PEM) REPLACEMENTS

Pre-identify supply sources and PEM stock numbers for all HVAC fan and pump motors so that as failures occur, replacement with PEM units can take place on a routine basis. As funding allows, pre-stock PEM replacements according to anticipated demand, i.e., motors in service more than 10 years, motors in stressful service, and particular motor types that are in service at several locations.

IMPROVE CONTROL OF INTERIOR & EXTERIOR LIGHTING

Establish procedures to monitor use of lighting at times and places of possible/probable unnecessary use: Offices and classes at lunchtime, maintenance shops, closets, exterior, and parking lots during daylight hours, etc. Encouraging staff (i.e. Teacher, Custodial, maintenance, and students) to participate in the District's efforts to limit unnecessary lighting use would help improve this effort.

EXTERIOR SECURITY AND SITE LIGHTING RETROFIT

Most areas in the District utilize High Intensity Discharge (HID) fixtures for exterior lighting. It is recommended that the District replace the existing HID fixtures with a combination of Pulse Start Metal Halide (MH), Light-Emitting Diode (LED), and Compact Fluorescent (CFL) fixtures suitable for the applications. Care should be used when developing a retrofit/replacement strategy so that minimum security lighting levels are not sacrificed when the retrofit is complete. Therefore, lighting levels should be calculated to determine if the post-retrofit levels are acceptable. In addition, compatibility with existing ballasts, local codes and other requirements must be verified prior to retrofitting. Nevertheless, if suitable for the application, switching to lower wattage lamps with greater lumen maintenance can have sustainable energy savings with minimal impact. The table below lists several retrofit possibilities.

SECURITY/SITE LIGHTING RETROFIT STRATEGY			
Existing Fixture	**Existing Example Lamp Type and Wattage**	**Retrofit Scope**	**Retrofit Lamp Type and Wattage**
Pole Light	400W HID	Lamp/Ballast Replacement	320W MH
Pole Light, Short	250W HID	Lamp/Ballast Replacement	200W MH
Security Wall Pack	150W/175W HID	LED Security Wall Pack Fixture Replacement	56W LED
Security Wall Pack, Low	70 HID	LED Security Wall Pack Fixture Replacement	26W LED
Security Wall Pack, Flood	250 HID	Lamp/Ballast Replacement	200W MH
Surface Mount	150W/175W HID	LED Surface Mount Fixture Replacement	56W LED
Recessed	70 HID	Lamp Replacement with CFL	50W CFL
Incandescent Wall	100W Incandescent	Lamp Replacement with CFL	26W CFL

SEPARATELY SCHEDULE TEMPERATURE CONTROL AND VENTILATION

It is typically necessary to start equipment and establish temperature control an hour or more before occupancy. Fresh air intake, however, should not begin until the occupants are due to arrive. Otherwise, fresh air is heated or cooled needlessly. In hot, humid weather, the outside air also raises the indoor humidity at a time when the cooling load is too low to produce sufficient dehumidifying effect from the cooling system.

TYPICAL EQUIPMENT MAINTENANCE CHECKLISTS

Effective operation and maintenance of equipment is one of the most cost effective ways to achieve reliability, safety, and efficiency. Failing to maintain equipment can cause significant energy waste and severely decrease the life of equipment. Substantial savings can result from good operation and maintenance procedures. In addition, such procedures require little time and cost to implement. Examples of typical maintenance checklists for common equipment including are provided in **Appendix E**. These checklists from the Federal Energy Management Program (FEMP), a branch of the Department of Energy (DOE), are based on industry standards and should supplement, not replace those provided by the manufacturer.

CONTROL OUTSIDE AIR INFILTRATION

Conduct periodic inspections of door and window weather-stripping, and schedule repairs when needed. Additionally, make sure doors and windows are closed during operation of HVAC systems (heating or cooling). Unintended outside air contributes to higher energy consumption and increases occupant discomfort.

REPLACE INCANDESCENT LAMPS WITH COMPACT FLUORESCENTS

Replace existing incandescent lamps with compact fluorescent lamps as they burn out. Compact fluorescents use 50 to 75 percent less wattage for the same light output, with ten times the operating life of incandescents.

ENERGY STAR POWER MANAGEMENT

ENERGY STAR Power Management Program promotes placing monitors and computers (CPU, hard drive, etc.) into a low-power “sleep mode” after a period of inactivity. The estimated annual savings can range from $25 to $75 per computer. ENERGY STAR recommends setting computers to enter system standby or hibernate after 30 to 60 minutes of inactivity. Simply touching the mouse or keyboard “wakes” the computer and monitor in seconds. Activating sleep features saves energy, money, and helps protect the environment.

INSTALL ENERGY SAVING DEVICES ON VENDING MACHINES

Install energy saving devices on vending machines with non-perishable food items to reduce the equipment power usage. These devices shut the vending machines down during unoccupied periods. There are several commercially available devices that can be easily installed on existing vending machines. These devices typical have a motion sensor which powers down the equipment after periods of inactivity. For example if the motion sensor does not sense activity within 15 minutes the device will shutdown the vending machine and turn on once motion is sensed. These devices range in price from $100 to $250 and have a typical annual savings of $20 to $150 per vending machine.

HAIL GUARDS ON CONDENSING AND PACKAGED ROOFTOP UNITS

When an HVAC unit is replaced the District should ensure the new unit be specified with hail guards. The hail guards protect the condensing unit’s heat exchanger coils from hail damage. Damage to the condensing unit heat exchangers reduces the efficiency of the units. If any existing unit(s) have damaged condensing coil fins, the fins should be straightened using a fin comb.

MAINTAIN INSULATION ON SPLIT A/C UNIT REFRIGERANT LINES

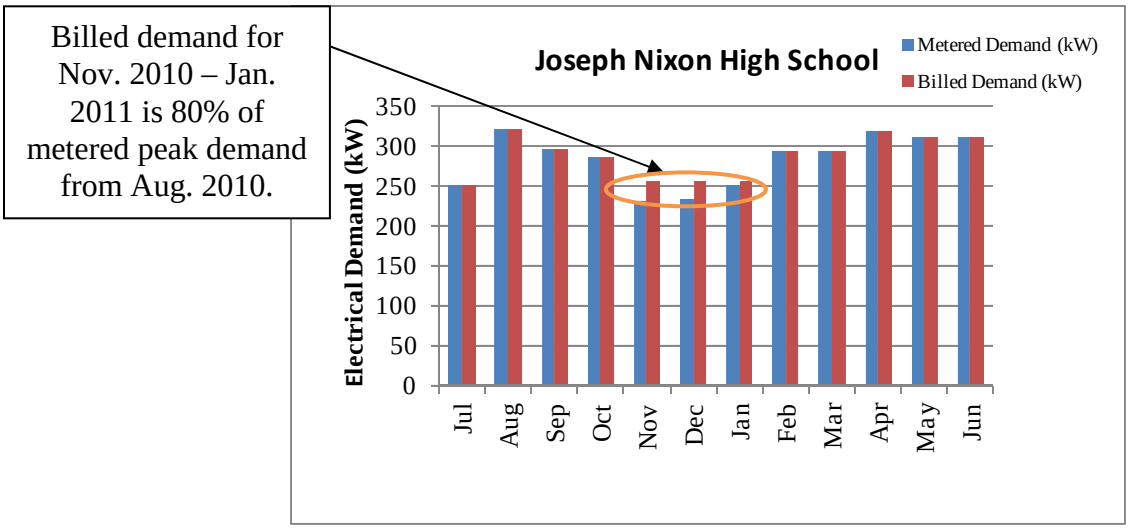
During the site visit, worn insulation was noted on split unit refrigerant lines at several facilities, as depicted below. It is recommended these lines be checked periodically and the insulation be maintained and replaced where necessary to ensure the efficiency of the units and eliminate unnecessary energy losses. In addition, it is recommended as little as possible of the refrigerant line be exposed to the elements. Overexposure increases energy losses and degrades insulation faster.

Damaged refrigerant line insulation on condensing unit at Martin High School.

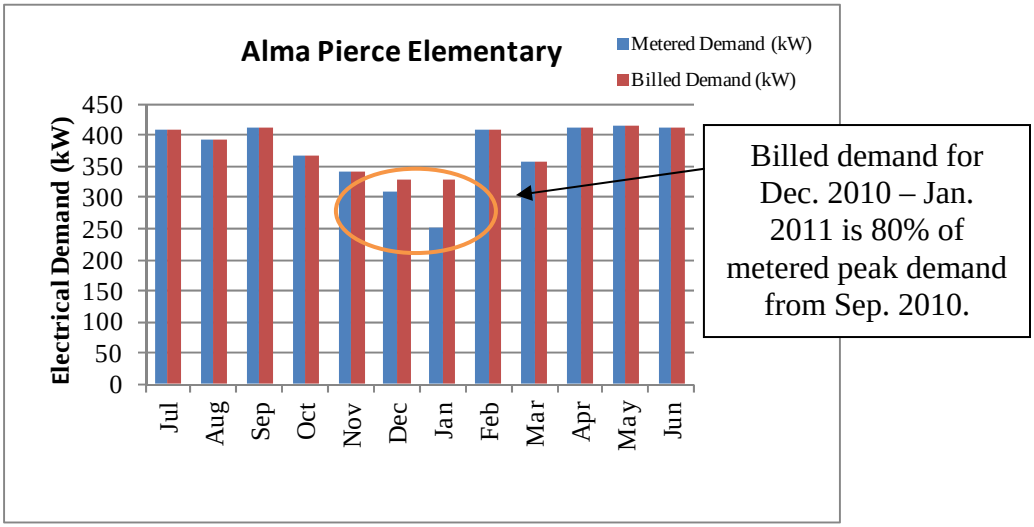
10.0 ELECTRICAL DEMAND ANALYSIS

Demand (kW) charges stem from a facility's peak power draw during a billing period, as opposed to consumption (kWh) charges, which total the energy usage over this period. The campuses analyzed in this report include electric meters that record demand.

