Susan Combs
Texas Comptroller of Public Accounts

Facility Preliminary Energy Assessments and Recommendations

Canutillo ISD

7965 Artcraft Rd.
El Paso, Texas 79932

Prepared by:

Texas Energy Engineering Services, Inc.
1301 S. Capital of Texas Highway
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Austin, Texas 78746
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TBPE# F-3502

March 2011

STATE OF TEXAS
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PROFESSIONAL ENGINEER
3/9/11

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Texas Registration #98125

SECO
State Energy Conservation Office

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Schools & Hospitals Energy Management Program
Canutillo ISD
7965 Artcraft Rd.
El Paso, TX 79932
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Phone: 915-877-7712

1.0 EXECUTIVE SUMMARY

Canutillo Independent 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 8.0 of this report.

Implementation Cost Estimate (Est.):	$506,130
Est. Annual Energy Savings (MBTU/Yr):	2,784,764
Est. Annual Greenhouse Gas Emissions Reduction (Metric Ton CO_2e):	487
Est. Annual Energy Cost Savings:	$91,600
Simple Payback:	5.5

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. Further studies of the effectiveness of evaporative cooling in the region and of the energy consumption of the District's Food Service Department are also included in this report as requested by the District. 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.

Building:	Bill Childress Elementary
Stories:	Single story
Area (estimated):	90,120 SF
Bldg. Components:	Masonry building, built-up roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with magnetic ballasts and High Intensity Discharge (HID) fixtures in gym/cafeteria
HVAC:	Evaporative Coolers and Packaged Rooftop units in new wing
Controls:	Manual selector switch for evaporative cooling, conventional thermostats for heating

Building:	Davenport Elementary
Stories:	Single story
Area (estimated):	75,173 SF
Bldg. Components:	Masonry building, built-up roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electric ballasts and High Intensity Discharge (HID) fixtures in gym/cafeteria
HVAC:	Evaporative Coolers
Controls:	Manual selector switch for evaporative cooling, conventional thermostats for heating

Building:	Damian Elementary
Stories:	Single story
Area (estimated):	84,692 SF
Bldg. Components:	Masonry building, built-up roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electric ballasts and High Intensity Discharge (HID) fixtures in gym/cafeteria
HVAC:	Evaporative Coolers
Controls:	Manual selector switch for evaporative cooling, conventional thermostats for heating

Building:	Garcia Elementary
Stories:	Single story
Area (estimated):	75,518 SF
Bldg. Components:	Masonry building, built-up roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electric ballasts and T5 fluorescent fixtures with electric ballasts in gym/cafeteria
HVAC:	Packaged Rooftop units
Controls:	Conventional thermostats

Building:	Canutillo Elementary
Stories:	Single story
Area (estimated):	131,362 SF
Bldg. Components:	Masonry building, built-up roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electric ballasts and High Intensity Discharge (HID) fixtures in gym/cafeteria
HVAC:	Evaporative Coolers
Controls:	Manual selector switch for evaporative cooling, conventional thermostats for heating

Building:	Canutillo Middle School
Stories:	Single story
Area (estimated):	169,639 SF
Bldg. Components:	Brick building, built-up roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electric ballasts and High Intensity Discharge (HID) fixtures in gym/cafeteria
HVAC:	Evaporative Coolers and Packaged Rooftop units
Controls:	Manual selector switch for evaporative cooling, conventional thermostats for heating and refrigerant cooling

Building:	Alderete Middle School
Stories:	Single story
Area (estimated):	112,986 SF
Bldg. Components:	Brick building, built-up roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electric ballasts and High Intensity Discharge (HID) fixtures in gym/cafeteria
HVAC:	Evaporative Coolers and Packaged Rooftop units
Controls:	Manual selector switch for evaporative cooling, conventional thermostats for heating and refrigerant cooling

Building:	Canutillo High School
Stories:	Single story
Area (estimated):	257,086 SF
Bldg. Components:	Masonry building, built-up roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electric ballasts and High Intensity Discharge (HID) fixtures in gym/cafeteria
HVAC:	Geothermal heat pumps
Controls:	Conventional thermostats

Building:	Administration Building
Stories:	Single story
Area (estimated):	45,753 SF
Bldg. Components:	Masonry building, built-up roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electric ballasts and High Intensity Discharge (HID) fixtures in gym/cafeteria
HVAC:	Evaporative Coolers and Packaged Rooftop units
Controls:	Manual selector switch for evaporative cooling, conventional thermostats for heating and refrigerant cooling

Building:	Facilities
Stories:	Single story
Area (estimated):	15,967 SF
Bldg. Components:	Metal building, built-up roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electric ballasts and High Intensity Discharge (HID) fixtures in gym/cafeteria
HVAC:	Evaporative Coolers
Controls:	Manual selector switch for evaporative cooling, conventional thermostats for heating

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 1,059,306 square feet.

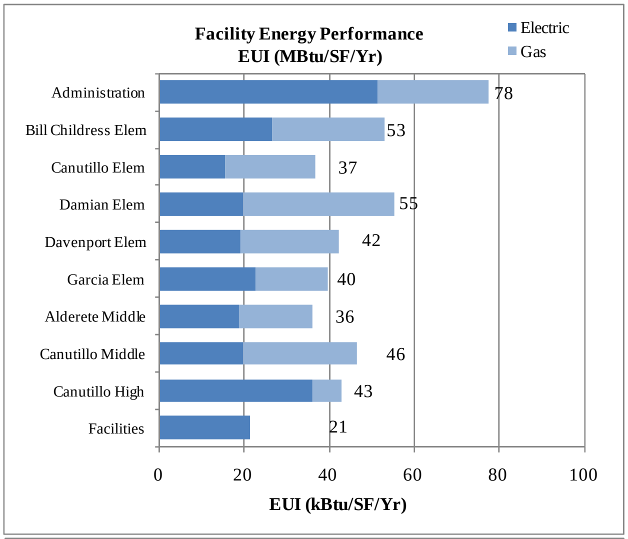
Annual electric and natural gas invoices for the buildings surveyed were $989,027 for the 12-month period ending September 2010. A summary of annual utility costs is provided in **Appendix C**, Base Year Consumption History.

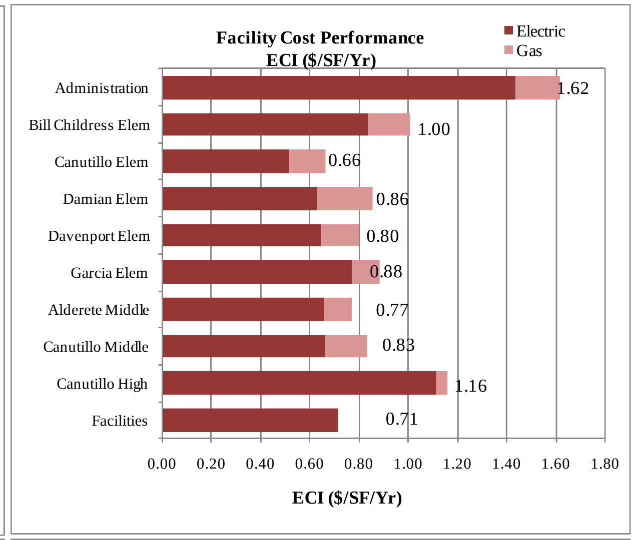
To help the District evaluate the overall energy performance of its facilities TEESI has calculated their Energy Utilization Index (EUI) and Energy Cost Index (ECI). The EUI represents a facility's annual energy usage per square foot; it is measured in thousands of BTUs per square foot per year (kBTU/SF/Year).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

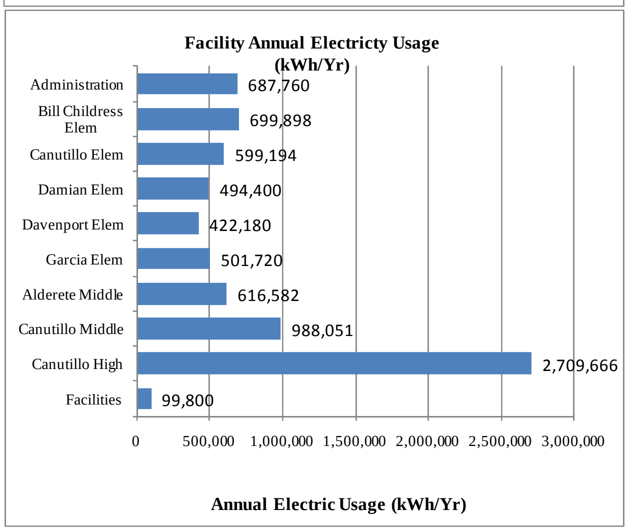
Energy Cost and Consumption Benchmarks													
		Electric			Natural Gas			Total	Total	EUI	ECI	
	Building	KWH/Yr	MMBTU/Yr	$Cost/Yr	MCF/Yr	MMBTU/Yr	$Cost/Yr	$Cost/Yr	MMBTU/Yr	MBTU/SF/Yr	$/SF/Yr	SF
1	Administration	687,760	2,347	65,769	1,164	1,199	8,225	73,994	3,546	78	1.62	45,753
2	Bill Childress Elem	699,898	2,389	75,353	2,321	2,390	15,159	90,512	4,779	53	1.00	90,120
3	Canutillo Elem	599,194	2,045	68,157	2,704	2,785	18,719	86,877	4,830	37	0.66	131,362
4	Damian Elem	494,400	1,687	53,985	2,958	3,047	19,331	73,316	4,734	55	0.86	85,692
5	Davenport Elem	422,180	1,441	48,780	1,684	1,735	11,140	59,920	3,176	42	0.80	75,173
6	Garcia Elem	501,720	1,712	58,399	1,240	1,277	8,328	66,727	2,990	40	0.88	75,528
7	Alderete Middle	616,582	2,104	74,181	1,900	1,957	12,826	87,006	4,061	36	0.77	112,986
8	Canutillo Middle	988,051	3,372	112,818	4,355	4,486	28,093	140,911	7,858	46	0.83	169,639
9	Canutillo High	2,709,666	9,248	286,190	1,723	1,775	12,189	298,380	11,023	43	1.16	257,086
10	Facilities	99,800	341	11,385	0	0	0	11,385	341	21	0.71	15,967
		KWH/Yr	MMBTU/Yr	$Cost/Yr	MCF/Yr	MMBTU/Yr	$Cost/Yr	$Cost/Yr	MMBTU/Yr	MBTU/SF/Yr	$/SF/Yr	SF
		7,819,251	26,687	855,016	20,049	20,650	134,011	989,027	47,337	45	0.93	1,059,306

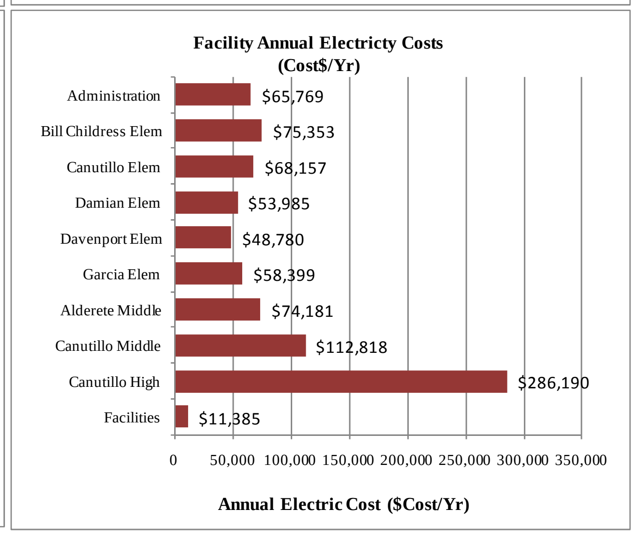
Knowing the EUI and ECI of each facility is useful to help determine the District's overall energy performance. In addition, the District's EUI was compared to TEESI's database of Texas schools. See **Appendix D** to determine how the EUIs of these facilities compared to those of other schools in Texas.

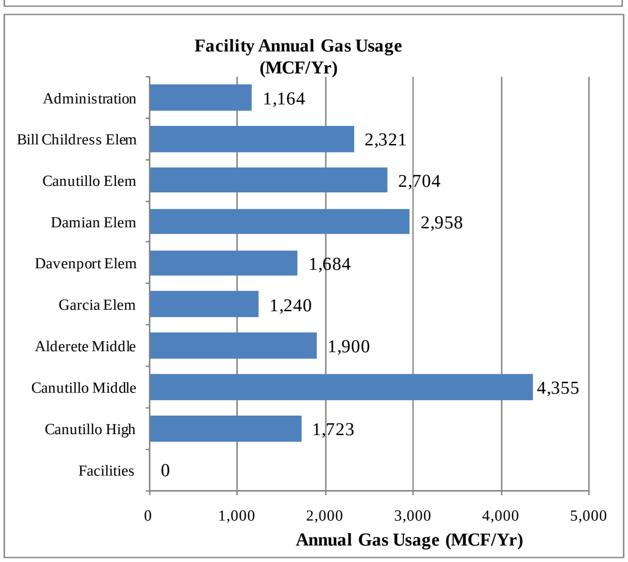
The following charts summarize the data presented in the previous table. See **Appendix C** for further detail.

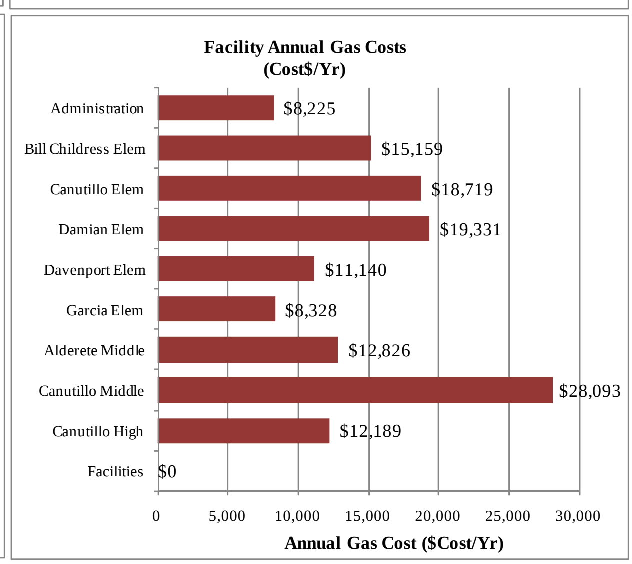




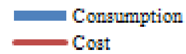




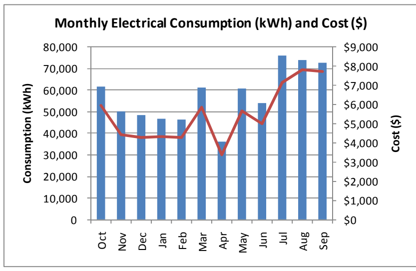


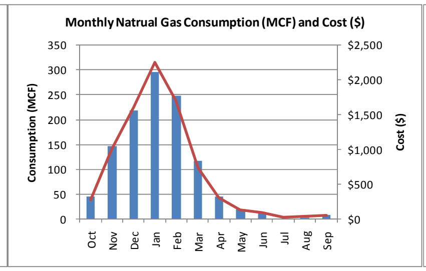


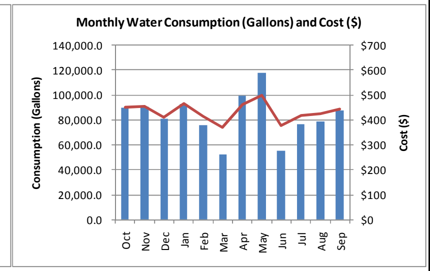
The following charts summarize each campus monthly utility data. See **Appendix C** for further detail.