LISD utility rates and/or contract documents were not provided. However, energy data (demand, consumption, and costs) were made available. After further analysis of monthly billed and meter demand (kW), it appears that a ratchet clause is in place as the minimum demand charge for certain months is 80% of the maximum demand charge seen during a prior period (typically summer months, from June to September) for the following campuses. The plots below show the metered demand and billed demand over a 12 month period for each campus. Notice periods of low metered demand where billed demand does not decrease. This is due to the demand ratchet. Note also the difference in demand from summer to winter. The demand increases during months of August and September, possibly due to pre-year equipment testing. These trends also suggest the District's demand peaks are primarily due to HVAC (cooling) systems.

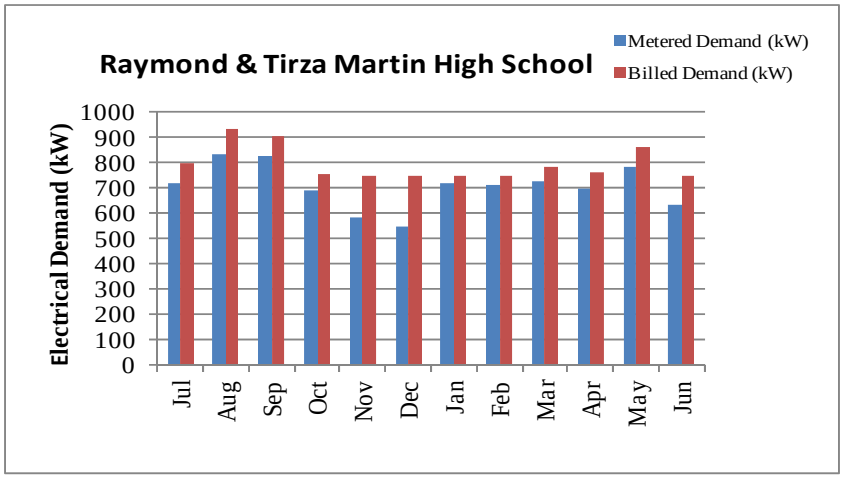


Nixon High School Account # 10032789425897518 (Main building meter)

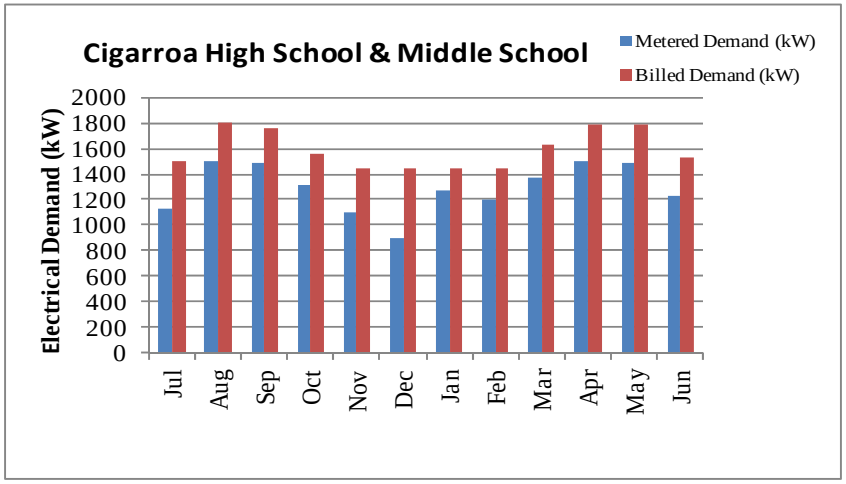


Alma Pierce Elementary Account # 10032789436035569

The plots below show the monthly metered demand and billed demand for Martin High School and Cigarroa High School and Middle School. **The billed demand is consistently higher than the metered demand throughout the year.** Detailed rate schedules were not available at the time of this report, and while a cause for this cannot be immediately inferred from the data available, **it is recommended the District research the causes for higher billed demand**.



Martin High School Account # 10032789493878471



Cigarroa High and Middle Schools Account # 10032789449347090 (Main buildings meter)

Some general recommendations for reducing demand costs include:

- Staggering HVAC equipment start up utilizing control systems.
- Installing motion sensors for lighting control to prevent unnecessary lighting on at once (see Section 11.0).
- Increasing temperature setpoints in the summer and decreasing them in the winter to reduce unit cycle times.
- During equipment startup for upcoming school year in the months of August and September, be mindful of simultaneous equipment operation as it sets potentially higher demand costs for the next few months.

11.0 UTILITY COST REDUCTION MEASURES

Utility Cost Reduction Measures (UCRMs) projects identified during the preliminary analysis are detailed below. Project cost estimates include complete design and construction management services.

REPLACE EXISTING T8 FLUORESCENT LAMPS WITH LOWER WATTAGE LAMPS

Low-wattage T8 fluorescent lamps are available in 30, 28 and 25-watt versions. It is recommended the District replace existing 32-watt T8 Fluorescent lamps with lower wattage lamps in most cases. However, lower wattage T8 lamps have reduced lighting levels, so it is important to ensure recommended lighting levels are maintained. Lighting levels should be verified prior to lamp replacement. In addition, compatibility with existing ballasts, local codes and other requirements must be verified prior to retrofitting. Nevertheless, if suitable for the application, switching to lower wattage T8 lamps will have sustainable energy savings with minimal impact. For example, replacing a 32-watt T8 lamp with a 28-watt T8 lamp will approximately have a 12% lighting energy reduction with only a lighting level drop near 4%.

The estimated costs and savings noted below are based on replacement of existing 32-watt T8 lamps and does not account for ballast replacements. Estimates are based on a preliminary walkthrough of the facilities. A detailed lighting analysis will be required to determine exact cost, quantities, and configuration to maximize the energy savings and lighting performance. The cost and savings calculations below are based on 48” F28T8, extended life linear fluorescent lamps. Lamp recycling is included in the cost estimates.

T8 TO LOW WATTAGE T8 FLUORESCENT LIGHTING RETROFIT				
Building	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Estimated Annual MMBTU Savings (MMBTU/yr)**	**Simple Payback (years)**
Joseph Nixon High School*	$40,600	$9,000	268	4.5
Raymond & Tirza Martin High School	$56,400	$12,500	379	4.5
Cigarroa High School	$79,300	$15,900	481	5.0
Alma Pierce Elementary	$21,100	$3,800	117	5.6
TOTAL	**$197,400**	**$41,200**	**1,245**	**4.8**

*Pertains to portion of existing buildings not scheduled for redesign.

GYMNASIUM HID TO FLUORESCENT FIXTURE LIGHTING RETROFIT

Some gyms and other large interior spaces in the District utilize High Intensity Discharge (HID) fixtures for light. It is recommended that the District replace the existing HID fixtures with T5HO fluorescent fixtures suitable for gym applications. Fluorescent fixtures offer improved control, reduce energy consumption, and improve lighting levels. In addition, due to the long re-strike times associated with HID fixtures, they cannot be effectively switched on/off during unoccupied periods. This causes the HID lamps to operate longer, which both consumes more energy and affects lamp life. The cost and savings estimates below are based on preliminary observations and analysis. Note that fixtures selected for unheated spaces or where subject to abuse (like gyms) will require special features.

HID TO FLUORESCENT LIGHTING RETROFIT				
Building	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Estimated Annual MMBTU Savings (MMBTU/yr)**	**Simple Payback (years)**
Joseph Nixon High School*	$8,400	$1,100	33	7.6
Raymond & Tirza Martin High School	$32,800	$5,000	152	6.6
Cigarroa High School	$11,200	$1,300	39	8.6
Alma Pierce Elementary	$8,000	$1,000	31	8.0
TOTAL	**$60,400**	**$8,400**	**254**	**7.2**

*Pertains to gymnasium not scheduled for redesign.

INSTALLATION OF OCCUPANCY SENSORS FOR INDOOR LIGHTING CONTROL

The District should consider installing occupancy sensors to improve control of interior lighting. Occupancy sensors will help ensure lights are only on when the space is occupied. The table below provides estimated costs and energy savings for the installation of these sensors. Please note these estimates are based on a preliminary assessment. Exact sensor locations, technology (Infrared, Ultrasonic, and Dual Technology), and quantity can be determined during a detailed energy assessment or design phase. In general, enclosed areas with intermittent use are typically good candidates for occupancy sensors (e.g. classrooms). The costs below reflect ceiling mounted occupancy sensors.

MOTION SENSOR INSTALLATION				
Building	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Estimated Annual MMBTU Savings (MMBTU/yr)**	**Simple Payback (years)**
Joseph Nixon High School*	$8,800	$1,800	54	4.9
Raymond & Tirza Martin High School	$19,800	$3,000	91	6.6
Cigarroa High School	$20,900	$3,300	100	6.3
Alma Pierce Elementary	$11,400	$1,600	49	7.1
TOTAL	**$60,900**	**$9,700**	**294**	**6.3**

*Pertains to portion of existing buildings not scheduled for redesign.

REPLACE HVAC SYSTEMS

Replace existing HVAC units with new high efficiency units at the facilities indicated in the table below. The existing systems are inefficient and are beyond their useful life. Units to be replaced consist of four (4) Split-DX systems totaling approximately 50 tons. The average system age is 18 years. The table below summarizes the estimated cost and savings for replacing the units indentified in the school.

HVAC REPLACEMENT				
Building	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Estimated Annual MMBTU Savings (MMBTU/yr)**	**Simple Payback (years)**
Raymond & Tirza Martin High School	$160,000	$9,100	276	17.6
TOTAL	**$160,000**	**$9,100**	**276**	**17.6**

HVAC SYSTEMS COMMISSIONING (Cx)

Detailed HVAC & Control system commissioning in an existing building involves analysis of existing systems to ensure compliance with original set-up/design conditions and, where feasible, conducting basic research to adjust operating parameters to enhance comfort and reduce energy consumption. Overall, the goal of commissioning is to deliver a facility that operates as it was intended, meets the needs of the building owner and occupants, and provides training of facility operators. To reach this goal it is necessary for the commissioning process to provide documentation and verification of the performance of all building equipment and systems. For the process to work successfully it is equally important to have good communications between all participants (owners, operators, and the commissioning agent) and to keep all parties involved and informed of all pertinent decisions. For general information on Commissioning, please refer to Appendix G.