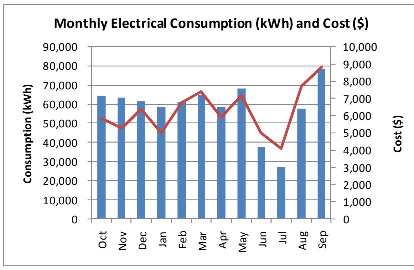
Administration

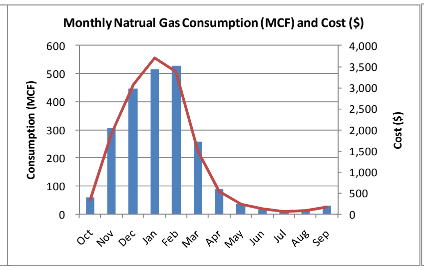


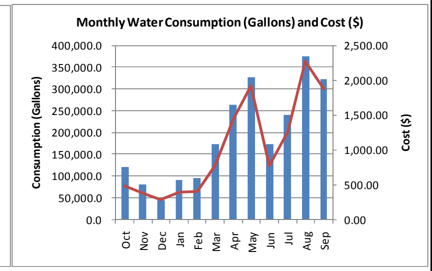




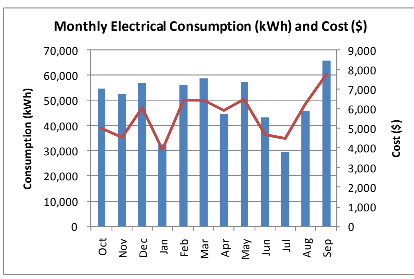
Childress Elem

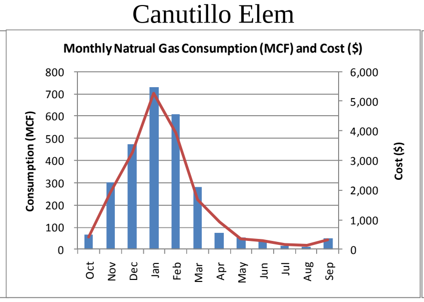


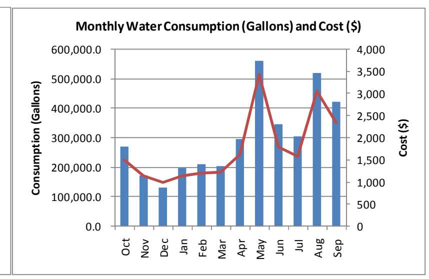




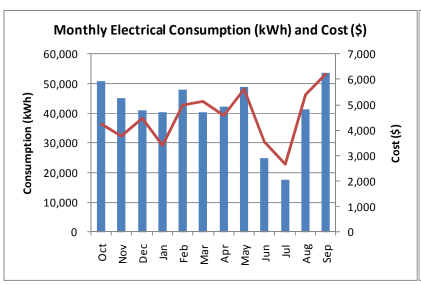
Canutillo Elem

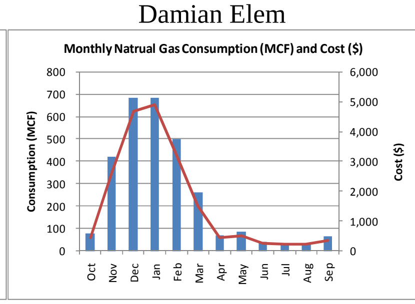


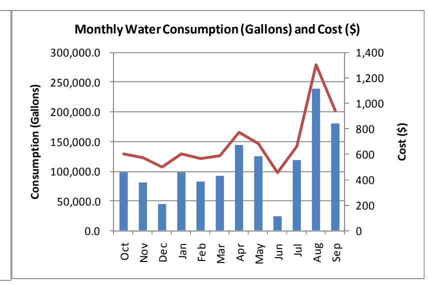




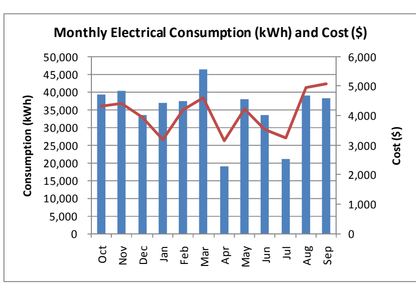
Damian Elem

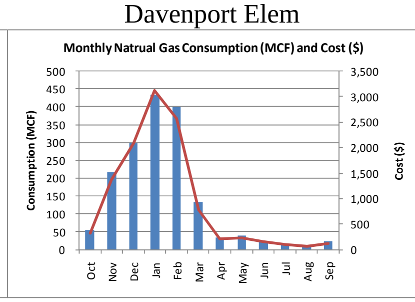


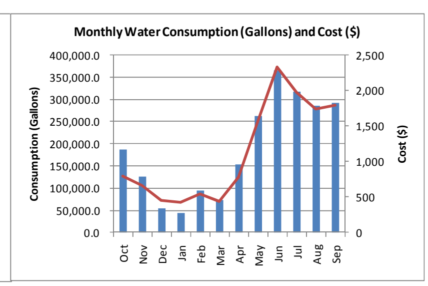


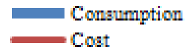


Davenport Elem

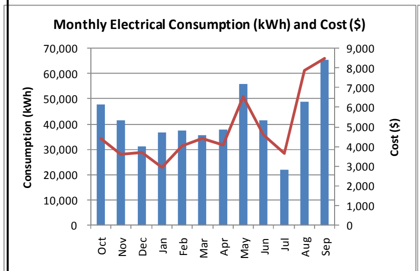


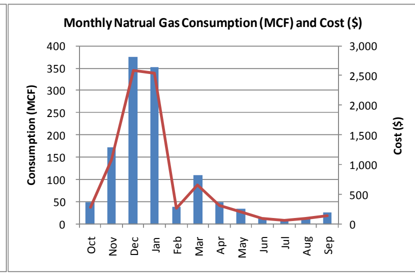


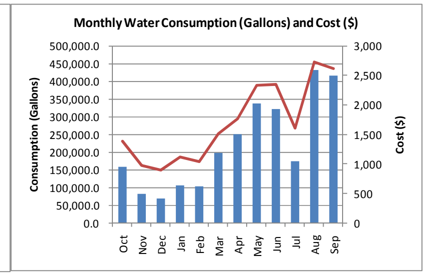




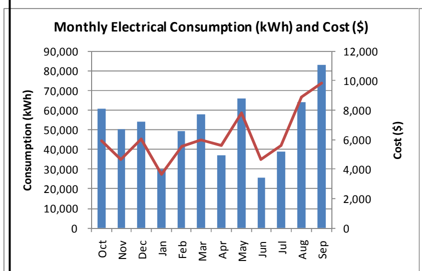
Garcia Elem

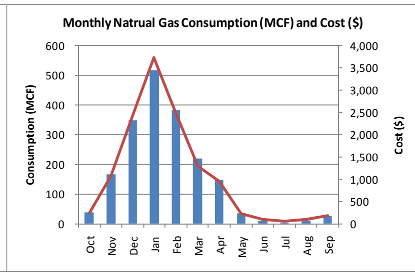


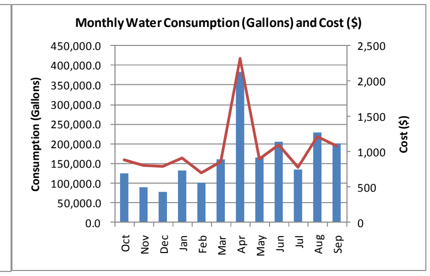




Alderete MS







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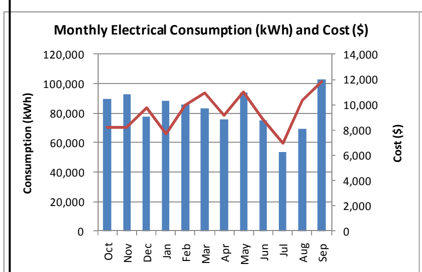
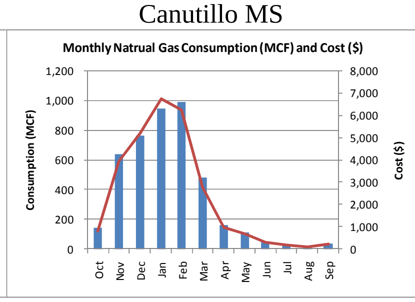
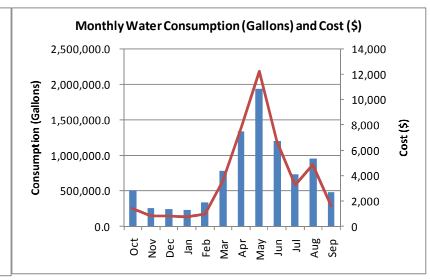
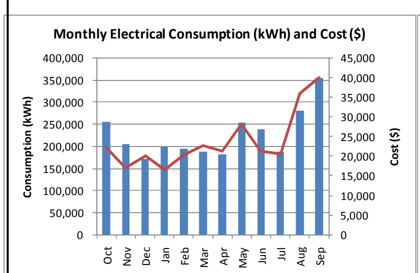
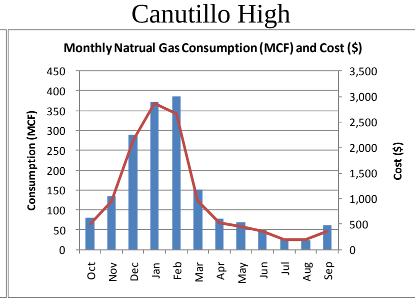


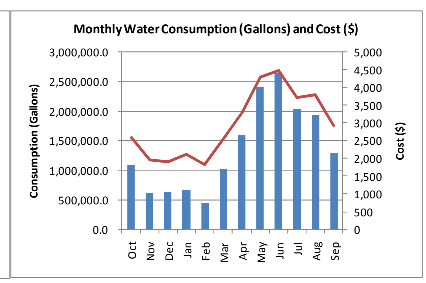




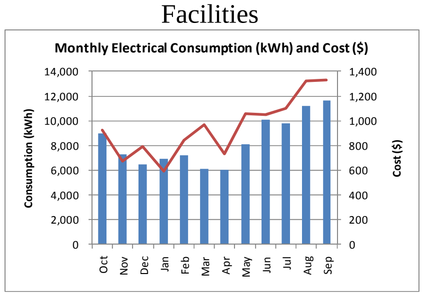
Canutillo High







Facilities



The following table shows a summary of the utility data for two similar schools with different HVAC systems (Garcia Elementary and Davenport Elementary).

		GARCIA	DAVENPORT
	HVAC	RTU	Evap
	SF	75,528	75,173
Consumption	Electric kWH/yr	501,720	422,180
	Nat. Gas MCF/yr	1,240	1,684
	Water kgal/yr	2,650	2,255
EUI (Energy Usage Index)	Electric MBtu/SF/yr	22.7	19.2
	Nat. Gas MBtu/SF/yr	16.9	23.1
	Total MBtu/SF/yr	39.6	42.2
	% Elec	57%	45%
	% Nat.Gas	43%	55%
UCI (Utility Cost Index)	Electric $/SF/yr	0.77	0.65
	Nat. Gas $/SF/yr	0.11	0.15
	Water $/SF/yr	0.27	0.18
	Total $/SF/yr	1.15	0.98

The table above directly conveys the following points, some of which could be misleading without detailed analysis.

1 Water consumption for the campus with evaporative cooling is lower than campus without evaporative coolers, in general schools with evaporate cooling should have same or slightly higher water usage. Variation in data can be due to summer use, irrigated areas, and condition of equipment during the baseline year, etc

2 Electric consumption of school with evaporative cooling is less than school with packaged units, while natural gas consumption of school with package units is lower than school with evaporate cooling.

3 Variation in electric consumption heavily dominates the differences in utility cost. As expected, overall utility costs index for school with evaporate coolers is lower than school with packaged units.

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 buildings.

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**.

To develop the District's baseline, 12 months of utility consumption, cost data, and Building Space Use information will be required. The table below 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. 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. For more information regarding Portfolio Manager, please visit www.energystar.gov.

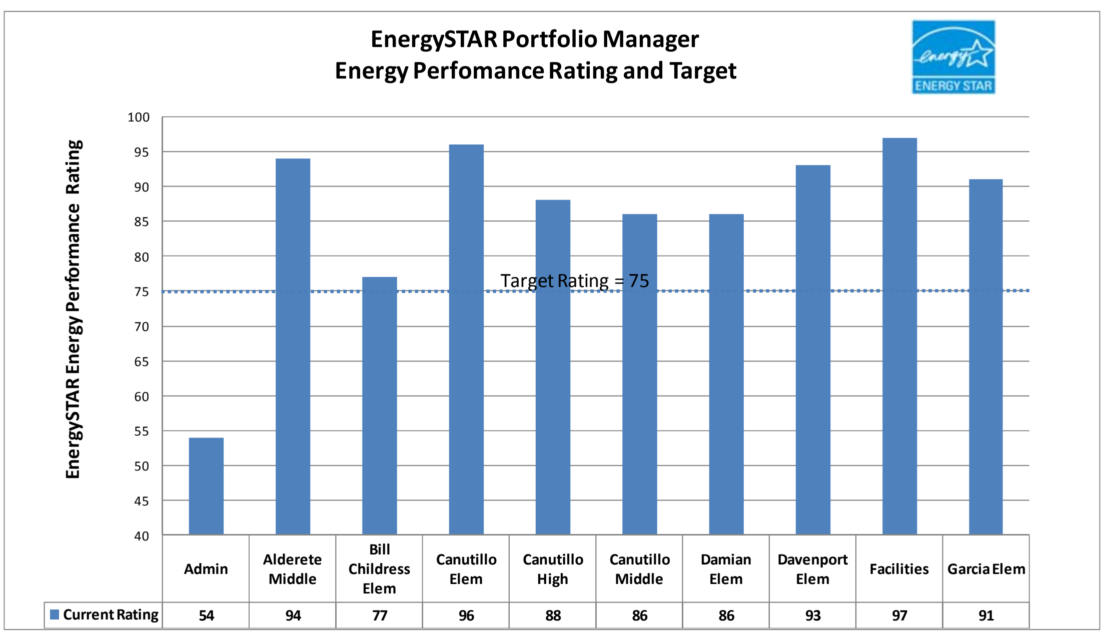
ENERGY STAR Portfolio Manager Example Space Use Data

Facility Type: K-12 School	
• 12 Months of Electric	• Presence of cooking facilities
• Gross Floor Area	• Percent Cooled
• Open Weekends (Y/N)	• Percent Heated
• # of PCs	• Months Open per Year
• # of Walk in refrigerators/freezers units	• 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 below 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 rating. The table below summarizes the preliminary results based on default values.

Facility Name	Current Rating (1-100)	Total Floor Space (Sq. Ft.)
Administration	54*	45,753
Alderete Middle School	94*	112,986
Bill Childress Elementary School	77*	90,120
Canutillo Elementary School	96*	131,362
Canutillo High School	88*	257,086
Canutillo Middle School	86*	169,639
Damian Elementary School	86*	85,692
Davenport Elementary School	93*	75,173
Facilities	97*	15,967
Garcia Elementary School	91*	75,528
* Ratings based on default values		

The following indicates the school's current energy performance ratings that were eligible ending in September 2010 (eligibility ends 120 days after the last month of input utility data). The target for each of these schools is a rating of at least 75 to qualify for ENERGY STAR. *However, the facility must also meet requirements in minimum ventilation, interior lighting, and thermal comfort to qualify for recognition. Currently, schools that utilize evaporative cooling at the District may not receive the minimum ventilation during the winter*. Thus, these facilities would not be eligible for ENERGY STAR even though they received the required performance rating.



5.0 ENERGY ACCOUNTING

UTILITY PROVIDERS

El Paso Electric provides electric service to the District. Texas Gas provides natural gas service to the District. The City of El Paso provides water to the District.

District average electric rate =	$0.1093/kWh
District average natural gas rate =	$6.684/MCF
District average water rate =	$0.00427/gal

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 Districts utility accounts (i.e., Electricity, Natural Gas, Propane, Water, etc.) into ENERGY STAR Portfolio Manager (preferred, see previous section for details) or 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. **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 6.0 for additional information regarding these requirements.

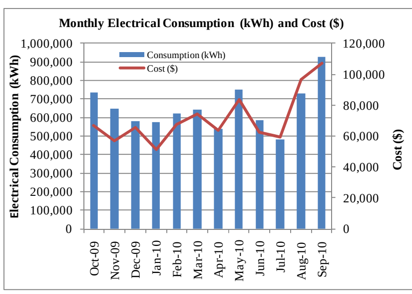
Furthermore, below is a sample format the District can customize to help summarize their overall utility usage and costs.

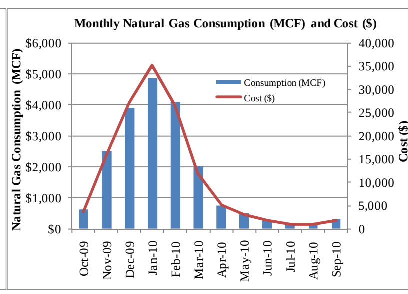
The data presented below is a summation of the data provided by the District. This data below includes only selected utility accounts and is for reference purposes only and does not represent the District's total utility data. See **Appendix C** for further detail regarding each utility account represented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

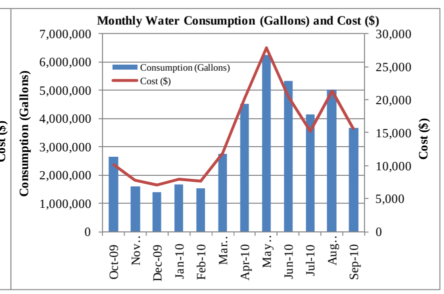
Canutillo ISD - Sample Utility Input Form

MONTH	ELECTRICITY			NATURAL GAS			WATER		
	KWH	COST $	Avg. Rate $/KWH	MCF	COST $	Avg. Rate $/MCF	GAL	COST $	$/GAL
Oct-09	733,578	67,079	$0.0914	$612	$3,678	$6.0	2,638,692	10,113	$0.00383
Nov-09	647,708	56,599	$0.0874	$2,509	$15,798	$6.3	1,600,308	7,791	$0.00487
Dec-09	581,307	65,415	$0.1125	$3,894	$27,112	$7.0	1,386,792	7,056	$0.00509
Jan-10	576,762	51,141	$0.0887	$4,844	$35,107	$7.2	1,648,592	7,950	$0.00482
Feb-10	622,304	67,353	$0.1082	$4,078	$26,428	$6.5	1,533,400	7,686	$0.00501
Mar-10	643,638	74,470	$0.1157	$2,012	$11,880	$5.9	2,747,656	11,870	$0.00432
Apr-10	539,250	63,817	$0.1183	$753	$5,162	$6.9	4,518,668	20,184	$0.00447
May-10	750,873	83,740	$0.1115	$491	$3,033	$6.2	6,248,044	27,829	$0.00445
Jun-10	583,783	62,230	$0.1066	$254	$1,837	$7.2	5,330,996	20,384	$0.00382
Jul-10	483,293	59,505	$0.1231	$138	$1,071	$7.8	4,131,204	15,258	$0.00369
Aug-10	731,307	96,626	$0.1321	$137	$1,010	$7.4	5,040,024	21,348	$0.00424
Sep-10	925,448	107,040	$0.1157	$325	$1,897	$5.8	3,683,900	15,637	$0.00424
Total	7,819,251	$855,016	$0.1093	20,049	$134,011	$6.7	40,508,276	$173,106	$0.00427

Gross Building Area:	1,059,306	SF







6.0 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.**

7.0 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.

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.

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.