HVAC Retro-commissioning (RCx) involves the optimization of an existing building's energy usage through testing and documentation. Typically, this procedure will review and improve a building's energy consumption levels by documenting staff and occupant observations as well as improving the building systems to meet the original design intent. This process is ideal for buildings that have not been commissioned previously.

Preliminary examination (utility data review, discussion with staff, EMS review, and walkthrough) of Laredo ISD facilities indicate potential for energy cost savings primarily in the HVAC systems operations. The facilities would greatly benefit by implementing a building Retro-Commissioning (Cx) program that ensures the optimization of HVAC systems for the building's existing conditions, works to improve the building air quality, increase comfort levels, and resolve any operating problems. The Commissioning program requires collaborative efforts between the commissioning engineers and the facility staff, and is an ongoing process that continues to both commission the building as well as train the facility staff.

The cost and savings estimates presented here are for a comprehensive commissioning program. The project implementation duration is typically 10 to 12 months. The following estimates are based on a preliminary walkthrough, available utility data analysis, and discussion with staff. Project, if authorized, would normally be accomplished by an organization/firm with engineers specializing in enhanced commissioning techniques and project implementation. The table below summarizes the implementation costs, annual savings, and payback for a comprehensive commissioning program at each campus. *Note: The table below includes estimated budget/cost for deferred maintenance items. Deferred maintenance budget is for repair items (such as sensor replacement, damper repair, etc.) identified by the commissioning team that the Owner needs to address.*

BUILDING COMMISSIONING (Cx)				
Building	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Estimated Annual MMBTU Savings (MMBTU/yr)**	**Simple Payback (years)**
Raymond & Tirza Martin High School	$105,300	$21,100	640	5.0
Cigarroa High School	$121,200	$22,000	666	5.5
Alma Pierce Elementary	$34,700	$5,300	163	6.5
Deferred Maintenance / Repair Costs for three campuses	$52,240	-	-	-
TOTAL	**$313,440**	**$48,400**	**1,468**	**6.5**

The following table summarizes the implementation costs, annual savings, and simple payback for the above projects:

SUMMARY OF ENERGY COST REDUCTION MEASURES				
Project Description	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Estimated Annual MMBTU Savings (MMBTU/yr)**	**Simple Payback (years)**
T8 TO LOW WATTAGE T8 FLUORESCENT LIGHTING RETROFIT	$197,400	$41,200	1,245	4.8
HID TO FLUORESCENT LIGHTING RETROFIT	$60,400	$8,400	254	7.2
MOTION SENSOR INSTALLATION	$60,900	$9,700	294	6.3
HVAC REPLACEMENT	$160,000	$9,100	276	17.6
BUILDING COMMISSIONING (Cx)	$313,440	$48,400	1,468	6.5
TOTAL:	**$792,140**	**$116,800**	**3,537**	**6.8**

The above projects implementation costs and annual savings are estimated based on a preliminary examination of the facilities. Furthermore, detailed assessment, contingency & any project administration costs and maintenance savings are not included in this preliminary energy assessment. Final costs will be determined from detailed building assessments, engineering calculations, and contractor estimates.

Project design (drawings and specifications), if authorized, would normally be accomplished by professional engineers. Project acquisition (competitive bidding) would be in accordance with District requirements, and construction management would be provided by the engineering group who prepared the drawings and specifications.

12.0 ENERGY MANAGEMENT POLICY

By requesting this study, the District has demonstrated interest in taking a more aggressive approach to energy management. In order to establish an effective Energy Management Program it should have support from top management. An Energy Management Policy adopted by the school board sends a strong signal that energy management is an institutional priority. A formal Energy Management Policy can be as simple as a two-page document that clearly states the District's energy management objectives. The policy should cover items such as:

- who is accountable for energy management
- what your energy savings targets are
- how you will monitor, review and report on progress
- staffing and training to support the policy
- criteria for energy management investment
- working energy efficiency into new capital investments

Along with a clear energy **policy** an energy management **plan** should be developed to ensure sustained energy savings. The energy management plan is a document that details roles, responsibilities, and objectives. Following are key items that should be included in an energy management plan:

1. ESTABLISH ROUTINE ENERGY TRACKING AND REPORTING PROCEDURES
   Establishing a procedure to monitor energy usage and cost will help identify energy use patterns. The data will also help determine the effectiveness of the Energy Management Program.

2. ESTABLISH AN ENERGY MANAGEMENT STEERING COMMITTEE
   The Energy Management Steering Committee will include representatives from a cross section of the District. The steering committee will serve as a review board to evaluate all energy management recommendations before adoption and implementation. The steering committee will meet quarterly or semiannually to review the District's energy cost and consumption. Regular meetings will ensure the Districts goals are being met prior to the end of the year.

3. PROMOTE ENERGY AWARENESS
   The energy management steering committee members shall establish a program to publicize the District's energy goals and progress on a quarterly or semiannually basis. For example, student drawn posters of the District's energy savings can be placed in hallways. This will encourage student involvement and act as an educational tool. Continuous promotion of the District's goals will ensure the sustainability of the energy management program and help achieve further energy savings.

4. ESTABLISH ACCEPTABLE EQUIPMENT PARAMETERS
   Establish a District-wide uniform temperature set point for all HVAC units. Having a standard setpoint will help keep HVAC runtimes to a minimum. The following are some suggested temperature settings, however, the district will need to monitor and ensure that other building parameters (humidity levels etc.) are within acceptable limits. Also, areas

with special equipment (MDF/IDF, server rooms, etc.) or materials (wood flooring, paper storage, etc.) shall be maintained at the equipment supplier's recommended settings and settings appropriate to the material.

Occupied Cooling Temperature Setpoints:

Instructional Areas	73 F – 76 F
Admin Areas	72 F – 76 F

Unoccupied Cooling Temperature Setpoints:

Instructional Areas	85 F
Admin Areas	85 F

Occupied Heating Temperature Setpoints:

Instructional Areas	67 F – 69 F
Admin Areas	67 F – 69 F

Unoccupied Heating Temperature Setpoints:

Instructional Areas	55 F
Admin Areas	55 F

5. DISALLOW OR DISCOURAGE PERSONAL APPLIANCES

Establish a policy that prohibits use of personal appliances by District staff, such as mini refrigerators and space heaters. Alternatively, establish disincentives such as a periodic fee for use of such appliances. Collected fees could be used for energy awareness and management in other areas.

6. STAFF INCENTIVES AND RECOGNITION PROGRAM

Establishing a student, staff, and campus incentive and recognition program would help promote and encourage support from staff and custodial members. The District may consider implementing a staff incentive and recognition program. Following are some program examples.

- The energy accounting system can be used to monitor cost savings and compare it to the base year consumption. An energy incentive plan consisting of a 50-50 sharing with the school campus and the Energy Management Program could be employed. The school would get 50% of the savings resulting from energy cost reduction. The school would be free to use the money for educational programs such as materials, supplies, etc. The other 50% would be used for continuing energy management efforts. On the following page is an example of the Building savings summary report.

EXAMPLE:

High School - Annual Total Electric Cost

Baseline (2006 - 07)	Current (2007 - 08)	Savings	50% Savings
$248,483	$240,483	$8,000	$4,000

In this example, the High School saved $8,000 where 50% ($4,000) will be assigned to the school. This money would be paid in October of the following fiscal year.

- An energy flag program should be implemented. There would be three energy flags, one flag per each grade level. An energy flag would be awarded to the schools exhibiting the greatest percentage reduction in energy costs. Energy flags would be awarded on a rotating basis each summer. In order to provide motivation, maintain enthusiasm, and recognize individuals doing their part to save the District taxpayers money through the Energy Management Program, the local media (including district newsletters) should be informed of the energy flag results. The energy flags would be awarded in January and August of each year based on the energy consumption of the previous four months.

- The successes of the program should also be communicated to the public through the media to show what the District is doing to reduce costs to taxpayers.

7. NEW BUILDING AND CONSTRUCTION

Ensure proper maintenance and operation of energy using equipment in new buildings by required adequate documentation of all systems and control strategies, specifying minimum content of M&O manuals; specifying contractor requirements for cleaning and adjusting equipment prior to occupancy; specifying on-site vendor training for M&O staff; and requiring as-built drawings.

8. ESTABLISH A WATER MANAGEMENT PROGRAM

Along with saving energy the District should establish a program to reduce water consumption. The following conservation measures should be employed.

a. Investigate the use of water conserving faucets, showerheads, and toilets in all new and existing facilities.
b. Utilize water-pervious materials such as gravel, crushed stone, open paving blocks or previous paving blocks for walkways and patios to minimize runoff and increase infiltration.
c. Employ Xeriscaping, using native plants that are well suited to the local climate, that are drought-tolerant and do not require supplemental irrigation.
d. Utilize drip irrigation systems for watering plants in beds and gardens.
e. Install controls to prevent irrigation when the soil is wet from rainfall.
f. Establish a routine check of water consuming equipment for leaks and repair equipment immediately.

13.0 FUNDING OPTIONS FOR UTILITY REDUCTION MEASURES

Institutional organizations have traditionally tapped bond money, maintenance dollars, or federal grants to fund energy-efficient equipment change outs or additions such as energy-efficient lighting systems, high efficiency air conditioning units, and computerized energy management control systems. Today, a broader range of funding options are available. A number of these are listed below.

Texas LoanSTAR Program

The LoanSTAR (Saving Taxes and Resources) Program, which is administered by the State Energy Conservation Office, finances energy-efficient building retrofits at a low interest rate (typically 3 percent). The program's revolving loan mechanism allows borrowers to repay loans through the stream of cost savings realized from the projects. Projects financed by LoanSTAR must have an average simple payback of ten years or less and must be analyzed in an Energy Assessment Report by a Professional Engineer. Upon final loan execution, the School District proceeds to implement funded projects through the traditional bid/specification process. Contact: Eddy Trevino (512/463-1876).