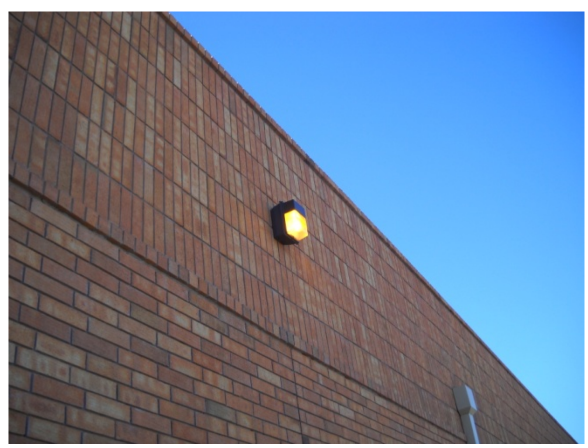
IMPROVE CONTROL OF INTERIOR & EXTERIOR LIGHTING

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. For example, the pictures below provide examples of unnecessary lighting use.

Example 1 - Interior Lights: The picture on the left is of the compact fluorescent lights in the entry to Canutillo High School. During the walkthrough, the lights were on and a light level of 60-70 foot-candles was measured. After turning off the lights, the area still had an acceptable light level of 40-50 foot-candles. The District should establish a procedure to reduce the time interior lighting is left on and utilize natural light from the windows and doors. A good energy awareness campaign, a collective effort, and good communication, will help ensure the success of this no/low cost energy saving strategy.

Example 2 - Exterior Lights: The picture on the right is of exterior lights on during daylight hours. Exterior lighting is typically controlled using light sensing photocells, timeclocks or manual switching. Another option is to use the Energy Management System (EMS) in the lighting circuits. Photocells tend to fail in the "On" state, so someone should check regularly to see that the lights are not on during the day. Timeclocks are more reliable, and those with astronomical control or that operate in series with photocells also provide dusk-to-dawn operation that is seasonally corrected. Timeclocks also offer the option of turning off the lights in the middle of the night. Manual control is limited to when someone is present and remembers to go to the switch and actuate it. EMS control can use a single light sensor and many schedules to control many lighting groups. It also offers easy means to override normal schedules for special events. The EMS light sensor calibration should be checked periodically, or a second sensor should be used for constant cross-calibration.

Interior lighting in entry way of Canutillo High School



Exterior lighting on during daytime hours at Alderete Middle School

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**. A checklist for typical maintenance of evaporative coolers is shown in the table below. 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.

Evaporative Cooler Maintenance Checklist

Action	**Time Relative to Cooling Season**		
	Pre	**Mid**	**Post**
Clean pads with hose. Replace if pads show deterioration.	X	X	
Check interior for corrosion and clean/repaint if necessary.	X		X
Remove all sediment and slime from basin with brush.	X		X
Treat basin with bleach or other suitable disinfectant.	X	X	
Check fan belt for tension and alignment.	X	X	
Align dampers for season and seal damper slots with tape.	X		X
Check ductwork for loose connections and leaks.	X		
Clean waterways.	X	X	
Drain basin and water supply lines; secure from freezing.			X
Establish water supply.	X		
Verify float valve operation.	X	X	

Typical Evaporative Coolers at Bill Childress Elementary

MANAGE TEMPERATURE CONTROL SETPOINTS

Most EMS systems and programmable thermostats have the capability to relax temperature control when close control is not needed (called *night setback*). An EMS system is usually required to change setpoints during times of free cooling with outdoor air (called *economizer* and *night flushing*). An EMS system also has means to automatically estimate how long ahead of occupancy the system needs to start operating to reach comfort conditions at the scheduled occupancy time (called *optimized start*). However, the optimized start/stop feature must be checked periodically to ensure it is functioning as intended. Refer to Section ***12.0 Energy Management Policy,*** Paragraph *4 Establish Acceptable Comfort Parameters*, for discussion of suitable heating and cooling setpoints.

MANAGE VENTILATION RATES

A certain amount of ventilation, typically about 15 CFM of outside air per person in a school, is required by building codes to insure adequate indoor air quality. This amount of ventilation must be included in the design of the ventilation system for each space, which is usually integrated into the heating and/or cooling system. Many ventilation systems are designed to bring in the design ventilation rate at all times that the cooling or heating system is operating, and to provide no ventilation at other times.

When the outdoor air conditions are such that ventilation at less than the design flow rate would save energy, and if means are available to determine that the number of people present is less than at design, and if the equipment has means to regulate the fresh air flow to a lower but still adequate rate, energy can be saved. Such sophistication (demand-controlled ventilation) requires suitable mechanical design and a control system such as an EMS.

When outdoor air conditions are such that ventilation in excess of the required rate would save energy, and if the rate of ventilation is controlled to maintain comfort conditions, energy can be saved. This feature (called *economizer cycle*) requires suitable mechanical design and a control system such as an EMS. When this feature is enabled using settings suitable for unoccupied times (called *night flushing*), it can reduce the morning cool-down load.

Where outdoor air is pre-cooled evaporatively, the condition of the air (measured or computed) after the evaporative process is what is used to determine whether and how much outdoor air would assist with needed cooling. In the El Paso, Texas area, evaporative cooling nearly always transforms outdoor air into air that is valuable for space cooling, or that at least does not greatly increase the cooling load. Refer to the section titled, ***11.0 Analysis of Evaporative Cooling Systems*** for further discussion on the topic.

Evaporative cooling uses 100% outdoor air, so it inherently provides abundant ventilation during use. However, the simple evaporative coolers most often used for schools in west Texas do not operate at all in the winter. Therefore, some other means of assuring ventilation, such as a heating furnace with an outdoor air intake, is needed in the non-cooling season. Note that where heating is supplied by baseboard convectors and cooling by evaporative coolers, a separate ventilation system is required when the evaporative cooling system is idle. The ventilation system should also warm the air in winter before supplying it to the occupied space.

SEPARATELY SCHEDULE TEMPERATURE CONTROL AND VENTILATION

For minimum energy use, ventilation rates should be controlled incrementally according to ventilation and cooling needs at the moment. Often, however, the equipment design and the control system capability do not support incremental control according to conditions as outlined in the *Manage Temperature Control Setpoints* and *Manage Ventilation Rates* articles above. If occupancy level is near peak design level or near zero on a predictable schedule, it is reasonable to switch ventilation on and off according to that schedule. Often that schedule seems similar to the schedule on which temperature control equipment needs to be operated, so ventilation is "tagged on" to the schedule for temperature control. However, it is typically necessary to start equipment to establish temperature control an hour or more before occupancy. Further, educational spaces are often occupied by only teachers and cleaning staff for an hour or more before and after student hours. Finally, heating and cooling equipment is sometimes called on at night in extreme weather to keep indoor temperatures from becoming extreme. Therefore, a separate schedule for ventilation is warranted that does not include the hours of virtual vacancy and of unoccupied temperature control.

Some spaces, like cafeterias and assembly areas, warrant a third level of ventilation because they have many hours of low, but not insignificant, occupancy. An override timer (self-contained or operating through an EMS) is useful for increasing ventilation during special events or reducing ventilation during low-occupancy periods.

Over-ventilating during times of low occupancy very frequently increases energy consumption. In hot, humid weather, the excess 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.

REPLACE INCANDESCENT LAMPS WITH COMPACT FLUORESCENTS

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

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, saves 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 shut down the vending machine. It will turn it back on once motion is sensed again. 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.

8.0 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.

T12 TO T8 FLUORESCENT LIGHTING RETROFIT

The District has a combination of T8 and T12 fluorescent fixtures. It is recommended the District replace the existing T12 fluorescent lamps and magnetic ballasts with high efficiency T-8 fluorescent lamps and electronic ballasts. Typical four-foot, two-lamp magnetic ballast fixtures require 80 watts, while electronic ballasts and T-8 lamps in the same fixture configuration require only 50 watts. The table below indicates the facilities where T-12 fluorescent lamps were observed during the preliminary walkthrough. The cost and savings noted below are based on preliminary observations of the facilities. Exact cost, quantities, and lamp types can be identified through a detailed energy audit. In addition, a detailed lighting design calculation will help ensure the appropriate lighting replacement is selected. For example, a detailed design calculation may identify areas that could operate with fewer lamps per fixtures or with low-wattage T8 lamps while still maintaining adequate lighting levels.

T12 TO T8 FLUORESCENT LIGHTING RETROFIT				
Building	Estimated Implementation Cost	Estimated Annual Savings ($/yr)	Estimated Energy Savings (MBTU/yr)	Simple Payback (years)
Davenport Elem	$5,700	$800	25,852	7.1
Damian Elem	$5,700	$800	23,913	7.1
Facilities	$2,600	$300	9,510	8.7
Administration	$25,200	$3,900	139,193	6.5
TOTAL	**$39,200**	**$5,800**	**198,467**	**6.8**

REPLACE EXISTING T8 FLUORESCENT LAMPS WITH LOWER WATTAGE LAMPS

4'-T8 fluorescent lamps are available in a variety of wattages, from the standard 32-watt to 30, 28 and 25-watt versions. It is recommended the District replace the existing 32-watt T8 Fluorescent lamps with lower wattage lamps throughout a facility where conditions permit. Changing to a lower wattage T8 Lamp is a relatively straightforward process but does have limitations and are only suitable for certain applications. Lower wattage T8 lamps have reduced lighting output so it is important to ensure recommended lighting levels are verified before lamp replacement. In addition, compatibility with existing ballasts, local codes and other requirements must be verified prior to retrofitting. Switching to lower wattage T8 lamps will have sustainable energy savings with minimal cost or impact. For example, replacing a "Standard" 32-watt, 2800 lumen T8 lamp with a high performance 28-watt, 2725 lumen T8 lamp will approximately have a 12% lighting energy reduction with only a lighting level drop of 3%.

The estimated costs and savings noted below are based on replacement of existing 32-watt T8 lamps. Estimates are based on a preliminary walkthrough of the facilities. A detailed lighting analysis should be performed to determine exact cost, quantities and configuration to maximize the energy savings and lighting performance.

Bill Childress Elementary: The existing fixtures are T8 fluorescent lamps with older ballasts. A retrofit to low wattage T8s would include replacing the ballasts as well.

Canutillo High School: This facility is substantially over-lit. A more efficient lighting design or de-lamping existing fixtures could achieve large energy savings. Following are some examples:

1. Typical corridor lighting uses a combination of HID fixtures, U-bend fluorescent fixtures and 4-lamp fluorescent fixtures at 8' on centers, where using 2-lamp fixtures at 14' on centers is usually considered adequate. If the ballast configuration allows it, half of the lamps should be removed from each fixture. If a ballast change is necessary, the replacement lamps and ballast should be the new low-wattage T8 lamps. The modifications must preserve or restore emergency egress lighting in the corridor.

2. Library lighting uses a combination of HID and U-bend fluorescent fixtures, where 3-4 lamp fluorescent fixtures are usually considered adequate. When lights were on, a light level of 100 footcandles was measured. Delamping to adequate lighting of 40-50 foot-candles could achieve approximately 50% in energy savings.

LOW WATTAGE T8 FLUORESCENT LIGHTING RETROFIT				
Building	Estimated Implementation Cost	Estimated Annual Savings ($/yr)	Estimated Energy Savings (MBTU/yr)	Simple Payback (years)
Bill Childress Elem	$47,100	$5,900	176,513	8.0
Davenport Elem	$12,900	$2,300	74,323	5.6
Damian Elem	$14,700	$2,900	86,683	5.1
Garcia Elem	$12,900	$2,600	73,758	5.0
Canutillo Elem	$22,500	$4,500	131,949	5.0
Canutillo Middle	$27,500	$5,700	168,373	4.8
Alderete Middle	$18,700	$4,000	125,027	4.7
Canutillo High	$41,600	$11,900	357,058	3.5
TOTAL	**$197,900**	**$39,800**	**1,193,685**	**5.0**

HID TO FLUORESCENT INDOOR LIGHTING FIXTURE RETROFIT

Some of the District's larger interior spaces utilize High Intensity Discharge (HID) fixtures. It is recommended that the District replace the existing HID fixtures with fluorescent fixtures suitable for these 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 Energy Savings (MBTU/yr)	Simple Payback (years)
Bill Childress Elem (gym/café)	$11,200	$1,600	47,868	7.0
Davenport Elem (gym/café)	$11,200	$1,600	51,703	7.0
Damian Elem (gym/café)	$11,200	$1,700	50,814	6.6
Canutillo Elem (gym/café)	$10,500	$1,600	46,915	6.6
Canutillo Middle (2 gyms)	$18,200	$3,300	97,479	5.5
Alderete Middle (gym)	$7,000	$1,100	34,382	6.4
Canutillo High (gym, library, hallways)	$16,100	$2,900	87,014	5.6
Facilities	$14,000	$1,300	41,211	10.8
TOTAL	**$99,400**	**$15,100**	**457,387**	**6.6**

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 following table below provides an estimated cost and energy savings for the installation of these types of sensors. Please note this estimate is 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., special-purpose classrooms, administration offices, break rooms and storage rooms).

MOTION SENSOR INSTALLATION				
Building	Estimated Implementation Cost	Estimated Annual Savings ($/yr)	Estimated Energy Savings (MBTU/yr)	Simple Payback (years)
Bill Childress Elem	$14,300	$1,900	56,843	7.5
Davenport Elem	$10,300	$1,400	45,240	7.4
Damian Elem	$9,700	$1,300	38,858	7.5
Garcia Elem	$9,700	$1,400	39,716	6.9
Canutillo Elem	$12,800	$1,900	55,712	6.7
Canutillo Middle	$15,400	$2,200	64,986	7.0
Alderete Middle	$14,300	$2,400	75,016	6.0
Canutillo High	$19,800	$3,300	99,016	6.0
Facilities	$2,200	$300	9,510	7.3
Administration	$7,700	$1,100	39,260	7.0
TOTAL	**$116,200**	**$17,200**	**524,157**	**6.8**

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, conduct basic research to adjust operating parameters to enhance comfort and reduce energy consumption. For more information regarding building commissioning, the different forms of commissioning, list of certification bodies, typical costs and benefits see **Appendix F**.

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.

Preliminary examination of Canutillo High School indicates potential for energy cost savings primarily in the **ground loop water pumping operation**. The following estimates are based on a preliminary walkthrough, available utility data analysis, and discussion with staff. Also included in the estimated implementation cost are deferred maintenance items which may include minor repairs and upgrades to the HVAC and control system, minor sequence changes that may need re-programming by vendor, and personnel training on control of the HVAC equipment. Deferred maintenance items are typically identified in the commissioning survey and included on the facility action list for the Owner to address. Project (detailed assessment plan, analysis and implementation), if authorized, would normally be accomplished by an organization/firm with engineers specializing in Cx and project implementation. The following table summarizes the implementation costs, annual savings and payback for the above project.

BUILDING COMMISSIONING (Cx)				
Building	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Estimated Energy Savings (MBTU/yr)**	**Simple Payback (years)**
Canutillo High	$41,100	$13,700	411,067	
Deffered Maintanence Items	$12,330	-	-	
TOTAL	**$53,430**	**$13,700**	**411,067**	**3.9**

The following table summarizes the implementation costs, annual savings and simple payback for the various energy cost reduction measures projects identified in this section:

SUMMARY OF UTILITY COST REDUCTION MEASURES				
Project Description	**Estimated Implementation Cost**	**Estimated Annual Savings ($/yr)**	**Estimated Energy Savings (MBTU/yr)**	**Simple Payback (years)**
LOW WATTAGE T8 FLUORESCENT LIGHTING RETROFIT	$197,900	$39,800	1,193,685	5.0
MOTION SENSOR INSTALLATION	$116,200	$17,200	524,157	6.8
T12 TO T8 FLUORESCENT LIGHTING RETROFIT	$39,200	$5,800	198,467	6.8
HID TO FLUORESCENT LIGHTING RETROFIT	$99,400	$15,100	457,387	6.6
BUILDING COMMISSIONING (Cx)	$53,430	$13,700	411,067	3.9
TOTAL:	**$506,130**	**$91,600**	**2,784,764**	**5.5**

The above projects implementation costs and annual savings are estimated based on a preliminary examination of the facilities. Furthermore, maintenance cost 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.

9.0 FACILITY IMPROVEMENT MEASURES

This section describes facility improvement measures that have energy savings opportunities but cannot be justified solely based on the potential energy savings. The following are the facility improvement measures recommended for the District.

INSTALL ENERGY MANAGEMENT SYSTEM (EMS)

Install Direct Digital Control (DDC) Energy Management System (EMS) to provide optimum scheduling and precise temperature supervision for the HVAC systems throughout each facility listed on the following page. The EMS will minimize the run time of the units while maintaining comfort throughout the facility. Additionally, EMS can remotely diagnose and document HVAC maintenance problems.

Local, manual selector switches (as shown in the figure below) presently control the District's Direct Evaporative Cooling (DEC) systems. The teachers or staff must manually select fan speeds, enable or disable the pumps, and in many cases, manually operate windows to achieve space comfort.

Typical selector switch for evaporative coolers

Stand-alone, local thermostats control heating water convectors, unit heaters, furnaces and Direct Expansion (DX) cooling systems. Boilers are started manually at the beginning of heating season and operate when the outdoor temperature is below a local thermostat limit and a local timeclock schedule allows. There is no centralized mechanism for managing, or even monitoring, the temperature in each space, or controlling the setpoints of thermostats.

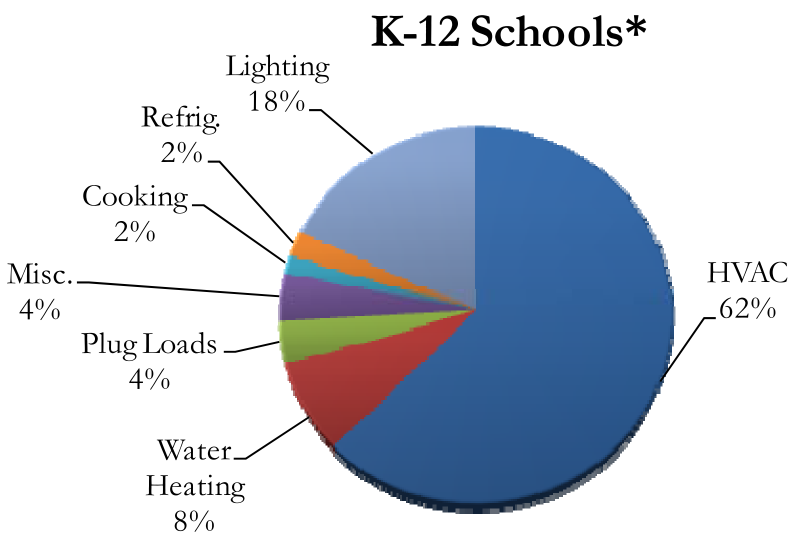
Installing an EMS for control of heating and cooling equipment (even if excluding DEC units) will improve maintenance, management and performance. Even a monitor-only system will allow the maintenance staff to see where equipment has failed and respond before poor comfort conditions are reported by phone. *The cost estimate below is for schools with DEC units are for an energy-monitoring only type system with additional control of the boiler.* EMS systems for schools with RTUs or other means of cooling are estimated to have basic functions such as remote access capabilities, multiple scheduling, space temperature reset, and optimum start/stop features. The table below summarizes the estimated cost and saving for each proposed EMS project.

EMS INSTALLATION	
Building	**Estimated Implementation Cost**
Bill Childress Elem	$38,100
Davenport Elem	$25,000
Damian Elem	$21,900
Garcia Elem	$57,900
Canutillo Elem	$27,200
Canutillo Middle	$39,800
Alderete Middle	$57,500
Canutillo High	$261,000
TOTAL	**$528,400**

10.0 FOOD SERVICE AND KITCHEN EQUIPMENT ENERGY SURVEY

Upon request of the District, TEESI investigated the energy consumption of the District's food service and kitchen equipment. The District's Food Service Department is a separate profit center, thus, being able to quantify the energy consumption of the food preparation activities will help the District better understand the energy performance of their Food Service operations. This section summarizes the findings of TEESI's investigation of the energy consumption of the District's Food Service Department.

Natural gas consumption in educational facilities consists of three main factors; space heating, water heating, and cooking. The following chart summarizes a breakdown of energy consumption for schools in Texas and surrounding states (Courtesy: DOE EIA 2003 CBECS).



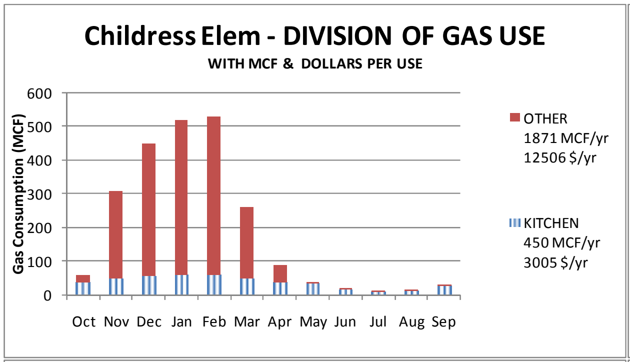
* DOE EIA 2003 CBECS - K-12 Schools in West South Central Region (TX, OK, AR, LA)

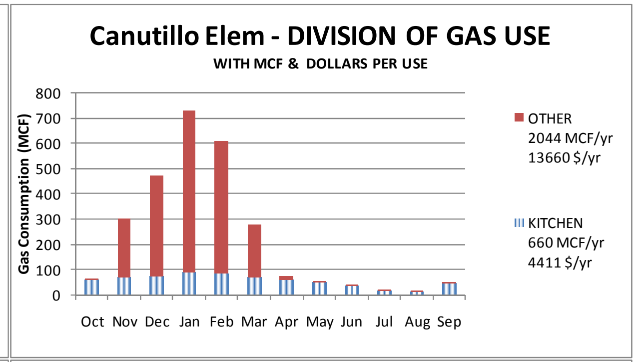
To assess the District's Food Service natural gas consumption, the 12-month utility data was analyzed and separated into the major usage categories.

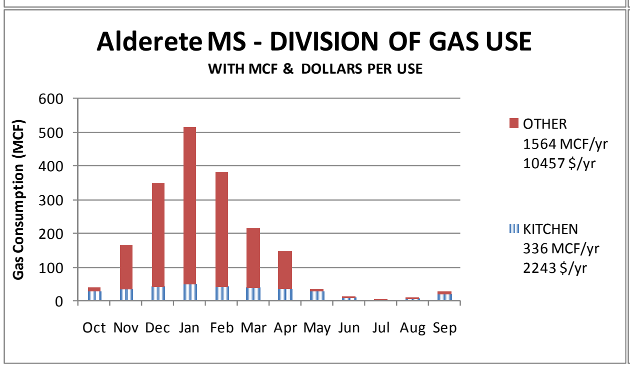
- **Seasonal & Non-Seasonal Usage:** Seasonal usage was separated from constant usage (such as water heating and cooking) by subtracting the May consumption (representative of non-heating season and full occupancy) from each month's bills.
  - **Seasonal usage** was all attributed to space heating.
    - Food service heating usage was extracted from the other heating usage by a square-footage ratio.
  - **Non-seasonal usage** was attributed to kitchen uses (cooking, potable water heating, dishwasher water heating, etc.) and domestic water heating for non-kitchen uses, such as lavatories and gym showers.
    - Non-kitchen uses were estimated as a small fraction the non-seasonal usage. This percentage ranged from 10% for elementary schools to 50% for the high school, allowing for more showering in the higher grades.

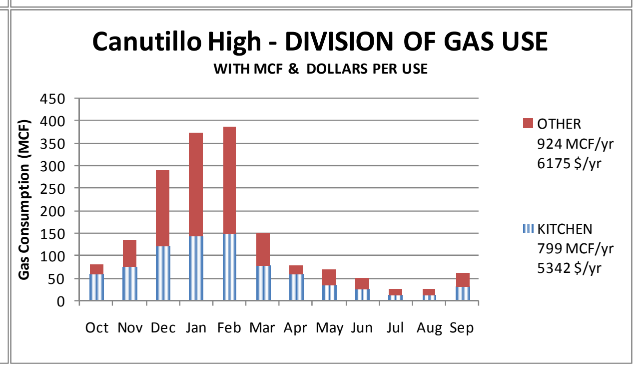
- **Foodservice Usage –** Foodservice usage was assumed to be the sum of the kitchen space heating usage and the kitchen part of the non-seasonal usage (water heating, cooking, dishwasher heating, etc.).

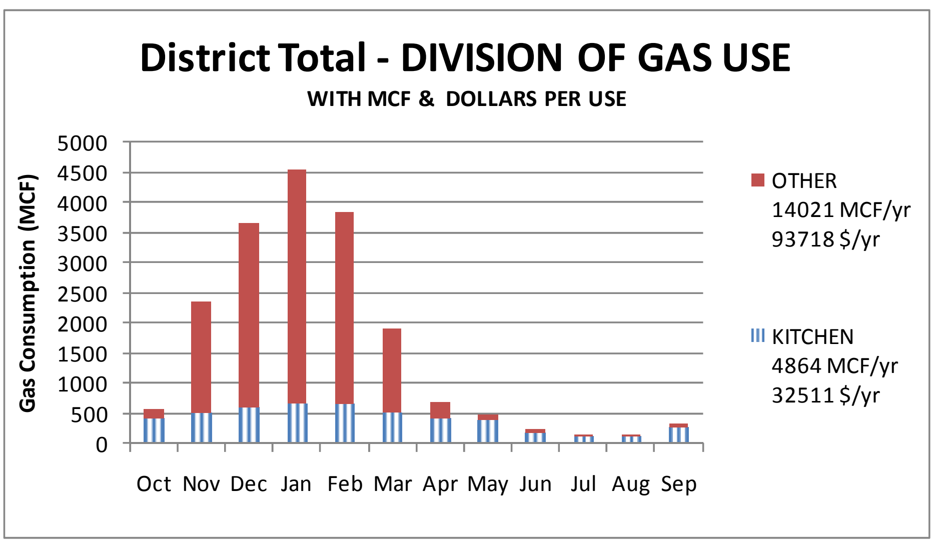
The following charts represent the findings of the natural gas consumption of the Food Service Department for selected schools over the 12-month utility data period.











The analysis of the natural gas use of the District's Food Service Department showed that the total estimated consumption was 4,864 MCF over the 12-month utility data period resulting in a cost of $32,511.

The district expressed an interest in sub-metering the kitchen gas use for purposes of obtaining reimbursement funds offered to the Food Service Department. If reimbursement offer is for 100% of the cost of foodservice gas, addition of gas meters would appear to be a very good investment. The table below summarizes the estimated meter installation cost and possible reimbursement for the project, along with estimated payback.

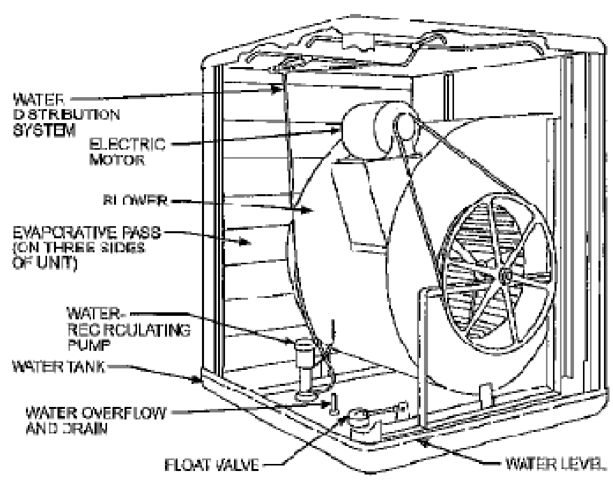
SUBMETER FOOD SERVICES DEPARTMENT			
Building	**Estimated Implementation Cost**	**100% Reimbursement ($/yr)**	**Simple Payback (years)**
Bill Childress Elem	$800	$3,005	0.3
Davenport Elem	$800	$4,411	0.2
Damian Elem	$800	$5,449	0.1
Garcia Elem	$800	$3,363	0.2
Canutillo Elem	$800	$2,140	0.4
Canutillo Middle	$800	$2,243	0.4
Alderete Middle	$800	$6,559	0.1
Canutillo High	$800	$5,342	0.1
TOTAL	**$6,400**	**$32,511**	**0.2**

11.0 ANALYSIS OF EVAPORATIVE COOLING SYSTEMS

Presently, the District uses Direct Evaporative Cooling (DEC) for some of its facilities. Some of the newer facilities use Direct Expansion (DX, or refrigeration) for cooling. The District requested help evaluating the advantages and disadvantages of evaporative cooling in their facilities. The climate in El Paso, TX is legendary for its suitability for effective evaporative cooling. Because evaporative cooling is less expensive to install and typically uses only ¼ as much energy as refrigerated air, facility managers are reluctant to abandon DEC in favor of DX. Requests to change from DEC to DX has been rising, based on experience with poor comfort control and perception that DEC is outdated and incapable of providing true comfort control. The maintenance department is largely trained for and familiar with DEC, but may need some additional training and staffing to maintain DX equipment, so a change to DX would require some change in that department.

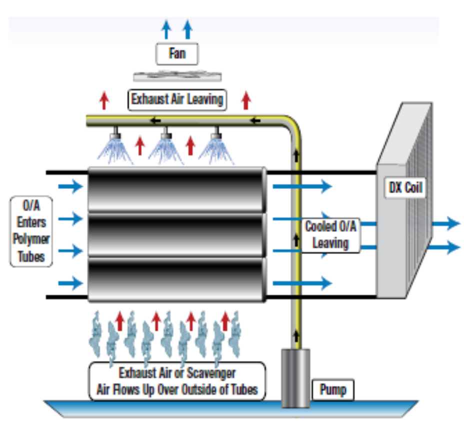
COMMON FORMS OF EVAPORATIVE COOLING

DEC: Direct Evaporative Cooling is the process of cooling air by evaporating water directly into it. DEC equipment is simple, usually including a two-speed blower and a very small water pump. Water is distributed over a wicking material through which air is drawn into the space to be cooled. Typically, the space occupants select the fan speed and decide whether to run the water pump, thereby controlling the space temperature to comfort conditions without any thermostat. The air passes through the DEC and the room one time and is released to the outdoors. All evaporative cooling in the District is of this type. Most of the District's DEC's are sized for about 6500 CFM, which is appropriate for about one (1) classroom. Multiple units are usually used for larger spaces, although larger units are also available. DEC systems are most commonly applied to space cooling, as they are at this District. However, a DEC can also be used to pre-cool ventilation air. In that application, it may be equipped with a heating system and even a refrigeration coil to insure that the ventilation air is fully conditioned all year. In the El Paso climate, a DEC ventilation unit would typically not have a refrigeration coil.



Source: 2008 ASHRAE Handbook

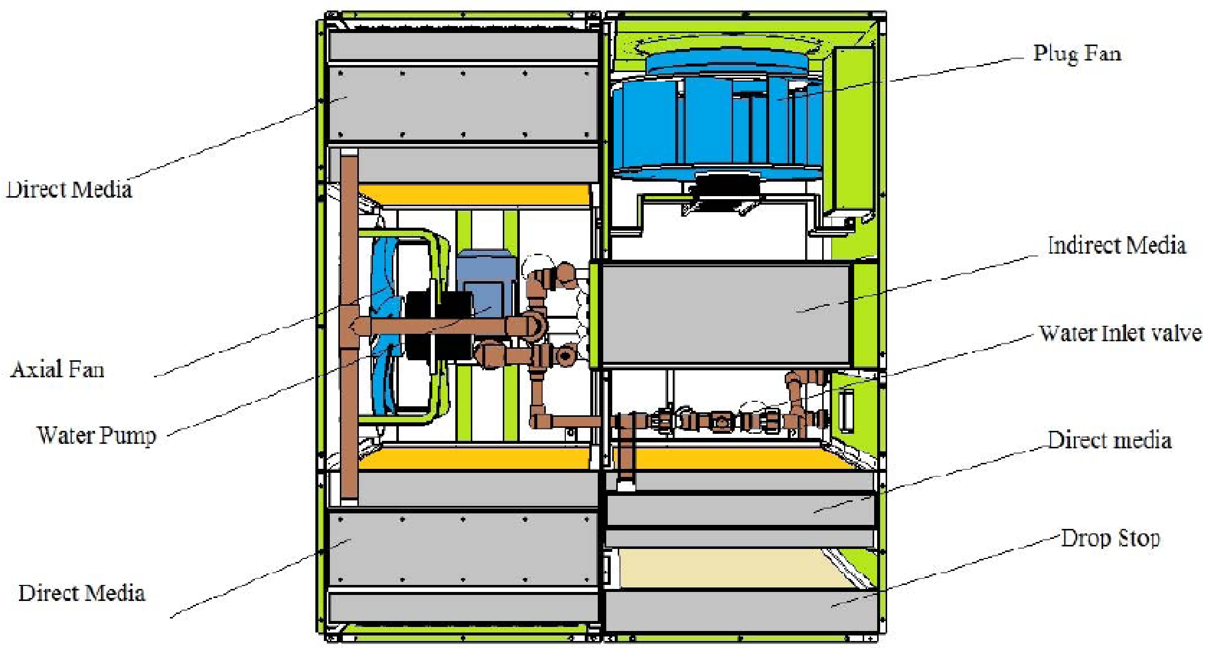
IEC: Indirect Evaporative Cooling is the process of cooling an airstream (primary air) by evaporating water from the outer surfaces of its duct into a second airstream (scavenger air). The direct water evaporation into the scavenger air cools the primary air without adding any moisture to it. While many configurations are possible, the most common is to pass the primary air once through the space to be cooled and then use it as scavenger air. This configuration can deliver cool, dry air to the space served. In winter



Source: Oasis EPX Product Guide

mode, it can be operated dry to transfer about 50% of the exhaust air heat to the intake air. No IEC systems are in use in the District. IEC is normally only economical at a scale larger than a single classroom. It is seldom applied except as part of an IDEC system, which is described below.

IDEC: Indirect-Direct Evaporative Cooling is an IEC followed by a DEC. Since the air exiting the IEC is cool and dry, it gets even cooler and remains dryer after passing through the DEC than if it were passed through the DEC only. Since the air all enters from the IEC end and goes out the other end. the DEC section is normally a wetted honeycomb or porous foam pad in a "tunnel" rather than multiple low-tech pads around a box. No IDEC systems are in use in the District. IDEC is only economical at a scale larger than a single classroom. The most common application of an IDEC is pre-cooling ventilation air. In that application, it may be equipped with a heating system to insure that the ventilation air is fully conditioned all year. In the El Paso climate, an IDEC ventilation unit would typically not have a refrigeration coil. The figure below illustrates one of the most recent designs on the market. It cools water on the left side with a little built-in cooling tower (fan and direct media). The tower basin water then cools the entering building air via a cooling coil ("indirect media"). Finally, the cooled air is further cooled by direct evaporation before exiting horizontally at the lower right.



Source: Speakman Air$_2$O IDEC (Top View)

ERC: An Evaporative Refrigerant Condenser uses direct evaporative cooling (DEC) to pre-cool outdoor air entering a refrigerant condensing coil. Typically, a DEC pad "bolts on" to the condenser coil, and the refrigeration unit fan moves the air through it. In the El Paso environment, this enables an air-cooled refrigerated air (DX) system to discharge its heat at 20°F to 30°F lower temperature than with dry condenser air. This results in a reduction of 1/3 to 1/2 in refrigeration power in very hot weather. The District is not using any ERC systems. These systems are most economical at sizes larger than most refrigeration cooling units in the District. However, they should be considered for large, air-cooled refrigeration units rated over 15 tons; especially air-cooled chillers, whether existing or future. Applying ERC kits to units in the vicinity of other evaporative cooling equipment (such as intakes to ventilation pre-treatment units) must be done carefully to avoid reducing the performance of those units.