Internal Financing

Improvements can be paid for by direct allocations of revenues from an organization's currently available operating or capital funds (bond programs). The use of internal financing normally requires the inclusion and approval of energy-efficiency projects within an organization's annual operating and capital budget-setting process. Often, small projects with high rate of return can be scheduled for implementation during the budget year for which they are approved. Large projects can be scheduled for implementation over the full time period during which the capital budget is in place. Budget constraints, competition among alternative investments, and the need for higher rates of return can significantly limit the number of internally financed energy-efficiency improvements.

Private Lending Institutions or Leasing Corporations

Banks, leasing corporations, and other private lenders have become increasingly interested in the energy efficiency market. The financing vehicle frequently used by these entities is a municipal lease. Structured like a simple loan, a municipal leasing agreement is usually a lease-purchase arrangement. Ownership of the financed equipment passes to the School District at the beginning of the lease, and the lessor retains a security interest in the purchase until the loan is paid off. A typical lease covers the total cost of the equipment and may include installation costs. At the end of the contract period the lessee pays a nominal amount, usually a dollar, for title to the equipment.

Performance Contracting with an Energy Service Company

Through this arrangement, an energy service company (ESCO) uses third party financing to implement a comprehensive package of energy management retrofits for a facility. This turnkey service includes an initial assessment by the contractor to determine the energy-saving potential for a facility, design work for identified projects, purchase and installation of equipment, and

overall project management. The ESCO guarantees that the cost savings generated by the projects will, at a minimum, cover the annual payment due to the ESCO over the term of the contract.

Utility Sponsored Energy Efficiency Incentive Programs

Many utilities in Texas offer energy efficiency incentive programs to offset a portion of the upfront cost associated with energy efficiency measures. The program requirements and incentives range from utility to utility. For example, CenterPoint Energy provides incentives for efficiency measures such as installation of high efficiency equipment, lighting upgrades, and building commissioning. These energy efficiency programs' incentives typically cover $0.06/kWh and $175/kW of verifiable energy and demand reductions, respectively. For further information, contact your utility provider to determine what programs are available in your area.

APPENDICES

APPENDIX A

ENERGY LEGISLATION
(SB12, HB3693 AND SB300)

How to comply with SB12 & HB 3693

What you need to know about Texas Senate Bill 12

The passage of Senate Bill 12 (SB12) by the 80th Texas Legislature signified the continuance of Senate Bill 5 (SB5), the 77th Texas Legislature's sweeping approach in 2001 to clean air and encourage energy efficiency in Texas. SB12 was enacted on September 1, 2007 and was crafted to continue to assist the state and its political jurisdictions to conform to the standards set forth in the Federal Clean Air Act. The bill contains energy-efficiency strategies intended to decrease energy consumption while improving air quality.

All political subdivisions in the 41 non-attainment or near non-attainment counties in Texas are required to:

*1) Adopt a goal to reduce electric consumption by 5 percent each year for six years, beginning September 1, 2007**

2) Implement all cost-effective energy-efficiency measures to reduce electric consumption by existing facilities. (Cost effectiveness is interpreted by this legislation to provide a 20 year return on investment.)

3) Report annually to the State Energy Conservation Office (SECO) on the entity's progress, efforts and consumption data.

*Note: The recommended baseline data for those reporting entities will consist of the jurisdiction's 2006 energy consumption for its facilities and based on the State Fiscal Year (September 1, 2006 to August 31, 2007).

What you need to know about Texas House Bill 3693

The passage of House Bill 3693 (HB3693) by the 80th Texas Legislature is intended to provide additional provisions for energy-efficiency in Texas. Adopted with an effective date of September 1, 2007, HB 3693 is an additional mechanism by which the state can encourage energy-efficiency through various means for School Districts, State Facilities and Political Jurisdictions in Texas.

HB 3693 includes the following state-wide mandates that apply differently according to the nature and origin of the entity:

Record, Report and Display Consumption Data
All Political Subdivisions, School Districts and State-Funded Institutes of Higher Education, are mandated to record and report the entity's metered resource consumption usage data for electricity, natural gas and water on a publically accessible internet page.
Note: The format, content and display of this information are determined by the entity or subdivision providing this information.

Energy Efficient Light Bulbs
All School Districts and State-Funded Institutes of Higher Education shall purchase and use energy-efficient light bulbs in education and housing facilities.

Who must comply?
The provisions in this bill will apply to entities including: Cities and Counties; School Districts; Institutes of Higher Education; State Facilities and Buildings.

How do you define energy-efficiency measures?

Energy-efficiency measures are defined as any facility modifications or changes in operations that reduce energy consumption. Energy-efficiency is a strategy that has the potential to conserve resources, save money** and better the quality of our air. They provide immediate savings and add minimal costs to your project budget.

Examples of energy-efficiency measures include:

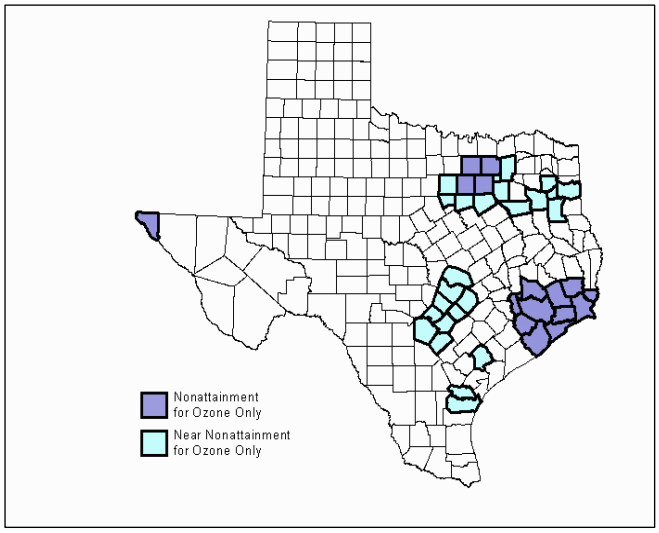
• installation of insulation and high-efficiency windows and doors • modifications or replacement of HVAC systems, lighting fixtures and electrical systems • installation of automatic energy control systems • installation of energy recovery systems or renewable energy generation equipment • building commissioning • development of energy efficient procurement specifications • employee awareness campaigns

***SECO's Preliminary Energy Assessment (PEA) program is an excellent resource for uncovering those energy-efficiency measures that can benefit your organization.*

What counties are affected?

All political jurisdictions located in the following Non-attainment and affected counties:

Bastrop Bexar Brazoria Caldwell Chambers Collin
Comal Dallas Denton El Paso Ellis Fort Bend
Galveston Gregg Guadalupe Hardin Harris Harrison
Hays Henderson Hood Hunt Jefferson Johnson
Kaufman Liberty Montgomery Nueces Orange Parker
Rockwall Rusk San Patricio Smith Tarrant Travis
Upshur Victoria Waller Williamson Wilson



What assistance is available for affected areas?

The Texas Energy Partnership is a partner with Energy Star©, who partners across the nation with the goal of improving building performance, reducing air emissions through reduced energy demand, and enhancing the quality of life through energy-efficiency and renewable energy technologies.

To assist jurisdictions, the Texas Energy Partnership will:

- Present workshops and training seminars in partnership with private industry on a range of topics that include energy services, financing, building technologies and energy performance rating and benchmarking

- Prepare information packages – containing flyers, documents and national lab reports about energy services, management tools and national, state and industry resources that will help communities throughout the region

- Launch an electronic newsletter to provide continuous updates and develop additional information packages as needed

Please contact Stephen Ross at 512-463-1770 for more information.

SECO Program Contact Information

LoanSTAR;
Preliminary Energy Assessments:
Eddy Trevino - 512-463-1876
Eddy.Trevino@cpa.state.tx.us

Schools Partnership Program:
Stephen Ross – 512-463-1770
Stephen.Ross@cpa.state.tx.us

Engineering (Codes / Standards):
Felix Lopez - 512-463-1080
Felix.Lopez@cpa.state.tx.us

Innovative / Renewable Energy:
Pamela Groce - 512-463-1889
pam.groce@cpa.state.tx.us

Energy / Housing
Partnership Programs:
Stephen Ross - 512-463-1770
Stephen.Ross@cpa.state.tx.us

Alternate Fuels / Transportation:
Venita Porter - 512-463-1779
Venita.Porter@cpa.state.tx.us

BILL ANALYSIS

Senate Research Center

S.B. 300
By: Patrick, Dan
Education
7/1/2009
Enrolled

AUTHOR'S / SPONSOR'S STATEMENT OF INTENT

Many independent school districts across Texas are reporting severe financial difficulties due to several factors, including the requirement to fulfill unfunded mandates. These mandates are particularly burdensome to fast-growth school districts. In a difficult economic climate and with dwindling resources, districts are forced to fulfill unnecessary mandates rather than focus on their basic mission, which is to educate students.

S.B. 300 amends current law relating to eliminating or modifying certain mandates on school districts.

RULEMAKING AUTHORITY

This bill does not expressly grant any additional rulemaking authority to a state officer, institution, or agency.

SECTION BY SECTION ANALYSIS

SECTION 1. Amends Section 11.1513(d), Education Code, as follows:

(d) Requires that the employment policy provide that not later than the 10th school day before the date on which a district fills a vacant position for which a certificate or license is required as provided by Section 21.003, other than a position that affects the safety and security of students as determined by the board of trustees, the district is required to provide to each current district employee notice of the position by posting the position on a bulletin board at certain locations or, rather than and, the district's Internet website, if the district has a website, and a reasonable opportunity to apply for the position.

SECTION 2. Amends Section 25.112, Education Code, by amending Subsection (d) and adding Subsections (e)-(g), as follows:

(d) Authorizes the commissioner of education (commissioner), on application of a school district (district), to except the district from the limit in Subsection (a) (relating to the prohibition of more than 22 students enrolled in an elementary school class) if the commissioner finds the limit works an undue hardship on the district. Provides that an exception expires at the end of the school year for which it is granted. Deletes existing text providing that an exception expires at the end of the semester for which it is granted, and prohibiting the commissioner from granting an exception for more than one semester at a time.