CT: A Cooling Tower is a direct evaporative cooler (DEC) in which the desired product is cool water rather than cool air. The cool water is typically used to condense refrigerant in a water chilling system, but in an environment like El Paso, it can also produce water cold enough for space cooling some of the cooling season, and cool enough for pre-cooling ventilation air most of the year. Cooling towers are commonly used to serve water-cooled chillers in a central chilled water systems. However, they can also be used to provide cooling water to water source heat pumps or water cooled packaged air conditioning systems. The CT system can be linked to the chilled water system via a heat exchanger to provide chilled water without using chiller during parts of the year.

A cooling tower can deliver colder water if the air entering it is first cooled by coils containing some of the cold water that it has generated. This configuration is known as an IDEC cooling tower. It is substantially more expensive than a single-stage cooling tower, but the colder water produced is able to cool rooms much more often than can the water from a single-stage tower. This colder water is especially attractive for use in the first stage of an IDEC system. To insure than an IDEC system built around it produces comfort conditions all year, a chiller can make the water even colder in times of high humidity.

EVAPORATIVE COOLING LIMITATIONS

Where DEC systems are used in this District, the Heating, Ventilating and Air Conditioning (HVAC) system is switched manually from heating to cooling in the spring and back to heating in the fall. In some facilities, DEC units and gas-fired furnaces share distribution ducts, so this process involves physically reconfiguring the ductwork with guillotine dampers, so going back and forth between heating and cooling as weather changes from morning to afternoon or from week to week is not practical. Where heating is provided by hot water convectors, control could be arranged to allow each room to choose heating or cooling during swing months. If the persons operating the DEC units and the manually-adjusted heating thermostats can be counted upon to manage them correctly, making the choice of heating or cooling a room-by-room decision could greatly extend the hours during which comfort conditions can be maintained by such systems.

Regardless of how diligently maintained and operated, however, the existing DEC systems cannot provide industry-standard comfort conditions during all school hours. Also, the DEC units and the exposed water distribution lines serving them must be drained before first prospect of freeze in the fall and not re-filled until after last threat of freeze in the spring; so hot days between those dates cannot utilize evaporative cooling.

In cooling season, DEC systems provide an abundance of fresh air. The maintenance crews disable the DEC fans, drain the water reservoirs and close the discharge air dampers to winterize the systems. This procedure precludes ventilation of the space through the DEC in the winter. Most spaces served by DEC have no reliable winter ventilation other than via natural ventilation through operable windows. Such ventilation is very uncomfortable during cold weather, and is not easily regulated or even measured. Some areas in some facilities have roof-mounted make-up air units with gas furnaces for winter ventilation.

ALTERNATIVES TO EXISTING EVAPORATIVE COOLING

Unitary DX Systems:

Where first cost is the limiting issue, Unitary DX Systems (DX RTU's or DX split systems) are highly attractive. They are among the least expensive forms of refrigerated air conditioning, and the service technician requirements are almost the same as for residential cooling systems. These units have a typical useful life of about 15 years, comparable to residential split DX systems. Unitary systems are widely used in schools, both in split system form (indoor furnace and outdoor condensing unit) and as single-package ground or rooftop form. Where used to replace DEC's, a major electrical distribution upgrade is required. Also, the DEC duct system is very large compared to the refrigerated unit's airflow, so duct and air diffuser modifications will be required.

Unitary Systems can be selected to totally replace the DEC units and provide full comfort cooling (and heating if needed) in all weather. However, it is difficult to configure a small DX cooling system sized for one or two classrooms to function correctly over a wide range of classroom loads, ventilation air temperatures and condensing temperatures. Multi-staged equipment is typically required, increasing the complexity, design and construction cost above what is common in residential and commercial applications. Therefore, it is very attractive to select unitary equipment to carry only the internal and shell loads, and to supply pre-treated fresh air through a Dedicated Outdoor Air Handler (DOAH).

Chilled Water System:

Chilled water is easily shared between the cooling needs of multiple spaces and ventilation systems, allowing one cooling plant to "swing" its capacity from one area to another and from one task to another without the need for many small pieces of variable-capacity equipment. If equipped with demand-responsive controls and variable-capacity equipment, a chilled water system is among the most efficient, durable and flexible cooling systems available. Because chilled water cooling is easily modulated, it interfaces well with a supplemental cooling method like evaporative cooling. It does not overcool the entering air even if it is already nearly cool enough. This is in contrast to the problem with one-stage DX cooling cited above.

Chilled water plants enhance cooling durability and reliability. Large chillers are constructed for longer life and easier maintenance than small DX units. The room air circulating equipment is separate from the chilling equipment, so one part does not have to be replaced if the other fails beyond repair. The piping infrastructure is expensive to install initially, but it has a long life. The piping also reduces the cost of electrical distribution that would be needed for distributed cooling units like DX RTU's.

Frequently, two chillers are used so that at least one chiller will remain in service while the other is down for maintenance or repair. One chiller sized for 1/2 of the peak load can typically handle the full system load if a chiller outage is scheduled during cool weather. Three chillers, each sized for 1/2 of the load, provide immunity from a single chiller failure even during peak load conditions. By comparison, it would take two or three DX units for each space to provide the same level of refrigeration reliability.

Chilled water plants are often too complex to be maintained by the maintenance staff of a school district. Service companies with chilled water service technicians are widely available, and most districts with chilled water plants retain the services of one on an annual contract basis to perform routine maintenance and service. In addition to regular equipment service and maintenance, water treatment contractor services are also required which are essential for chilled water system. The scope of services contracted out can be reduced if and as the District acquires internal expertise

For systems large enough to utilize centrifugal compressors (each chiller rated 300 tons or more), at least one chiller (and perhaps two of three chillers) should have variable speed drives to improve efficiency at the reduced condensing temperatures available in the El Paso climate.

Chilled water systems also integrate easily with chilled water thermal storage, which allows chillers to operate mostly at night, when heat rejection can be accomplished at low temperatures. Additionally, the chillers can be sized smaller because they will have more hours in which to provide the daily cooling demand. The electrical demand charge for the chillers will be substantially reduced in any case, and most utilities offer incentives for the use of thermal storage. Typical incentives include reduction of demand charges and token assistance with the cost of storage tanks and added controls. System operations are slightly complicated due to added complexity of controls, as such, additional training of maintenance and operation staff is essential for project to be successful.

Water Source Heat Pump System:

A water source heat pump system is another method of distributing cooling from a central cooling tower and boiler or from a network of pipes embedded in the ground. The nearly-constant ground temperature provides a modest temperature store from which to draw heat in winter and dispose of it in summer. However, the cost of a ground-coupling piping network is high. A cooling tower for summer heat rejection provides approximately the same annual cooling benefit for a smaller investment and little more energy use. A boiler provides heat less expensively. Water-source heat pump systems allow great design flexibility, as individual room cooling systems need not be located outdoors to take advantage of evaporative heat rejection.

Two-Pipe Ventilation Pretreatment System:

In the humid part of the summer, a cooling tower, even an IDEC one, typically cannot provide water cool enough to cool room air from 75°F to 55°F like a DX or chilled water system can. However, it can be used to cool 100°F outdoor air to somewhere around 85°F (maybe as low as 75°F for an IDEC CT), which is a great reduction of cooling load for ventilation air. If this air is then passed through a DEC system, it can often come out well below room temperature, assisting with room cooling as well as removing the outdoor air cooling load. This system is a type of IDEC, with the cooling tower water cooling the air indirectly and the DEC completing the IDEC process. See the IDEC heading under "Common Forms of Evaporative Cooling" above for similarities between this system and the Speakman IDEC system illustrated there. Additionally, a cooling tower water loop and water coils used only for ventilation air cooling is never needed for cooling when the outdoor temperature is low, so if connected to a boiler, it can serve as a heating water supply system for preheating outdoor air in cold weather.

COMPARATIVE ANALYSIS OF SEVERAL COOLING SYSTEMS

Reports by the American Society of Heating and Refrigeration Engineers (ASHRAE) and many published research papers and case studies indicate strongly that evaporative cooling is an economical and viable school cooling method, especially in a hot, dry climate like west Texas. A study funded by the State of New Mexico has a wealth of information about how to design, maintain and operate evaporative cooling systems in schools.[1] The maintenance and operating sections are especially recommended. The table "*Performance and Cost Comparisons for Cooling Systems*" following this section was developed from an in-house study by TEESI, in which evaporative cooling was modeled as an alternative to and/or a supplement to refrigerated air conditioning. All scenarios are for a single classroom in the climate of El Paso, TX.
The system pricing in the chart below does not include infrastructure upgrades such as extended electrical distribution, new water distribution, or roof structure upgrades, as the need for these upgrades is not universal to all sites, and upgrade costs are highly variable from one facility to the next.

In the following analyses, be aware of the distinction between space cooling and ventilation air cooling. To cool a space, the air supplied to it must be colder than the desired space temperature. In refrigerated air systems, the supply air is typically cooled 20°F below the room temperature. In DEC cooling systems, the air is usually cooled only 4°F below space temperature under high load conditions, so about five times as much air is needed to deliver the same cooling. An IDEC system typically delivers air at about a 8°F below room temperature, so it uses 2.5 times as much air as a refrigerated air system and half as much as a DEC system.

When cooling ventilation air, the primary task is to bring the air temperature down to room temperature so that it doesn't add heat to the room. If it can be brought lower than room temperature, that additional cooling is considered space cooling.

Notice that a DEC or IDEC system uses 100% outdoor air. When used for space cooling, only 450 CFM of that outside air (about 7% of a DEC system or 14% of an IDEC system) is really

[1] *Evaporative Cooling Design Guidelines Manual for New Mexico Schools and Commercial Buildings by J.D. Palmer, P.E. of NRG Engineering; funded by US DOE and NM EMNRD. www.emnrd.state.nm.us/ December 2002.*

needed for ventilation. If the system cools all of the air to room temperature, only 7% (DEC) or 14% (IDEC) of that cooling is actually beneficial. Only when the air is cooled to below room temperature is the system accomplishing space cooling. Water use includes the water evaporated to cool the unneeded ventilation air, so the cooling efficiency per gallon goes down sharply in hot weather. This hot weather water inefficiency is much worse for DEC than for IDEC because the airflow is more and the beneficial cooling is less.

Space Cooling with DEC: Evaporative cooling with a simple 6,500 CFM “swamp cooler” produces satisfactory room temperatures all school year, but produces unsatisfactory humidity about 9% of that time. If additional controls were added to limit humidity, it would fail to meet temperature goals for about 5% of the school year. To achieve this amount of cooling success requires very careful control of the fan speed and the fraction of air that passes through the wetted pad. The simple DEC units used in the District are not capable of achieving the full performance indicated in the chart. Real performance is anticipated to be poorer,
Using a DEC for cheap cooling and a refrigerated air unit for difficult cooling produces very low operating cost, but high initial and maintenance costs. The DEC does about 75% of the load on an annual basis, with the DX unit doing the other 25%. The DEC would need to operate at 450 CFM (7% of its design flow rate) during hot, dry weather while the DX unit caries the remainder of load. The simple DEC units used in the District are not capable of achieving the full performance indicated in the chart below. Real performance will be poorer, but TEESI is not prepared to say how much poorer.

Space Cooling with IDEC: Due to late discovery of this system in a package suitable for a single classroom, TEESI was unable to accurately correlate its in-house simulation with the manufacturer’s performance data. Whether that unit will provide full comfort all year in an El Paso classroom is not clear. However, the published ratings look good enough to warrant a one-classroom trial. This system is the overall top contender for both retrofit of classrooms (and most other spaces) with existing DEC units and for future new classrooms (and most other spaces) that are used only in the non-summer months. Performance will be significantly poorer in summer, when outdoor humidity is higher.

Ventilation Air Cooling with DEC: Using a DX unit all year, but providing an evaporative cooler in its fresh air intake is the most promising strategy for combining DX and evaporative cooling that was explored in this limited study. Evaporatively cooling just the minimum ventilation air flow (450 CFM) when the humidity is low enough eliminates about 37% of the DX cooling and ventilation cost. This strategy outperforms a 1330 CFM economizer (which uses raw outdoor air for free cooling in cool weather). To make the scale of the DEC unit large enough to be economical, one 4500 CFM DEC can pre-treat ventilation air for about ten (10) classroom DX units. This strategy requires ventilation air distribution ducts, which are minimally included in the budget cost. This type of fresh air pretreatment can be used with DX, Chilled Water and Water Source Heat Pump primary cooling systems.

Ventilation Air Cooling with IDEC: A 2500 CFM IDEC unit can supply ventilation air to about five (5) classrooms, reducing the DX cooling capacity required by each of them by about 2 tons. Currently, the District is using 4-ton DX systems to replace DEC units on classrooms. This type of fresh air pretreatment can be used with DX, Chilled Water and Water Source Heat Pump primary cooling systems.

Not analyzed in this study is the potential to use exhaust air for scavenging in the IEC section of an IDEC, providing additional cooling savings and also providing some ventilation heat recovery in winter. (The 2,500 CFM IDEC unit used for estimating cost and savings does not have that feature.)

The costs of some specific DEC and IEC components required for some configurations in the chart following could not be clearly determined during this study. Further engineering analysis will be required to identify the optimum configuration and construction budget. The costs presented are for retrofit applications where water and fan power (but not refrigeration power) are already distributed to each classroom roof.

PERFORMANCE AND COST COMPARISONS FOR COOLING SYSTEMS

Rate.e	0.109	$/kWh	Electric Rate
Rate.w	0.00427	$/Gal	Water Rate
SEER.c	13.0	BTU/Wh	Cooling Efficiency
Rate.c	8.41	$/MBTU	(DX) Cooling Rate
Rate.ec	0.48	$/MBTU	Evapor. Cooling Rate

OVERALL SYSTEM DESCRIPTION	CIRCULATING CFM	ONCE-THRU CFM	COOLING BLOWER HR/YR	COOLING BLOWER KW	BLOWER ENERGY (KWH/YR)	REFRIGERA'N (MBTU/YR)	REFRIGERA'N (KWH/YR)	EVAP'TIVE COOLING (MBTU/YR)	EVAPORATED WATER (GAL/YR)	COOLING & VENTILATION ($/YR)	COOLING COST REL. "BASE CASE"	ANNUAL SAVINGS ($/YR)	FIRST COST ($)	SIMPLE PAYBACK (YR)	NOTES:
DIRECT EVAPORATIVE COOLING, AS EXISTS	0	6,500	1,200	0.622	746	0.00	0	26.50	3,044	94.54	29.7%	224	2,675	-16.2	1,7
DIRECT EVAPORATIVE COOLING w/ DX BACK-UP	950	6,500	1,200	0.622	746	6.74	518	19.77	1,739	145.59	*45.7%*	173	8,975	15.4	3,4,7
DIRECT-INDIRECT EVAPORATIVE COOLING	0	2,500	1,784	0.699	1,248	0.00	0	23.50	2,504	147.06	46.1%	172	5,000	-7.6	2,7
REFRIGERATED AIR WITH RAW OA ECONOMIZER	950	1,400	1,784	0.622	1,109	23.50	1,808			318.83	100.0%	0	6,300	**BASE CASE**	4,7
REFRIGERATED AIR WITH DEC MIN. VENTILATION	950	450	1,784	0.658	1,174	10.17	783	16.33	1,739	221.32	69.4%	98	6,975	6.9	4,5,7
REFRIGERATED AIR WITH IDEC MIN. VENTILATION	950	450	1,784	0.699	1,248	3.27	252	23.23	2,475	174.43	54.7%	144	7,425	7.8	4,5,7
REFRIGERATED AIR WITH DEC ECONOMIZER	950	1,400	1,784	0.699	1,248	7.55	581	18.95	2,019	208.48	65.4%	110	7,350	9.5	4,6,7

NOTES:

1 DEC system alone does not readily provide any winter ventilation. Indoor RH exceeds 60% about 5% of the school year. Indoor RH can exceed 95% occasionally. Also, control is manual rather than thermostatic, so both comfort and economy are dependent on optimal operation each moment. In reality, such control cannot be achieved manually, especially since the fan speed is staged rather than variable, and the fraction of flow through the DEC pad is not variable. DEC does not provide design cooling conditions at all times, so its owning and operating cost cannot be compared fairly with those of a DX RTU that provides comfort conditions at all times.

2 IDEC package priced may be slightly below ideal capacity, but is expected to yeild full comfort about 95% of the year, and be close to comfort conditions all hours. Even if doubled in size, it would not provide full comfort more than about 97% of the year. IDEC with a single remote IDEC cooling tower instead of many mini-towers could have similar performance but different costs.

3 The RTU is only needed for about 9% of the school year, but provides nearly 25% of the required cooling, since it operates in the dampest, hottest weather. The DEC must have fully variable fan speed and fully variable pad bypass to achieve the performance indicated.

4 Pricing and efficiency of refrigerated units is based on rooftop packages. An application engineer can extrapolate data to split systems and central chillers. Pricing for all systems is based on new construction or replacement of a similar system. It does not include power, structual or water supply modifications or demolition of the existing systems that will be required in most retrofit applications. These costs will be quite variable between facilities, and should be considered when budgeting any specific building renovation.

5 Pricing of evaporatively cooled minimum OA packages is based on purchase of a package able to serve several classrooms and sharing the air (and the cost) between them.