(e) Requires a district seeking an exception under Subsection (d) to notify the commissioner and apply for the exception not later than the later of October 1 or the 30th day after the first school day the district exceeds the limit in Subsection (a).

(f) Authorizes the commissioner, if a district repeatedly fails to comply with this section, to take any appropriate action authorized to be taken by the commissioner under Section 39.131 (Sanctions for Districts).

(g) Requires the Texas Education Agency, not later than January 1, 2011, to report to the legislature the number of applications for exceptions under Subsection (d) submitted by

each district and for each application indicate whether the application was granted or denied. Provides that this subsection expires February 1, 2011.

SECTION 3. Amends Section 34.0021, Education Code, by amending Subsections (a) and (b) and adding Subsection (c-1), as follows:

(a) Authorizes, rather than requires, each school district, pursuant to the safety standards established by the Department of Public Safety under Section 34.002, to conduct a training session for students and teachers concerning procedures for evacuating a school bus during an emergency.

(b) Provides that a school district that chooses to conduct a training session under Subsection (a) is encouraged to conduct the school bus emergency evacuation training session in the fall of the school year. Provides that the school district is also encouraged to structure the training session so that the session applies to school bus passengers, a portion of the session occurs on a school bus, and the session lasts for at least one hour. Deletes existing text requiring a school district to conduct the school bus emergency evacuation training at least twice each school year, with one training session occurring in the fall and one training session occurring in the spring. Deletes existing text requiring that a portion of the training session occur on a school bus and requiring the training session to last for at least one hour.

(c-1) Provides that a school district, immediately before each field trip involving transportation by school bus, is encouraged to review school bus emergency evacuation procedures with the school bus passengers, including a demonstration of the school bus emergency exits and the safe manner to exit.

SECTION 4. Amends Section 44.902, Education Code, as follows:

Sec. 44.902. New heading: LONG-RANGE ENERGY PLAN TO REDUCE CONSUMPTION OF ELECTRIC ENERGY. (a) Creates this subsection from existing text. Requires the board of trustees of a district to establish a long-range energy plan to reduce the district's annual electric consumption by five percent beginning with the 2008 state fiscal year and consume electricity in subsequent fiscal years in accordance with the district's energy plan. Deletes existing text requiring the board of trustees of a district to establish a goal to reduce the school district's annual electric consumption by five percent each state fiscal year for six years beginning September 1, 2007.

(b) Requires that the plan required under Subsection (a) include strategies for achieving energy efficiency that result in net savings for the district or can be achieved without financial cost to the district and for each strategy identified under Subdivision (1), the initial, short-term capital costs and lifetime costs and savings that may result from implementation of the strategy.

(c) Requires the board of trustees, in determining under Subsection (b) whether a strategy may result in financial cost to the district, to consider the total net costs and savings that may occur over the seven-year period following implementation of the strategy.

(d) Authorizes the board of trustees to submit the plan required under Subsection (a) to the State Energy Conservation Office for the purposes of determining whether funds available through loan programs administered by the office are available to the district.

SECTION 5. Repealer: Section 44.901(b) (regarding the requirement that the board of trustees establish a goal to reduce electric consumption by five percent each year for six years), Education Code.

SECTION 6. Provides that this Act applies beginning with the 2009-2010 school year.

SECTION 7. Effective date: upon passage or September 1, 2009.

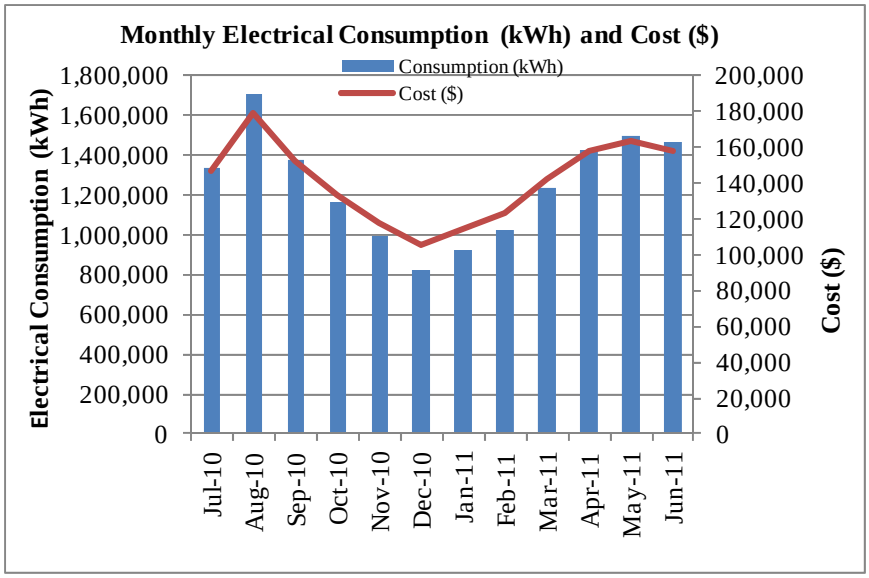
APPENDIX B

SAMPLE UTILITY DATA REPORTING FORM

Laredo ISD - Sample Utility Input Form

MONTH	ELECTRICITY		
	KWH	COST $	Avg. Rate $/KWH
Jul-10	1,339,428	146,833	$0.1096
Aug-10	1,704,237	179,331	$0.1052
Sep-10	1,380,382	152,511	$0.1105
Oct-10	1,169,341	133,000	$0.1137
Nov-10	989,609	117,663	$0.1189
Dec-10	820,816	105,575	$0.1286
Jan-11	920,269	114,046	$0.1239
Feb-11	1,028,718	122,786	$0.1194
Mar-11	1,237,146	141,711	$0.1145
Apr-11	1,427,897	157,634	$0.1104
May-11	1,491,860	163,588	$0.1097
Jun-11	1,461,954	158,010	$0.1081
Total	14,971,657	$1,692,688	$0.1131

Gross Building Area:	1,196,529	SF



APPENDIX C

BASE YEAR CONSUMPTION HISTORY

Energy Cost and Consumption Benchmarks									
		Electric				Total	EUI	ECI	
	Building	kWh/Yr	MMBTU/Yr	kWh/SF	$Cost/Yr	MMBTU/Yr	kBTU/SF/Yr	$/SF/Yr	SF
1	Joseph Nixon High School	4,052,132	13,830	12.12	464,064	13,830	41	1.39	334,271
2	Raymond & Tirza Martin High School	4,337,771	14,805	14.01	487,877	14,805	48	1.58	309,569
3	Cigarroa High School & Middle School	5,606,754	19,136	12.03	632,284	19,136	41	1.36	466,000
4	Alma Pierce Elementary	975,000	3,328	11.25	108,463	3,328	38	1.25	86,689
		kWh/Yr	MMBTU/Yr	kWh/SF	$Cost/Yr	MMBTU/Yr	kBTU/SF/Yr	$/SF/Yr	SF
		14,971,657	51,098	12.51	1,692,688	51,098	43	1.41	1,196,529

District: Laredo ISD

ACCOUNT# 10032789419600065 10032789425897518
10032789485515260 10032789485982135
10032789487926111 10032789407453835
10032789411395060 10032789443682010 Electric
Gas

BUILDING: Joseph Nixon High School

FLOOR AREA: 334,271 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND (*)			TOTAL ALL		
		CONSUMPTION	METERED	BILLED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
Jul	2010	356,328		1,484		$39,688	0	$0
Aug	2010	497,740		1,646		$52,267	0	$0
Sep	2010	351,044		1,530		$39,471	0	$0
Oct	2010	286,284		1,496		$33,904	0	$0
Nov	2010	257,440		1,431		$30,785	0	$0
Dec	2010	249,204		1,462		$30,692	0	$0
Jan	2011	282,352		1,584		$34,376	0	$0
Feb	2011	275,456		1,507		$33,529	0	$0
Mar	2011	384,508		1,592		$43,110	0	$0
Apr	2011	353,876		1,648		$40,884	0	$0
May	2011	398,084		1,648		$44,385	0	$0
Jun	2011	359,816		1,615		$40,973	0	$0
TOTAL		4,052,132				$464,064	0.0	$0

Annual Total Energy Cost = 464,064 $/year

Total KWH/yr x 0.003413 = 13,829.93 MMBTU/year
Total MCF/yr x 1.03 = 0.00 MMBTU/year
Total Other x_____ = 0.0 MMBTU/year
Total Site MMBTU's/yr = 13,830 MMBTU/year

Energy Use Index:
Total site BTU's/Yr ÷ Total Area (SF) = 41 kBTU/SF/year

Energy Cost Index:
Total Energy Cost/Yr ÷ Total Area (SF) = 1.39 $/SF/year

Electric Utility: AEP & Just Energy

Gas Utility:

District: Laredo ISD

ACCOUNT# 10032789409411698 10032789449605600 Electric
10032789493878471 10032789444046301 Gas

BUILDING: Raymond & Tirza Martin High School

FLOOR AREA: 309,569 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	BILLED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
Jul	2010	412,814		1,586		$44,394	0	$0
Aug	2010	469,698		1,803		$50,308	0	$0
Sep	2010	402,188		1,725		$44,394	0	$0
Oct	2010	362,699		1,492		$39,830	0	$0
Nov	2010	300,908		1,487		$35,060	0	$0
Dec	2010	242,355		1,452		$30,583	0	$0
Jan	2011	274,228		1,452		$32,831	0	$0
Feb	2011	306,056		1,455		$35,667	0	$0
Mar	2011	329,732		1,529		$38,217	0	$0
Apr	2011	424,282		1,579		$45,887	0	$0
May	2011	400,825		1,775		$45,392	0	$0
Jun	2011	411,986		1,624		$45,313	0	$0
TOTAL		4,337,771				$487,877	0.0	$0

Annual Total Energy Cost = 487,877 $/year

Total KWH/yr x 0.003413 = 14,804.81 MMBTU/year
Total MCF/yr x 1.03 = 0.00 MMBTU/year
Total Other x_____ = 0.0 MMBTU/year
Total Site MMBTU's/yr = 14,805 MMBTU/year