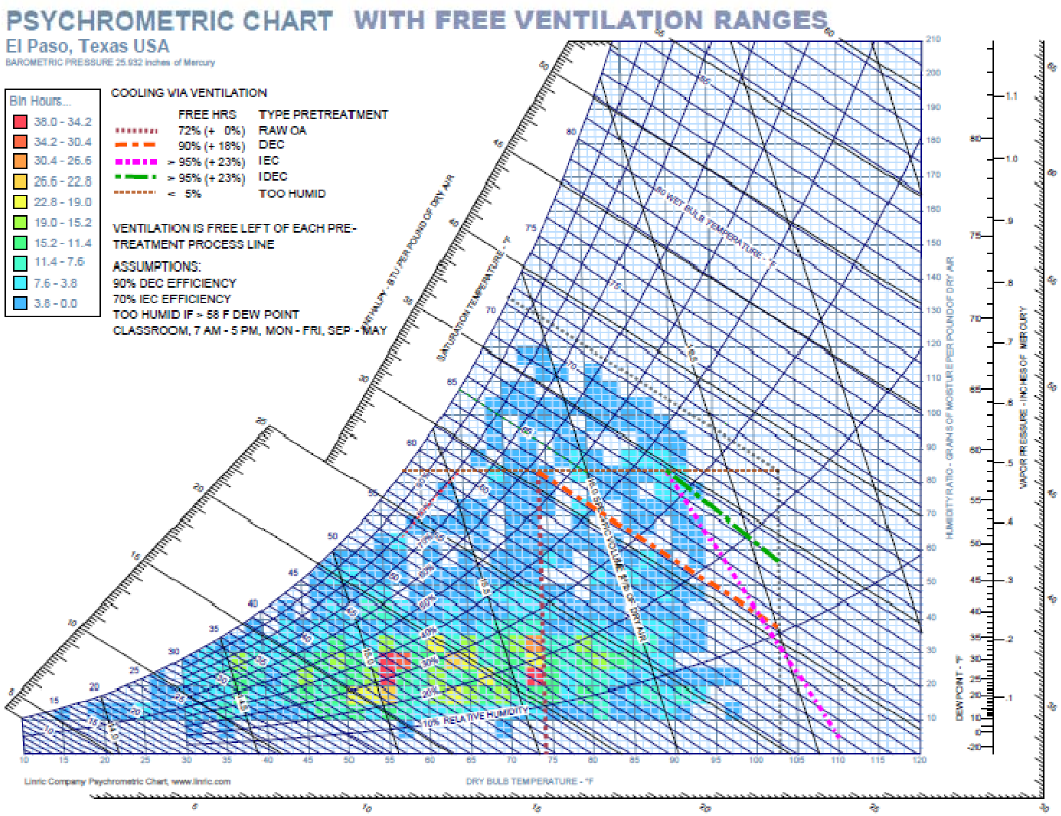
6 Pricing of an evaporative assist kit for an economizer is only approximate. Manufacturers do not offer standard pricing for this feature.

7 In addition to evaporation, systems may bleed off water to prevent mineral deposits. This water is not charged to the evaporative cooling process, as it is reusable for irrigation.

Potential for Ventilation Air Cooling: Even if refrigeration is necessary to provide full-year comfort or is chosen over evaporative cooling as the space cooling method, evaporative cooling is still an economical alternative for ventilation pre-cooling. This is of special importance to the district since many of the existing evaporatively cooled schools have no ventilation during the heating season, and some ventilation system is needed. The climatic data was studied to determine how much of the annual ventilation cooling load could be provided through evaporative cooling without exceeding indoor humidity preferences (about 60°F dewpoint, or 60% RH at 74°F). As noted before, hot, dry ventilation air can be cooled more easily (with less equipment and a more modest temperature source) than room air. Ventilation air, therefore, is an easy target for evaporative cooling in the dry El Paso climate.

Ventilation can be provided by evaporative cooling methods regardless of the type of refrigerated air space cooling system used. Of course, features of the space cooling system may dictate what forms of evaporative cooling will be most easily incorporated. For comparison purposes, the free cooling effect of raw outdoor air (no evaporative cooling) is included in the evaluation of ventilation systems below. Such free cooling with outdoor air is mandated by energy conservation codes, so only the additional benefit of evaporative cooling should be considered. That is, the hours and the cooling savings that can be provided by raw outdoor air must be discounted from the hours and savings that each evaporative cooling system supplies.
Refer to "Psychrometric Chart with Free Ventilation Ranges" below and in Appendix G. The study shows that direct evaporative cooling (DEC) supplies ventilation air without excess humidity for about 90% of the cooling hours in a school year. More hours with acceptable humidity are achievable with IEC and IDEC units. Any of these evaporative cooling methods could be equipped with a heat source to supply warm ventilation in winter. The chart findings are summarized in the following table:

Type of Ventilation	100% Free Ventilation Conditions *(See Psychrometric Chart Below)* and Range of Economizer Benefit *(See Second Psych. Chart Below)*	Fraction of School Yr. Hours
Raw OA (required by code)	Below 69°F (dotted brown lines on graph)	59% (base case)
DEC	Below 63°F wetbulb (dotted red line on graph)	90%
IEC	Up to 58°F dewpoint (dotted purple line on graph)	92%
IDEC	Up to 58°F dewpoint (dotted green line on graph)	96%



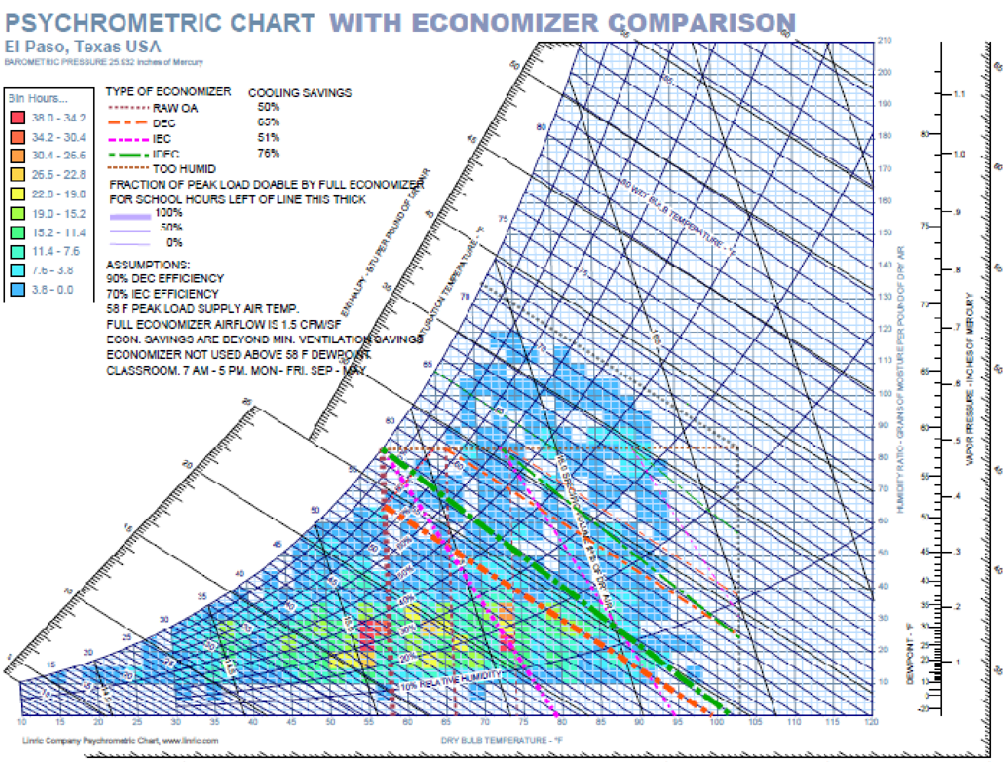
***For expanded view of this Figure, please reference appendix G**

DEC or even IDEC cooling units will not provide adequate comfort cooling for many spaces in summer, requiring that refrigeration units be used to supply space cooling. DEC and IDEC units will still be more cost effective than refrigeration systems for cooling ventilation air. The "*Performance and Cost Comparisons for Cooling Systems*" table shows that DEC pre-cooling has a slight payback advantage over IDEC, but that may reverse if the IDEC unit also serves a heating function and/or provides heat reclaim. In most cases, one DEC or IDEC unit will supply the ventilation needs of many classrooms. The DEC sections of these ventilation units should have variable dry bypasses built in to best control the temperature and humidity of the air they supply.

This type of equipment will not only provide the required ventilation, but will extend comfort cooling through the winter for days that are unseasonably warm. If equipped with suitable heaters, IDEC units will provide comfortable ventilation in cold weather without the need to upgrade heating systems. These ventilation systems can be retained to supply pre-treated ventilation air even if the DEC units are later replaced with refrigerated air units. The pretreatment units will reduce the required cooling and heating capacities of the replacement units.

Evaporative cooling offers a method of extending the effective operating range of economizer cycles. Refer to "Psychrometric Chart with Economizer Comparison" on the following page and in Appendix G. A raw outdoor air temperature-based economizer is required by the International Energy Conservation code, so that is the standard for comparison. This standard economizer insures that no space will need refrigerated cooling if the outdoor air temperature is below about 58°F. (Of course, the space may not need much cooling when it is that cold outdoors. Even if only minimum ventilation is supplied at 58°F, about 38% of the cooling load will be met.) Therefore, the point of interest is how much each evaporative cooling method will expand the conditions under which an economizer will provide free cooling. The approximate results are summarized below:

Type of Economizer	100% Free Cooling Conditions *(See Psychrometric Chart Below)*	School Year Cooling Savings
Raw OA (required by code)	Below 58°F, any RH (dotted brown line on graph)	11% (base case)
DEC	Up to 58°F and below 54°F Wetbulb (heavy dotted red line on graph)	71%
IEC	Up to 58°F @100% RH Up to 79°F @0% RH (heavy dotted purple line on graph)	82%
IDEC	Up to about 58°F Dewpoint (heavy dotted green line on graph)	96%



***For expanded view of this Figure, please reference appendix G**

While the results of this examination show that an evaporative economizer has great promise, the analysis behind the chart "Performance and Cost Comparisons of Several Cooling Systems," revealed that evaporative economizers save little more than evaporative ventilation systems. Most of the savings from evaporative economizer cooling come from the first 450 CFM of mandatory fresh air. Extending the evaporative system airflow capacity by a factor of 2.5 to coincide with the capacity of a refrigeration system supply fan does not greatly increase savings, but it does increase cost substantially.

In conclusion, evaporative cooling systems should be applied where they are most suitable. Direct Evaporative Cooling (DEC) is very energy efficient, but is not capable of meeting all comfort cooling standards under all El Paso weather conditions.

The capabilities and costs of various evaporative cooling configurations and the limitations imposed on them by El Paso weather suggest limiting them to the following applications within existing campuses as well as in future facilities:

1. In Gymnasia, where the acceptable comfort range is broader that in classrooms, DEC is a very practical and cost-effective cooling method.

2. Make-up Air Systems for kitchen and dressing room exhaust replacement can use DEC with acceptable impact on comfort.

3. Where large, air-cooled DX cooling systems larger than 7.5 tons or chillers are present, adding Evaporative Refrigeration Condenser (ERC) kits would greatly reduce energy use and raise capacity.

4. Ventilation Air Pre-Cooling Systems can reduce the refrigeration load required to bring ventilation air to room conditions. Direct (DEC) and direct-indirect (IDEC) evaporative cooling systems have merit. These systems can be used with any type of refrigerated cooling system, such as DX rooftop units, DX split systems, water source heat pumps, and chilled water systems. Applications can be unitary, with one fresh air unit serving a large space or several classrooms, or can be woven into a water cooled chilled water system

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. <u>ESTABLISH ROUTINE ENERGY TRACKING AND REPORTING PROCEDURES</u>
   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. <u>ESTABLISH AN ENERGY MANAGEMENT STEERING COMMITTEE</u>
   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. <u>PROMOTE ENERGY AWARENESS</u>
   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. <u>ESTABLISH ACCEPTABLE COMFORT PARAMETERS</u>
   Establish a District-wide uniform temperature set point for all HVAC units. Having a standard setpoint will make comfort preference disputes less personal. Various legislative standards for temperature setpoints have been proposed and invariably fail

because a comfortable temperature is affected several degrees by any of the following parameters:

Humidity	Air motion
Clothing	Radiant heat
Age	Activity level

During occupied times, temperature setpoints are necessarily a compromise between the differing comfort needs of the occupants. If conditions require that energy be expended to maintain the compromise comfort conditions, additional compromise must be made between comfort needs and energy use. When outdoor air, either untreated or evaporatively cooled, can be used to cool the space, the energy used for cooling is so small that energy cost need not be a factor in selecting the cooling temperature setpoint.

At 50% RH, very light air motion, surrounding surfaces at room air temperature, lighting at usual levels, and no direct sunshine, reasonable beginning setpoints are 74°F cooling, 69°F heating. Obviously, reducing the heating setpoint or raising the cooling setpoint will save energy, but consideration should be given to improving one of the other comfort parameters to compensate.

During unoccupied times, limiting temperature to between about 85°F and 55°F is generally considered good practice, as this reduces damage to the building and contents from frequent, severe temperature changes and from freezing and baking damage. To insure comfort conditions at the start of occupancy, the controller should ramp (or just step, depending on controller sophistication) the temperature setpoint from the unoccupied setting to the occupied setting a few hours before scheduled occupancy. An EMS usually has an "optimized start" routine for determining how far ahead of occupancy the setpoint change should begin. Otherwise, experience within one school year usually reveals the needed lead-time for each space in each season.

Following are some suggested temperature settings. However, the district will need to monitor and ensure that other building parameters (e.g., humidity, sunlight and air motion) are within normal limits, or adjust the setpoints appropriately. Also, areas with special equipment (MDF/IDF, server rooms, etc.) or materials (wood flooring, paper storage, etc.) should be maintained at the equipment supplier's recommended settings and settings appropriate to the material.

Occupied Cooling Temperature Setpoints:

Instructional Areas	74 F – 76 F
Admin Areas	74 F – 75 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

When establishing design criteria for new construction projects, consider using the criteria 74°F at 60% RH for cooling season indoor conditions instead of the more traditional 75°F at 50% RH. This condition is well within the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) comfort envelope, and will nearly always result in similar comfort, a less expensive design and lower operating costs.

5. 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. The following 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.

6. <u>NEW BUILDING AND CONSTRUCTION</u>

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.

7. <u>ESTABLISH A WATER MANAGEMENT PROGRAM</u>

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 COST 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, more funding options are available. Several 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 of the State's utilities 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.

Qualified School Construction Bond (QSCB)

The federal government authorizes tax-free bonds (QSCBs) through the American Recovery and Reinvestment Act (ARRA), which help school districts fund new construction and major renovation projects as well as land acquisition. In total, schools will save an estimated $10 billion in taxes using these bonds. They will also help reduce the cost of borrowing for use in construction projects for public schools. For more information, please visit http://www.qscb.us.

Build America Bonds

Under the American Recovery and Reinvestment Act, the Build America Bond program provides funding for local and state governments in order to allow for capital projects on public buildings, including public schools, water and sewer projects, energy projects, and environmental projects. The bonds work by having the Treasury Department issue a state or local government 35 percent of an interest payment on the bonds. This will cause the borrowing costs incurred by the state of local government to be much less, allowing them to reach further sources of borrowing. For further information, please visit http://www.ustreas.gov.

Energy Efficiency and Conservation Block Grant (EECBG)

The Office of Weatherization and Intergovernmental Programs (WIP) has administered the EECBG, which provides funding to state and local governments for the purpose of improving energy usage and efficiency, as well as improving environmental effects. It is being funded under the ARRA, and can include building retrofits and audits, which aim to reduce energy use in buildings and transportation. The State Energy Conservation Office receives a portion of these funds to distribute to cities and counties interested in these projects. Further information can be found by visiting: http://www1.eere.energy.gov/wip/eecbg.html

Qualified Energy Conservation Bonds (QECB)

Energy projects can be eligible for QECBs, which are tax credit bonds that serve to assist with energy efficient capital projects, renewable energy usage, and reductions in energy consumption. The federal government has issued this loan program, which assists with funding of the interest costs for the bonds. These energy conservation bonds are different from tax-exempt bonds traditionally used because they can be regarded as taxable income. For more information on QECBs, please visit http://www.dsireusa.org.

Qualified Zone Academy Bond (QZAB)

QZABs are available for school districts that can utilize the bonds from the federal government for repair and rehabilitation projects. Tax credits are provided to bondholders nearly equal to the interest that the state or community would normally be expected to pay. It can be utilized for projects that qualify for the program. More information can be found by visiting http://www2.ed.gov/programs/qualifiedzone, contact your utility provider to determine what programs are available in your area.

14.0 ANALYST IDENTIFICATION

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Jeremy Taylor, E.I.T.

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.

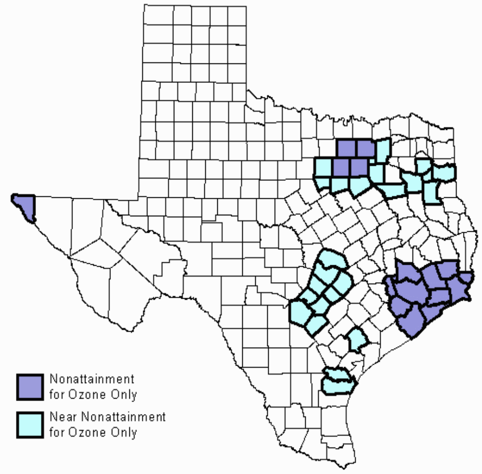
Examples of energy-efficiency measures include:
• installation of insulation and high-efficiency windows and doors • modifications or replacement of HVAC systems, lighting fixtures and electrical systems • installation of automatic energy control systems • installation of energy recovery systems or renewable 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
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Schools Partnership Program:
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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.

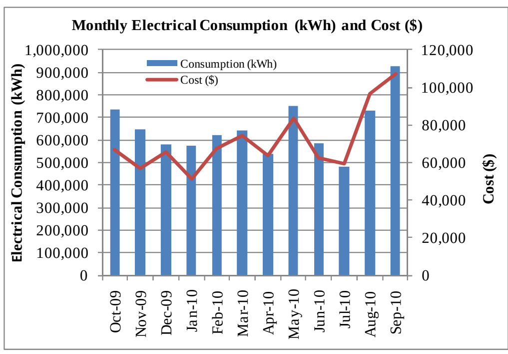
APPENDIX B

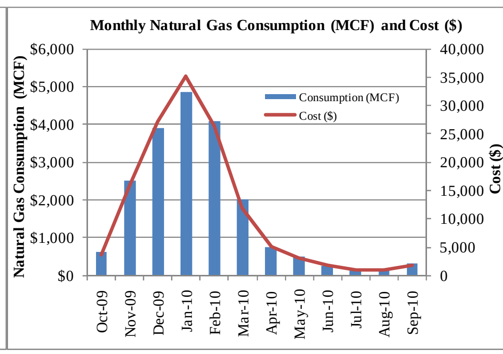
SAMPLE UTILITY DATA REPORTING FORM

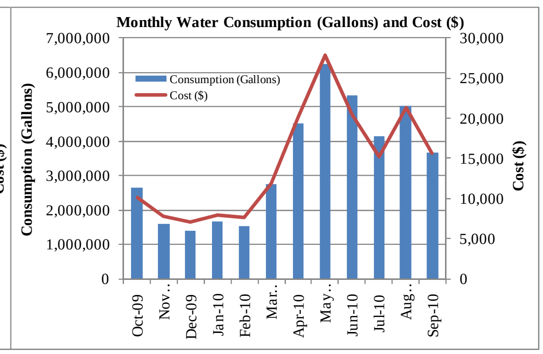
Canutillo ISD - Sample Utility Input Form

MONTH	ELECTRICITY			NATURAL GAS			WATER		
	KWH	COST $	Avg. Rate $/KWH	MCF	COST $	Avg. Rate $/MCF	GAL	COST $	$/GAL
Oct-09	733,578	67,079	$0.0914	$612	$3,678	$6.0	2,638,692	10,113	$0.00383
Nov-09	647,708	56,599	$0.0874	$2,509	$15,798	$6.3	1,600,308	7,791	$0.00487
Dec-09	581,307	65,415	$0.1125	$3,894	$27,112	$7.0	1,386,792	7,056	$0.00509
Jan-10	576,762	51,141	$0.0887	$4,844	$35,107	$7.2	1,648,592	7,950	$0.00482
Feb-10	622,304	67,353	$0.1082	$4,078	$26,428	$6.5	1,533,400	7,686	$0.00501
Mar-10	643,638	74,470	$0.1157	$2,012	$11,880	$5.9	2,747,656	11,870	$0.00432
Apr-10	539,250	63,817	$0.1183	$753	$5,162	$6.9	4,518,668	20,184	$0.00447
May-10	750,873	83,740	$0.1115	$491	$3,033	$6.2	6,248,044	27,829	$0.00445
Jun-10	583,783	62,230	$0.1066	$254	$1,837	$7.2	5,330,996	20,384	$0.00382
Jul-10	483,293	59,505	$0.1231	$138	$1,071	$7.8	4,131,204	15,258	$0.00369
Aug-10	731,307	96,626	$0.1321	$137	$1,010	$7.4	5,040,024	21,348	$0.00424
Sep-10	925,448	107,040	$0.1157	$325	$1,897	$5.8	3,683,900	15,637	$0.00424
Total	7,819,251	$855,016	$0.1093	20,049	$134,011	$6.7	40,508,276	$173,106	$0.00427

Gross Building Area:	1,059,306	SF







APPENDIX C

BASE YEAR
CONSUMPTION HISTORY

Energy Cost and Consumption Benchmarks												
		Electric			Natural Gas			Total	Total	EUI	ECI	
	Building	KWH/Yr	MMBTU/Yr	$Cost/Yr	MCF/Yr	MMBTU/Yr	$Cost/Yr	$Cost/Yr	MMBTU/Yr	kBTU/SF/Yr	$/SF/Yr	SF*
1	Administration	687,760	2,347	65,769	1,164	1,199	8,225	73,994	3,546	78	1.62	45,753
2	Bill Childress Elem	699,898	2,389	75,353	2,321	2,390	15,159	90,512	4,779	53	1.00	90,120
3	Canutillo Elem	599,194	2,045	68,157	2,704	2,785	18,719	86,877	4,830	37	0.66	131,362
4	Damian Elem	494,400	1,687	53,985	2,958	3,047	19,331	73,316	4,734	55	0.86	85,692
5	Davnenport Elem	422,180	1,441	48,780	1,684	1,735	11,140	59,920	3,176	42	0.80	75,173
6	Garcia Elem	501,720	1,712	58,399	1,240	1,277	8,328	66,727	2,990	40	0.88	75,528
7	Alderete Middle	616,582	2,104	74,181	1,900	1,957	12,826	87,006	4,061	36	0.77	112,986
8	Canutillo Middle	988,051	3,372	112,818	4,355	4,486	28,093	140,911	7,858	46	0.83	169,639
9	Canutillo High	2,709,666	9,248	286,190	1,723	1,775	12,189	298,380	11,023	43	1.16	257,086
10	Facilities	99,800	341	11,385	0	0	0	11,385	341	21	0.71	15,967
		KWH/Yr	MMBTU/Yr	$Cost/Yr	MCF/Yr	MMBTU/Yr	$Cost/Yr	$Cost/Yr	MMBTU/Yr	kBTU/SF/Yr	$/SF/Yr	SF
		7,819,251	26,687	855,016	20,049	20,650	134,011	989,027	47,337	45	0.93	1,059,306

* Facility Square footages are based on estimates.

Version 1

District: Canutillo ISD

ACCOUNT# 0137-3040-03 Electric
910336782 1131471 64 Gas
BUILDING: Administration FLOOR AREA: 45,753 estimated

		Electrical					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
Oct	2009	61,760		188		$5,972.94	45	$282.34
Nov	2009	50,120		126		$4,431.86	147	$1,000.06
Dec	2009	48,520		121		$4,277.26	219	$1,608.91
Jan	2010	46,920		128		$4,317.67	295	$2,251.97
Feb	2010	46,240		127		$4,270.00	248	$1,696.34
Mar	2010	61,320		113		$5,844.50	118	$737.34
Apr	2010	36,160		128		$3,349.58	46	$302.62
May	2010	60,520		157		$5,649.99	21	$135.65
Jun	2010	53,960		177		$4,976.82	12	$88.95
Jul	2010	75,800		199		$7,152.32	2	$29.20
Aug	2010	73,760		192		$7,829.18	3	$35.85
Sep	2010	72,680		188		$7,696.75	8	$55.98
TOTAL		687,760				65,769	1,164.2	8,225

Energy Use Index:

Annual Total Energy Cost = 73,994 $/year

Total site BTU's/Yr ÷ Total Area (SF) = 78 kBTU/SF/year

Total KWH/yr x 0.003413 = 2,347.32 MMBTU/year
Total MCF/yr x 1.03 = 1,199.13 MMBTU/year
Total Other x________ = 0.0 MMBTU/year
Total Site MMBTU's/yr = 3,546 MMBTU/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 1.62 $/SF/year

Electric Utility: El Paso Electric

Gas Utility: Texas Gas

ACCOUNT#	3916000000/ 0117-1677-01 4916000000/ 0117-1679-01 5916000000/ 0117-1681-01	Electric	District: Canutillo ISD
	910053318 1494892 36	Gas	
BUILDING:	Bill Childress Elem		FLOOR AREA: 90,120 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
Oct	2009	64,134		213		5,871	61	355
Nov	2009	63,292		179		5,284	308	1,912
Dec	2009	61,357		183		6,360	448	3,083
Jan	2010	58,644		183		4,991	516	3,700
Feb	2010	60,930		181		6,735	529	3,378
Mar	2010	64,631		163		7,400	258	1,500
Apr	2010	58,611		175		5,907	90	549
May	2010	67,996		185		7,178	39	235
Jun	2010	37,340		165		5,007	19	131
Jul	2010	27,141		116		4,081	10	73
Aug	2010	57,628		204		7,711	14	78
Sep	2010	78,194		200		8,828	30	167
TOTAL		699,898				75,353	2,320.5	15,159

* Natural Gas service not included in this summary.

Annual Total Energy Cost = 90,512 $/year

Energy Use Index:
Total site BTU's/Yr ÷ Total Area (SF) = 53 kBTU/SF/year

Total KWH/yr x 0.003413 = 2,388.75 MMBTU/year
Total MCF/yr x 1.03 = 2,390.12 MMBTU/year
Total Other x_________ = 0.0 MMBTU/year
Total Site MMBTU's/yr = 4,779 MMBTU/year

Energy Cost Index:
Total Energy Cost/Yr ÷ Total Area (SF) = 1.00 $/SF/year

Electric Utility: El Paso Electric

Gas Utility: Texas Gas

ACCOUNT#	8365000000/ 0112-3237-02 0465000000/ 0112-3239-01 0112-3205-01 0111-2680-01 0112-3230-01 0112-3220-01 0111-2675-01 Electric
	1522852 82 1452122 64 910315394 1464449 91 Gas
BUILDING:	Canutillo Elem
District:	Canutillo ISD
FLOOR AREA:	131,362 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
Oct	2009	54,772		183		5,034	67	427
Nov	2009	52,554		153		4,548	303	1,921
Dec	2009	56,919		159		6,067	472	3,299
Jan	2010	32,711		156		3,926	729	5,281
Feb	2010	56,163		159		6,427	606	3,932
Mar	2010	58,994		138		6,460	281	1,671
Apr	2010	44,957		156		5,925	76	914
May	2010	57,307		168		6,491	53	359
Jun	2010	43,299		147		4,699	38	299
Jul	2010	29,623		141		4,506	17	170
Aug	2010	46,066		156		6,277	13	134
Sep	2010	65,829		21		7,798	49	312
TOTAL		599,194				68,157	2,703.5	18,719

Annual Total Energy Cost = 86,877 $/year

Energy Use Index:
Total site BTU's/Yr ÷ Total Area (SF) = 37 kBTU/SF/year

Total KWH/yr x 0.003413 = 2,045.05 MMBTU/year
Total MCF/yr x 1.03 = 2,784.61 MMBTU/year
Total Other x________ = 0.0 MMBTU/year
Total Site MMBTU's/yr = 4,830 MMBTU/year

Energy Cost Index:
Total Energy Cost/Yr ÷ Total Area (SF) = 0.66 $/SF/year

Electric Utility: El Paso Electric

Gas Utility: Texas Gas

District: Canutillo ISD

ACCOUNT# 0228-1492-01 Electric
910216881 1091809 27 Gas
BUILDING: Damian Elem

FLOOR AREA: 85,692 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
Oct	2009	50,700		186		4,251	78	450
Nov	2009	45,000		165		3,782	421	2,602
Dec	2009	41,100		153		4,457	682	4,667
Jan	2010	40,200		162		3,396	685	4,891
Feb	2010	48,000		165		4,968	502	3,203
Mar	2010	40,500		153		5,143	261	1,516
Apr	2010	42,300		141		4,561	70	429
May	2010	48,900		186		5,595	87	512
Jun	2010	24,900		147		3,555	40	272
Jul	2010	17,700		93		2,667	34	220
Aug	2010	41,400		159		5,401	34	222
Sep	2010	53,700		165		6,208	64	346
TOTAL		494,400				53,985	2,958.1	19,331

Annual Total Energy Cost = 73,316 $/year

Energy Use Index:
Total site BTU's/Yr ÷ Total Area (SF) = 55 kBTU/SF/year

Total KWH/yr x 0.003413 = 1,687.39 MMBTU/year
Total MCF/yr x 1.03 = 3,046.84 MMBTU/year
Total Other x________ = 0.0 MMBTU/year
Total Site MMBTU's/yr = 4,734 MMBTU/year

Energy Cost Index:
Total Energy Cost/Yr ÷ Total Area (SF) = 0.86 $/SF/year

Electric Utility: El Paso Electric

Gas Utility: Texas Gas

District: Canutillo ISD

ACCOUNT# 0122-1166-01 0122-1168-01 Electric
910003742 1243294 00 Gas

BUILDING: Davenport Elem

FLOOR AREA: 75,173 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
Oct	2009	39,200		132		4,304	56	327
Nov	2009	40,360		147		4,403	218	1,359
Dec	2009	33,480		138		3,930	299	2,074
Jan	2010	37,020		147		3,190	433	3,113
Feb	2010	37,320		141		4,180	401	2,569
Mar	2010	46,480		126		4,617	133	785
Apr	2010	18,880		120		3,133	35	219
May	2010	37,920		132		4,221	39	237
Jun	2010	33,420		123		3,534	24	162
Jul	2010	21,000		120		3,235	14	100
Aug	2010	39,000		141		4,962	11	64
Sep	2010	38,100		150		5,070	23	130
TOTAL		422,180		1617		48,780	1,684.4	11,140

Annual Total Energy Cost = 59,920 $/year

Energy Use Index:
Total site BTU's/Yr ÷ Total Area (SF) = 42 kBTU/SF/year

Total KWH/yr x 0.003413 = 1,440.90 MMBTU/year
Total MCF/yr x 1.03 = 1,734.93 MMBTU/year
Total Other x________ = 0.0 MMBTU/year
Total Site MMBTU's/yr = 3,176 MMBTU/year

Energy Cost Index:
Total Energy Cost/Yr ÷ Total Area (SF) = 0.80 $/SF/year

Electric Utility: El Paso Electric

Gas Utility: Texas Gas

District: Canutillo ISD

ACCOUNT# 5772000000/ 0104-2308-01 Electric

2327970 45 Gas

BUILDING: Garcia Elem

FLOOR AREA: 75,528 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
Oct	2009	47,880		200		4,415	49	288
Nov	2009	41,400		160		3,619	172	1,077
Dec	2009	31,080		136		3,722	376	2,594
Jan	2010	36,720		138		2,948	352	2,541
Feb	2010	37,440		138		4,046	39	267
Mar	2010	35,520		123		4,423	110	653
Apr	2010	37,680		153		4,078	49	308
May	2010	56,040		223		6,523	34	208
Jun	2010	41,520		178		4,586	14	101
Jul	2010	21,960		143		3,654	7	57
Aug	2010	48,960		275		7,889	13	89
Sep	2010	65,520		256		8,495	26	146
TOTAL		501,720		2123		58,399	1,240.1	8,328

Annual Total Energy Cost = 66,727 $/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 40 kBTU/SF/year

Total KWH/yr x 0.003413 = 1,712.37 MMBTU/year

Total MCF/yr x 1.03 = 1,277.30 MMBTU/year

Total Other x_________ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 2,990 MMBTU/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 0.88 $/SF/year

Electric Utility: El Paso Electric

Gas Utility: Texas Gas

ACCOUNT#	0112-3217-01 0112-3345-01 0112-3347-01 0117-3193-01 0112-3195-01	Electric	District: Canutillo ISD
	910068670 1451119 45 910068670 2324748 64	Gas	
BUILDING:	Alderete Middle		FLOOR AREA: 112,986 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
Oct	2009	60,522		178		5,902	37	239
Nov	2009	50,201		148		4,666	167	1,066
Dec	2009	54,148		140		6,036	348	2,431
Jan	2010	30,064		140		3,631	516	3,729
Feb	2010	49,282		143		5,549	381	2,475
Mar	2010	57,994		128		5,994	218	1,289
Apr	2010	36,954		138		5,588	147	945
May	2010	66,121		178		7,827	34	230
Jun	2010	25,532		130		4,680	10	97
Jul	2010	39,063		130		5,608	4	62
Aug	2010	63,805		185		8,868	9	90
Sep	2010	82,896		175		9,834	27	173
TOTAL		616,582		1813		74,181	1,900.0	12,826

Annual Total Energy Cost = 87,006 $/year

Energy Use Index:
Total site BTU's/Yr ÷ Total Area (SF) = 36 kBTU/SF/year

Total KWH/yr x 0.003413 = 2,104.39 MMBTU/year
Total MCF/yr x 1.03 = 1,957.02 MMBTU/year
Total Other x________ = 0.0 MMBTU/year
Total Site MMBTU's/yr = 4,061 MMBTU/year

Energy Cost Index:
Total Energy Cost/Yr ÷ Total Area (SF) = 0.77 $/SF/year

Electric Utility: El Paso Electric

Gas Utility: Texas Gas

ACCOUNT# 0107-2547-01 0107-2548-01 0107-2585-01 0107-2595-01 0107-2580-01 0107-2575-01 0107-2590-01 0107-2549-01 0107-2570-01 0107-2565-01 Electric

910549171 1212259 82 Gas

BUILDING: Canutillo Middle

District: Canutillo ISD

FLOOR AREA: 169,639 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
Oct	2009	89,869		246		8,187	142	802
Nov	2009	92,602		219		8,223	639	3,920
Dec	2009	77,665		243		9,755	760	5,196
Jan	2010	88,465		225		7,654	946	6,736
Feb	2010	85,888		216		9,939	987	6,252
Mar	2010	83,323		219		10,914	482	2,767
Apr	2010	75,754		225		9,198	161	964
May	2010	93,841		270		10,991	114	663
Jun	2010	75,005		258		8,873	47	316
Jul	2010	53,452		186		6,914	25	167
Aug	2010	69,143		279		10,339	16	109
Sep	2010	103,044		252		11,832	36	202
TOTAL		988,051		2838		112,818	4,355.1	28,093

Annual Total Energy Cost = 140,911 $/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 46 kBTU/SF/year