Energy Use Index:
Total site BTU's/Yr ÷ Total Area (SF) = 48 kBTU/SF/year

Energy Cost Index:
Total Energy Cost/Yr ÷ Total Area (SF) = 1.58 $/SF/year

Electric Utility: AEP & Just Energy

Gas Utility:

10032789415011769 10032789432669076
10032789449347090 10032789479165287

District: Laredo ISD

ACCOUNT# 10032789456523306 Electric

Gas

BUILDING: Cigarroa High School & Middle School

FLOOR AREA: 466,000 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	BILLED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
Jul	2010	484,786		2,003		$53,136	0	$0
Aug	2010	642,899		2,377		$66,691	0	$0
Sep	2010	519,150		2,314		$57,470	0	$0
Oct	2010	424,358		2,097		$49,327	0	$0
Nov	2010	362,261		1,974		$44,018	0	$0
Dec	2010	269,257		1,956		$37,262	0	$0
Jan	2011	313,289		1,973		$40,580	0	$0
Feb	2011	380,306		1,954		$45,349	0	$0
Mar	2011	452,106		2,194		$52,270	0	$0
Apr	2011	558,239		2,353		$60,807	0	$0
May	2011	602,351		2,352		$63,781	0	$0
Jun	2011	597,752		2,064		$61,593	0	$0
TOTAL		5,606,754				$632,284	0.0	$0

Annual Total Energy Cost = 632,284 $/year

Total KWH/yr x 0.003413 = 19,135.85 MMBTU/year
Total MCF/yr x 1.03 = 0.00 MMBTU/year
Total Other x_____ = 0.0 MMBTU/year
Total Site MMBTU's/yr = 19,136 MMBTU/year

Energy Use Index:
Total site BTU's/Yr ÷ Total Area (SF) = 41 kBTU/SF/year

Energy Cost Index:
Total Energy Cost/Yr ÷ Total Area (SF) = 1.36 $/SF/year

Electric Utility: AEP & Just Energy

Gas Utility:

District: Laredo ISD

ACCOUNT# 10032789436035569 Electric

Gas

BUILDING: Alma Pierce Elementary

FLOOR AREA: 86,689 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	BILLED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
Jul	2010	85,500		411		$9,615	0	$0
Aug	2010	93,900		394		$10,065	0	$0
Sep	2010	108,000		412		$11,176	0	$0
Oct	2010	96,000		367		$9,938	0	$0
Nov	2010	69,000		341		$7,800	0	$0
Dec	2010	60,000		330		$7,038	0	$0
Jan	2011	50,400		330		$6,258	0	$0
Feb	2011	66,900		410		$8,240	0	$0
Mar	2011	70,800		357		$8,114	0	$0
Apr	2011	91,500		412		$10,055	0	$0
May	2011	90,600		416		$10,030	0	$0
Jun	2011	92,400		414		$10,131	0	$0
TOTAL		975,000				$108,463	0.0	$0

Annual Total Energy Cost = 108,463 $/year

Total KWH/yr x 0.003413 = 3,327.68 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 3,328 MMBTU/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 38 kBTU/SF/year

Energy Cost Index:

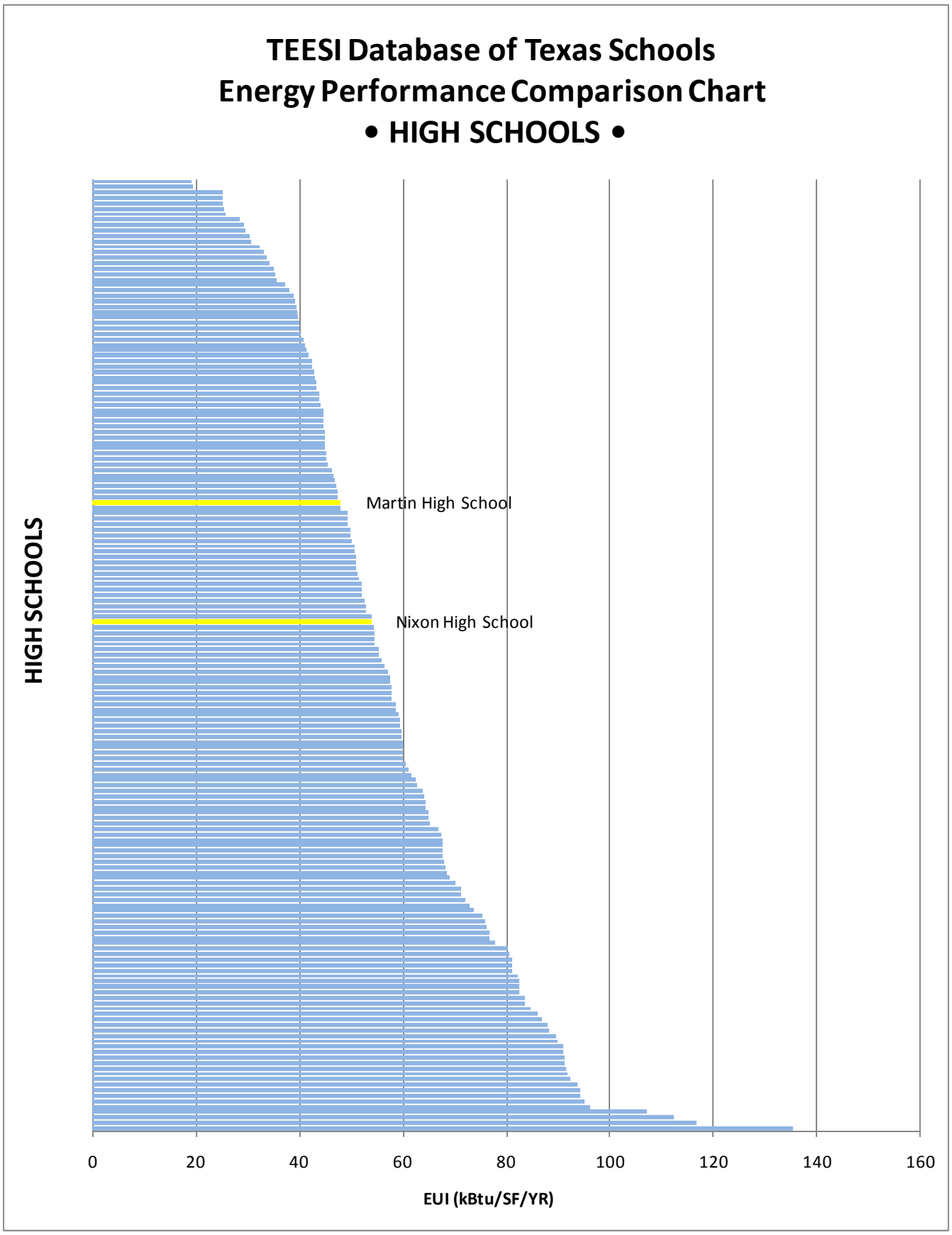
Total Energy Cost/Yr ÷ Total Area (SF) = 1.25 $/SF/year

Electric Utility: AEP & Just Energy

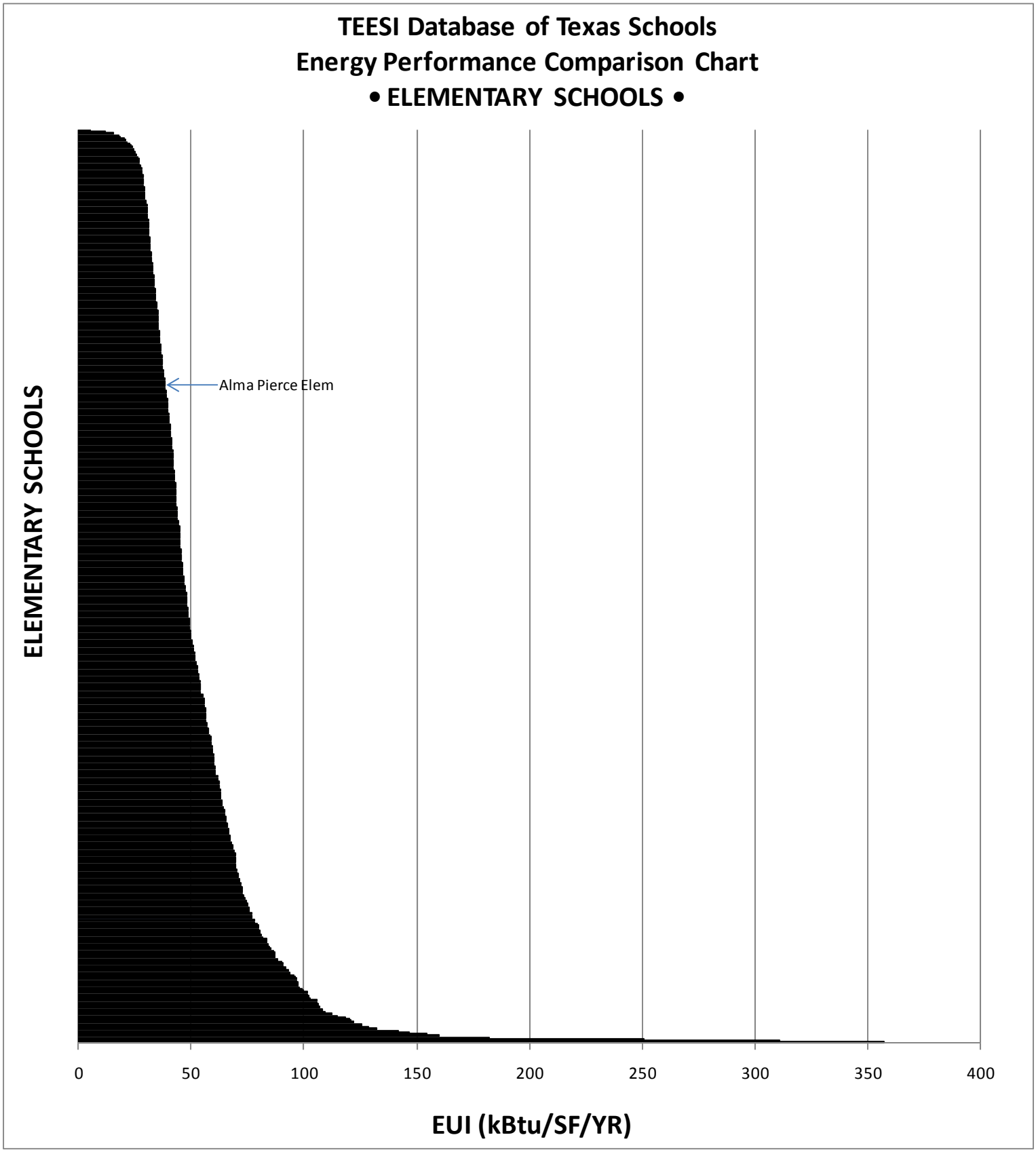
Gas Utility:

APPENDIX D

ENERGY PERFORMANCE COMPARISON CHARTS



(The chart above is a comparison of EUIs based on sample data from TEESI's database of Texas Schools)



(The chart above is a comparison of EUIs based on sample data from TEESI's database of Texas Schools)

APPENDIX E

TYPICAL EQUIPMENT MAINTENANCE CHECKLIST

Building Controls Checklist

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Semi-Annually	Annually
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Verify control schedules	Verify in control software that schedules are accurate for season, occupancy, etc.	X			
Verify setpoints	Verify in control software that setpoints are accurate for season, occupancy, etc.	X			
Time clocks	Reset after every power outage	X			
Check all gauges	Check all gauges to make sure readings are as expected		X		
Control tubing (pneumatic system)	Check all control tubing for leaks		X		
Check outside air volumes	Calculated the amount of outside air introduced and compare to requirements		X		
Check setpoints	Check setpoints and review rational for setting		X		
Check schedules	Check schedules and review rational for setting		X		
Check deadbands	Assure that all deadbands are accurate and the only simultaneous heating and cooling is by design		X		
Check sensors	Conduct thorough check of all sensors - temperature, pressure, humidity, flow, etc. - for expected values			X	
Time clocks	Check for accuracy and clean			X	
Calibrate sensors	Calibrate all sensors: temperature, pressure, humidity, flow, etc.				X

Fans Checklist

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
System use/sequencing	Turn off/sequence unnecessary equipment	X			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Observe belts	Verify proper belt tension and alignment			X	
Inspect pulley wheels	Clean and lubricate where required			X	
Inspect dampers	Confirm proper and complete closure control; outside air dampers should be airtight when closed			X	
Observe actuator/linkage control	Verify operation, clean, lubricate, adjust as needed			X	
Check fan blades	Validate proper rotation and clean when necessary			X	
Filters	Check for gaps, replace when dirty - monthly			X	
Check for air quality anomalies	Inspect for moisture/growth on walls, ceilings, carpets, and in/outside of duct-work. Check for musty smells and listen to complaints.			X	
Check wiring	Verify all electrical connections are tight				X
Inspect ductwork	Check and refasten loose connections, repair all leaks				X
Coils	Confirm that filters have kept clean, clean as necessary				X
Insulation	Inspect, repair, replace all compromised duct insulation				X

APPENDIX F

LOANSTAR INFORMATION

Texas LoanSTAR Program

FACTS ABOUT LoanSTAR

The State of Texas LoanSTAR (Saving Taxes and Resources) Program finances energy efficient facility up-grades for state agencies, public schools, institutions of higher education, local governments, municipalities, and hospitals. The program's revolving loan mechanism allows participants to borrow money and repay all project costs through the stream of **cost savings** produced.

ELIGIBLE PROJECTS

Up-grades financed through the program include, but are not limited to, (1) energy efficient lighting systems; (2) high efficiency heating, ventilation and air conditioning systems; (3) energy management systems; (4) boiler efficiency improvements; (5) energy recovery systems; (6) building shell improvements; and (7) load management projects. The prospective borrower hires a Professional Engineer to analyze the potential energy efficient projects that will be submitted for funding through the Loan STAR Program. All engineering costs are covered under the program.

PROGRAM REQUIREMENTS

Once the projects are analyzed and the prospective borrower agrees with the recommended projects, the engineer prepares an Energy Assessment Report (EAR) with the project descriptions and calculations. The EAR must be prepared according to the LoanSTAR Technical Guidelines. The EAR is reviewed and approved by the State Energy Conservation Office (SECO) technical staff before project financing is authorized. Projects financed by LoanSTAR must have an average simple payback of ten years or less. Borrowers do, however, have the option of buying down paybacks to meet the composite ten-year limit.

To ensure up-grade projects are designed and constructed according to the EAR, SECO performs a review of the design documents at the 50% and 100% completion phases. On-site construction monitoring is also performed at the 50% and 100% completion phases.

SAVINGS VERIFICATION

To ensure that the Borrower is achieving the estimated energy savings, monitoring and verification is required for all LoanSTAR funded projects. The level of monitoring and verifications may range from utility bill analysis to individual system or whole building metering depending on the size and type of retrofit projects. If whole building metering is required, metering and monitoring cost can be rolled into the loan.

For additional information regarding the
LoanSTAR program, please contact:

Eddy Trevino
SECO, LoanSTAR Program Manager
(512) 463-1876

APPENDIX G

BUILDING COMMISSIONING INFORMATION

EnergyIdeas Clearinghouse

Energy Efficiency FACTSHEET

Building commissioning provides benefits such as a smoother construction process, reduced operation and maintenance costs, lower energy costs, and satisfied building occupants and tenants.

Building Commissioning for New Buildings

Building commissioning for new buildings is a quality assurance process to verify and document that building systems function as designed and meet the operational needs of the building owner and building users. The initial costs of commissioning are recovered many times over through operating savings, improved staff performance, and avoidance of costly construction problems.

Photo courtesy of DOE/NREL

What is building commissioning?

The key elements in building commissioning include:

- Thoroughly documenting system design intent, operating sequences and test procedures.
- Verifying system performance based on extensive functional testing and measurement.
- Ensuring that building operations staff members receive the training and resources they need on system operation and maintenance procedures.

It is important to realize that building commissioning is not standard practice, although it is becoming more common for large or complicated buildings. Building commissioning goes beyond standard testing, adjusting, and balancing and beyond traditional inspections. The Building Commissioning Association describes building commissioning as *"a quality based process with documented confirmation that building systems are planned, designed, installed, tested, operated and maintained in compliance with the owner's project requirements."*

Why perform building commissioning?

Commissioned buildings are more likely to perform as intended and avoid operational problems. Poorly performing buildings inherently have high costs. Benefits from commissioning include a smoother construction process (from improved communication, fewer change orders, and avoided litigation), reduced operation and maintenance costs, lower energy costs (through improved energy efficiency) and satisfied building occupants and tenants (through improved indoor air quality and thermal comfort).

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www.nwalliance.org

Experience has shown that a building that is not commissioned will cost 8 to 20 percent more to operate than a commissioned building. A 2004 report[1] showed that, on average, the cost of performing commissioning was paid back in 4.8 years from energy savings alone. When other benefits were accounted for (from improved equipment lifetimes, reduced change-orders due to early detection of problems, prevention of premature equipment breakdown by timely correction of problems, reduced operation and maintenance costs, and improved indoor environment), they essentially offset the entire cost of new-building commissioning.

As buildings and systems have become more complex and occupant requirements have increased, the need for commissioning is even greater. Informed building owners recognize that a high performance building is a key element for business success. It gives them a competitive advantage.

In addition, the Washington State and Seattle Energy Codes for non-residential buildings require systems commissioning for mechanical and lighting systems (see sections 1416 and 1513.7). For lighting and simple HVAC systems, the requirements are limited to controls[2]. The code states that drawing notes specify commissioning, that specifications and plans identify the equipment to be tested and the procedures to be used, that systems be tested to ensure they operate in accord with the approved plans, and that a commissioning report be submitted to the owner. For complex mechanical systems, a preliminary commissioning report is to be completed prior to the building official issuing a final certificate of occupancy.

[1] *The Cost-Effectiveness of Commercial-Buildings Commissioning: A Meta-Analysis of Energy and Non-Energy Impacts in Existing Buildings and New Construction in the United States*, Report Number 56637, Lawrence Berkeley National Laboratory, Portland Energy Conservation Inc., Texas A&M University Energy Systems Laboratory, December 2004. http://eetd.lbl.gov/emills/PUBS/Cx-Costs-Benefits.html

[2] ASHRAE Standard 90.1-2004, the model for the energy codes in many states, includes a minimum level of systems commissioning as part of the completion requirements (6.7.2) for mechanical systems that is less detailed than the Washington and Seattle Energy Codes. California and Massachusetts have commissioning-like provisions in their codes and Oregon has considered a commissioning requirement for their energy code.

Photo courtesy of DOE/NREL, Photographer Kenneth Shipp, DOE

It is important to recognize that these minimum requirements fall short of the level of commissioning recommended by many commissioning providers and that the local jurisdictions often do not have the resources to fully enforce all the requirements in the energy code. A building owner needs to be sure they are receiving an adequate level of commissioning from a qualified commissioning provider in order to obtain the benefits that commissioning offers.

When should building commissioning start?

Ideally, building commissioning should begin early in the design phase of the project. This allows the commissioning provider to work with the design team and become familiar with the project goals and design intent as decisions are made. Plans can be made to effectively incorporate commissioning into the development process. This helps to ensure success and avoid problems and additional work later in the project. Commissioning can occur in the construction process or after construction is complete, but this makes it more difficult to document the design intent, identify design problems, develop testing plans and conduct tests. This can compromise the potential for success.

Who should perform building commissioning?

Who actually performs commissioning depends on the owner and the project. Typically, the building owner hires an independent third party to perform commissioning. This individual is often referred to as the commissioning provider (or authority).

Those involved in the building commissioning field generally believe the commissioning provider should work for the owner and should represent the owner's interest. However, there are numerous options. As commissioning becomes

more popular, a greater number of firms are offering building commissioning as part of their services. These include construction managers, test and balance contractors, design engineers, and mechanical contractors. The nature of the project will determine which option is best.

Trained and certified commissioning providers can be located through the Building Commissioning Association (see list of resources at the end of this factsheet).

What are the steps in a commissioning process?

The extent of the commissioning process can vary as well as the roles of those involved in the project. A comprehensive process beginning in pre-design and running through post-occupancy is justified for large, complex projects. The commissioning process for smaller buildings should be simpler, focusing on system balancing, simple functional tests of key systems, and documentation. The commissioning process, with an emphasis on the roles of the commissioning provider (CP), is described below for the phases of the design and construction process.

Predesign

The CP, working with the owner, establishes the parameters and expectations for the commissioning process. The CP may have a limited input and review role in this phase.

Design Phase

The CP outlines the scope of design requirements and design intent, describes the systems to be installed, outlines the documentation requirements for each party involved in the commissioning process, defines subsequent commissioning procedures, and documents the process. This includes design review to identify design issues and the development of a commissioning specification that describes the roles and responsibilities of the contractor in the commissioning process.

Photo courtesy of DOE/NREL, Photographer David Parsons

Construction Phase

The CP completes the commissioning plan at the beginning of the construction phase. The CP obtains project schedules and develops a commissioning project schedule. The CP gathers and reviews the contractor submittals and operation and maintenance manuals. The CP writes detailed functional performance test plans for each system and piece of equipment involved in the commissioning process.

The CP makes site visits to observe construction, notes details that might affect equipment and system performance or operation, and coordinates with the various contractors to perform the pre-functional performance tests. The CP oversees all start-up tests and ensures that the pre-functional performance tests and checklists are completed and all deficiencies resolved.

Acceptance Phase

Using the functional performance test plans, the CP observes and verifies the proper operation of equipment, systems, and controls per contract documents; verifies that corrective measures are taken; and ensures the presence of completed operation and maintenance manuals. The actual performance testing is usually carried out by the various contractors. The CP oversees this process and may be actively involved. Shortly after the functional performance test is complete, the CP finishes the draft commissioning report, including all documentation, and submits it to the owner.

Training for the building operation staff generally occurs near the end of the acceptance phase or shortly after building occupancy. It can be performed prior to, or as part of, the functional performance testing. This provides an opportunity for hands-on experience that can reinforce the training. The training should be done by the installation contractors, designers and manufacturers' representatives, and may include the CP. The CP should be involved in establishing

the training needs of the building operation and maintenance staff and ensuring those needs are met.

Post-Acceptance Phase

Building operation and maintenance staff ensure that the facility's systems function properly, adapt the systems to changing occupancy and use, maintain a facility history, and document all changes. The CP can be involved in establishing the documentation methods for this phase and can review performance and recommend improvements. The CP may also be involved in conducting any seasonal performance testing that could not be performed when the building was completed. Results from the post-acceptance phase are added to the commissioning report. The tools and resources developed during the commissioning process provide the basis for ongoing performance monitoring by building and operation staff to ensure that the benefits of commissioning are maintained.

How much does building commissioning cost?

The price of building commissioning varies depending on the size of the project, complexity of building systems, the systems to be commissioned, when commissioning begins, and the level of detail required in the commissioning process. A good rule of thumb is between two to four percent of the construction cost of the systems being commissioned. In the 2004 study referenced in footnote 1, the median cost for new-building commissioning was $1.00/square foot (0.6 percent of total construction costs).

Owners often say they cannot afford to pay for building commissioning. It is important to recognize the potential costs of *not* commissioning. These costs can include schedule overruns, change orders, litigation costs, high vacancy levels, uncomfortable occupants, excessively long shakedown periods, costly post-occupancy corrections, inability to perform adequate operation and maintenance, and high operation costs. These costs can far exceed the price paid for commissioning. Commissioning reduces the risk of incurring these costs.

Where can I get more information about building commissioning?

The following resources provide more information on building commissioning for new commercial buildings.

Programs and Organizations

BetterBricks.com – Articles, success stories, and other resources on commissioning from BetterBricks, an initiative of the Northwest Energy Efficiency Alliance.
www.betterbricks.com/commissioning

Building Commissioning Association – BCA promotes building commissioning practices that maintain high professional standards and fulfill building owners' expectations. Site includes *White Paper on Commissioning*, February 2005.
www.bcxa.org

Portland Energy Conservation, Inc. (PECI) Resource Library – Access to commissioning documents and links to other information resources. *www.peci.org/library.htm*

The National Conference on Building Commissioning – An annual forum of owners, contractors, designers, and commissioning professionals to further the practices of building commissioning. *www.peci.org/ncbc/index.htm*

National Clearinghouse for Educational Facilities (NCEF) – Created in 1997 by the U.S. Department of Education, NCEF is a free public service that provides information about K-12 school planning, design, financing, construction, operations and maintenance.
www.edfacilities.org/rl/commissioning.cfm

U.S. General Services Administration Commissioning Program – Provides resources including a guide for building commissioning.
www.gsa.gov/Portal/gsa/ep/channelView.do?pageTypeId=8195&channelPage=%2Fep%2Fchannel%2FgsaOverview.jsp&channelId=-15374

Documents

Commissioning for Better Buildings in Oregon (pdf file) – A comprehensive 44-page introduction to building commissioning. *www.energy.state.or.us/bus/comm/commintr.pdf*

The Cost-Effectiveness of Commercial-Buildings Commissioning: A Meta-Analysis of Energy and Non-Energy Impacts in Existing Buildings and New Construction in the United States, Report Number 56637, Lawrence Berkeley National Laboratory, Portland Energy Conservation, Inc., Texas A&M University Energy Systems Laboratory, December 2004. *http://eetd.lbl.gov/emills/PUBS/Cx-Costs-Benefits.html*

Energy User News Fundamentals Series – "Understanding the Commissioning Process." *www.energyusernews.com/CDA/Article_Information/Fundamentals_Item/0,2637,27467,00.html*

State and Local Resources

Idaho Department of Water Resources Energy Division – For information on building commissioning in Idaho. *www.idwr.state.id.us/energy/builders/index.htm*

Montana Department of Environmental Quality – For information on building commissioning and related activities in Montana. *www.deq.state.mt.us/Energy/buildings/index.asp*

Oregon Department of Energy – Activities in Oregon to promote building commissioning including handbooks for new and existing building commissioning, a commissioning toolkit, and case studies. *www.energy.state.or.us/bus/comm/bldgcx.htm*

Washington State Department of General Administration Building Commissioning – Information on the department's building commissioning program, success stories, and resources. *www.ga.wa.gov/Eas/bcx/index.html*

The California Commissioning Collaborative – Government, utility and building services organizations and professionals have come together to create a viable market for building commissioning in California. The website includes a comprehensive library and hundreds of resources for building owners and service providers. *www.cacx.org/index.html*

Commissioning for Nonresidential Mechanical and Lighting Systems (pdf file), Seattle Department of Planning and Development. *www.ci.seattle.wa.us/dclu/Publications/cam/cam419.pdf*

Seattle City Light Building Commissioning Assistance – Assistance and support for building commissioning projects. This includes a link to Seattle City Light's Building Commissioning Handbook, which has case studies and standard commissioning procedures. *www.cityofseattle.net/light/conserve/business/bdgcoma/cv5_bca.htm*

Technical Assistance

If you are a commercial or industrial customer of a Northwest utility, you can call the EnergyIdeas Clearinghouse with your specific questions about building commissioning or other energy efficiency issues.

The EnergyIdeas Clearinghouse provides information on a broad range of energy technologies for commercial and industrial customers of Pacific Northwest utilities. The EnergyIdeas Clearinghouse provides a searchable website and has a team of energy specialists ready to respond to technical information requests by phone or email. Sponsored by the Northwest Energy Efficiency Alliance.

Web: *www.EnergyIdeas.org*
Regional Hotlline: 1-800-872-3568
Email: *info@energyideas.org*

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APPENDIX H

REQUEST FOR ENERGY ASSISTANCE

State Energy Conservation Office

Public Schools, Colleges and Non-Profit Hospitals

Preliminary Energy Assessment
Service Agreement

Investing in our public schools, colleges and non-profit hospitals through improved energy efficiency in public buildings is a win-win opportunity for our communities and the state. Energy-efficient buildings reduce energy costs, increase available capital, spur economic growth, and improve working and living environments. The Preliminary Energy Assessment Service provides a viable strategy to achieve these goals.

Description of the Service

The State Energy Conservation Office (SECO) will analyze electric, gas and other utility data and work with _____, hereinafter referred to as Partner, to identify energy cost-savings potential. To achieve this potential, SECO and Partner have agreed to work together to complete an energy assessment of mutually selected facilities.

SECO agrees to provide this service at no cost to the Partner with the understanding that the Partner is ready and willing to consider implementing the energy savings recommendations.

Principles of the Agreement

Specific responsibilities of the Partner and SECO in this agreement are listed below.

- ✓ Partner will select a contact person to work with SECO and its designated contractor to establish an Energy Policy and set realistic energy efficiency goals.
- ✓ SECO's contractor will go on site to provide walk through assessments of selected facilities. SECO will provide a report which identifies no cost/low cost recommendations, Capital Retrofit Projects, and potential sources of funding. Portions of this report may be posted on the SECO website.
- ✓ Partner will schedule a time for SECO's contractor to make a presentation of the assessment findings key decision makers.

Acceptance of Agreement

This agreement should be signed by your organization's chief executive officer or other upper management staff.

Signature: _____ Date: 02/25/2011

Name (Mr./Ms./Dr.) MR. ANGEL E. VELAZQUEZ Title: DIRECTOR - DIVISION OF OPERATIONS

Organization: LAREDO I.S.D. Phone: (956) 795-3600

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Please sign and mail or fax to: Juline Ferris, **Schools and Education** Program Administrator, State Energy Conservation Office, 111 E. 17th Street, Austin, Texas 78774. Phone: 512-936-9283. **Fax 512-475-2569.**