Total KWH/yr x 0.003413 = 3,372.22 MMBTU/year

Total MCF/yr x 1.03 = 4,485.75 MMBTU/year

Total Other x________ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 7,858 MMBTU/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 0.83 $/SF/year

Electric Utility: El Paso Electric

Gas Utility: Texas Gas

ACCOUNT#: 0115-4516-02 0115-4517-02 0115-4518-02 01115-4529-01 0115-4519-02 Electric

910549171 1646397 36 Gas

BUILDING: Canutillo High

District: Canutillo ISD

FLOOR AREA: 257,086 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
Oct	2009	255,741		760		22,218	80	507
Nov	2009	204,879		556		16,969	135	940
Dec	2009	170,538		560		20,021	290	2,159
Jan	2010	199,118		584		16,495	372	2,863
Feb	2010	193,841		508		20,400	385	2,656
Mar	2010	188,776		489		22,705	151	962
Apr	2010	181,954		605		21,342	79	531
May	2010	254,128		785		28,205	70	454
Jun	2010	238,707		613		21,271	50	369
Jul	2010	187,754		509		20,587	26	193
Aug	2010	280,345		893		36,028	25	189
Sep	2010	353,885		869		39,950	62	366
TOTAL		2,709,666		7731		286,190	1,723.0	12,189

Annual Total Energy Cost = 298,380 $/year

Total KWH/yr x 0.003413 = 9,248.09 MMBTU/year

Total MCF/yr x 1.03 = 1,774.69 MMBTU/year

Total Other x________ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 11,023 MMBTU/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 43 kBTU/SF/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 1.16 $/SF/year

Electric Utility: El Paso Electric

Gas Utility: Texas Gas

District: Canutillo ISD

ACCOUNT# 6916000000/ 0117-1682-01 Electric

Gas

BUILDING: Facilities

FLOOR AREA: 15,967 estimated

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
Oct	2009	9,000		39		923	0	0
Nov	2009	7,300		26		674	0	0
Dec	2009	6,500		25		791	0	0
Jan	2010	6,900		24		593	0	0
Feb	2010	7,200		26		839	0	0
Mar	2010	6,100		15		969	0	0
Apr	2010	6,000		15		735	0	0
May	2010	8,100		22		1,059	0	0
Jun	2010	10,100		24		1,049	0	0
Jul	2010	9,800		26		1,102	0	0
Aug	2010	11,200		26		1,323	0	0
Sep	2010	11,600		25		1,328	0	0
TOTAL		99,800		293		11,385	0.0	0

Annual Total Energy Cost = 11,385 $/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 21 kBTU/SF/year

Total KWH/yr x 0.003413 = 340.62 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x_________ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 341 MMBTU/year

Energy Cost Index:

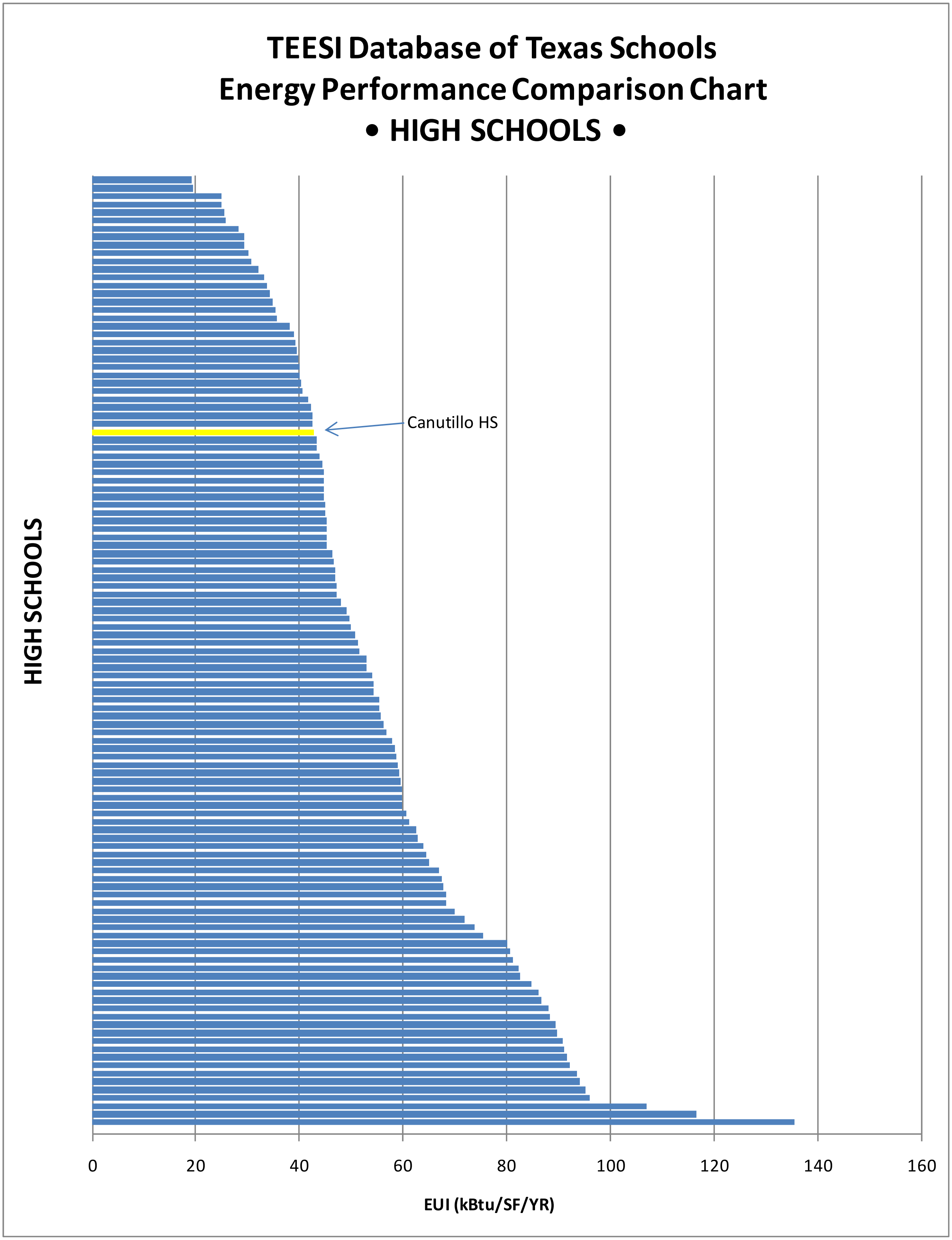
Total Energy Cost/Yr ÷ Total Area (SF) = 0.71 $/SF/year

Electric Utility: El Paso Electric

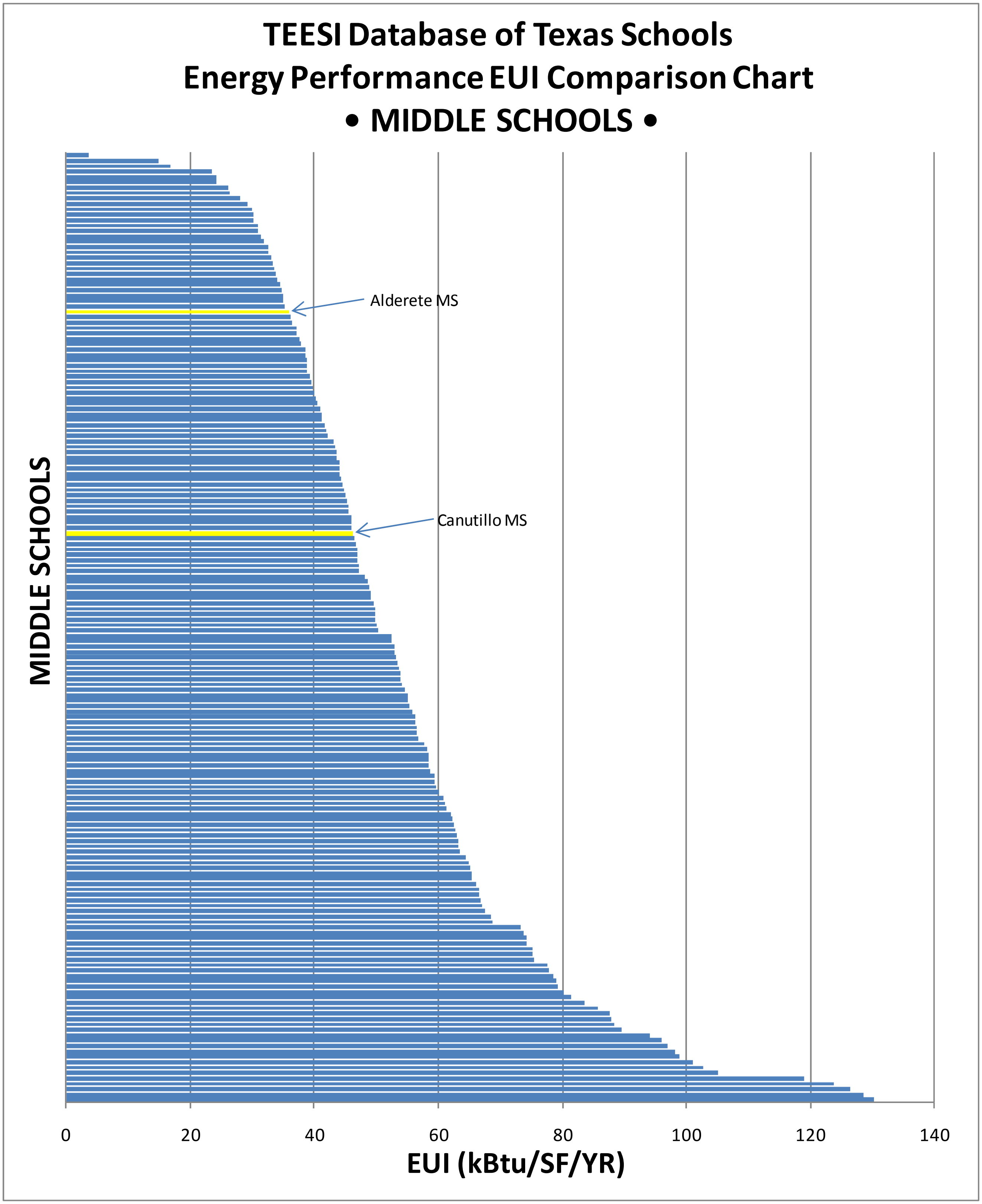
Gas Utility: Texas Gas

APPENDIX D

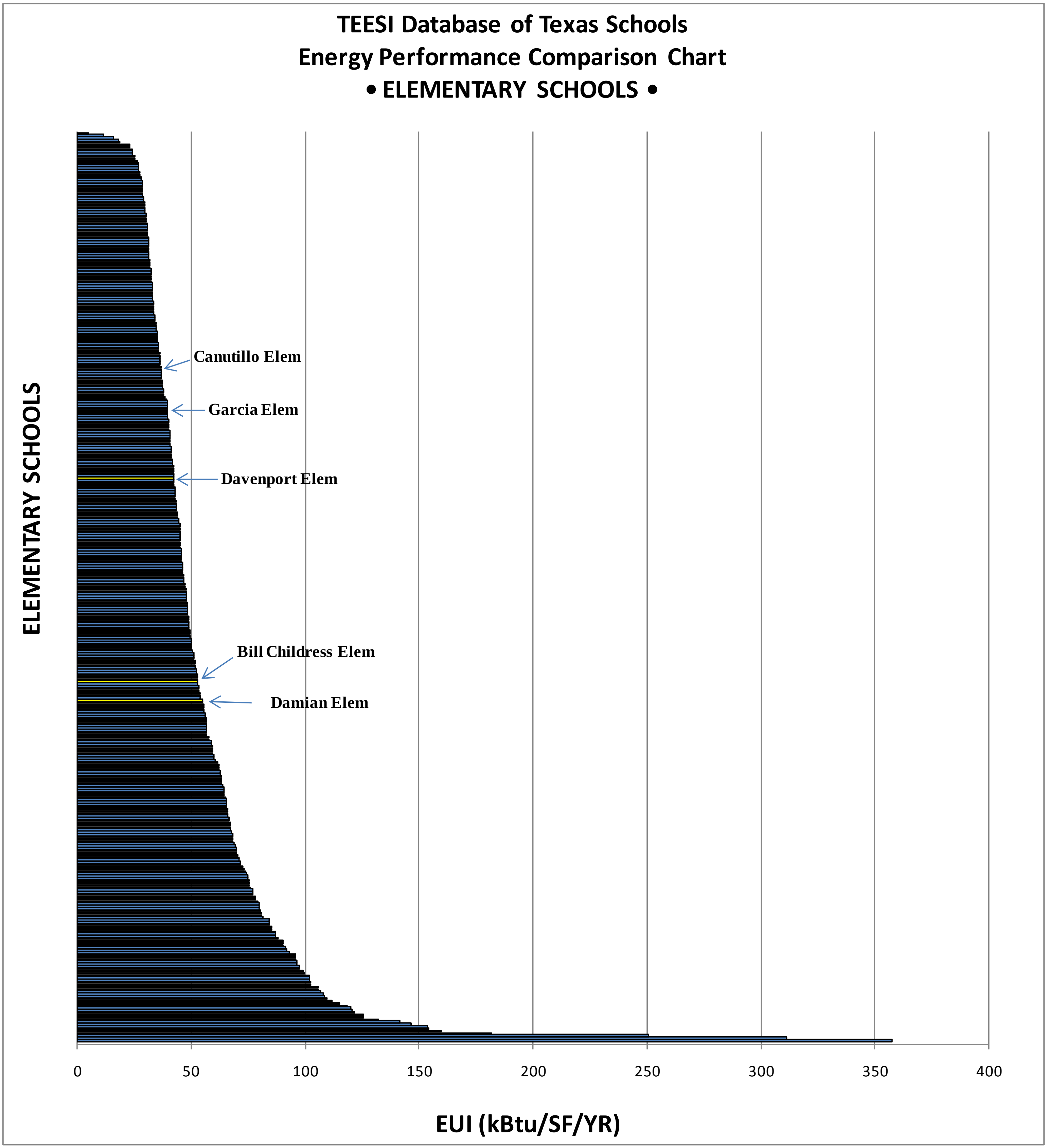
ENERGY PERFORMANCE COMPARISON CHARTS



(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)



Note: kBtu = MBtu = 1000 Btu

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

APPENDIX E

TYPICAL EQUIPMENT MAINTENANCE CHECKLISTS

9.2.9 Boilers Checklist

Description	Comments	Maintenance Frequency Daily	Weekly	Monthly	Annually
Boiler use/sequencing	Turn off/sequence unnecessary boilers	X			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Follow manufacturer's recommended procedures in lubricating all components	Compare temperatures with tests performed after annual cleaning	X			
Check steam pressure	Is variation in steam pressure as expected under different loads? Wet steam may be produced if the pressure drops too fast	X			
Check unstable water level	Unstable levels can be a sign of contaminates in feedwater, overloading of boiler, equipment malfunction	X			
Check burner	Check for proper control and cleanliness	X			
Check motor condition temperatures	Check for proper function	X			
Check air temperatures in boiler room	Temperatures should not exceed or drop below design limits	X			
Boiler blowdown	Verify the bottom, surface and water column blow downs are occurring and are effective	X			
Boiler logs	Keep daily logs on: • Type and amount of fuel used • Flue gas temperature • Makeup water volume • Steam pressure, temperature, and amount generated Look for variations as a method of fault detection	X			
Check oil filter assemblies	Check and clean/replace oil filters and strainers	X			
Inspect oil heaters	Check to ensure that oil is at proper temperature prior to burning	X			
Check boiler water treatment	Confirm water treatment system is functioning properly	X			
Check flue gas temperatures and composition	Measure flue gas composition and temperatures at selected firing positions - recommended O2% and CO2% Fuel — O2 % — CO2% Natural gas — 1.5 — 10 No. 2 fuel oil — 2.0 — 11.5 No. 6 fuel oil — 2.5 — 12.5 Note: percentages may vary due to fuel composition variations		X		

Boilers Checklist (contd)

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
Check all relief valves	Check for leaks		X		
Check water level control	Stop feedwater pump and allow control to stop fuel flow to burner. Do not allow water level to drop below recommended level.		X		
Check pilot and burner assemblies	Clean pilot and burner following manu-facturer's guidelines. Examine for mineral or corrosion buildup.		X		
Check boiler operating characteristics	Stop fuel flow and observe flame failure. Start boiler and observe characteristics of flame.		X		
Inspect system for water/ steam leaks and leakage opportunities	Look for: leaks, defective valves and traps, corroded piping, condition of insulation		X		
Inspect all linkages on combustion air dampers and fuel valves	Check for proper setting and tightness		X		
Inspect boiler for air leaks	Check damper seals		X		
Check blowdown and water treatment procedures	Determine if blowdown is adequate to prevent solids buildup			X	
Flue gases	Measure and compare last month's readings flue gas composition over entire firing range			X	
Combustion air supply	Check combustion air inlet to boiler room and boiler to make sure openings are adequate and clean			X	
Check fuel system	Check pressure gauge, pumps, filters and transfer lines. Clean filters as required.			X	
Check belts and packing glands	Check belts for proper tension. Check packing glands for compression leakage.			X	
Check for air leaks	Check for air leaks around access openings and flame scanner assembly.			X	
Check all blower belts	Check for tightness and minimum slippage.			X	
Check all gaskets	Check gaskets for tight sealing, replace if do not provide tight seal			X	
Inspect boiler insulation	Inspect all boiler insulation and casings for hot spots			X	
Steam control valves	Calibrate steam control valves as specified by manufacturer			X	
Pressure reducing/regulating valves	Check for proper operation			X	

Boilers Checklist (contd)

Description	Comments	Maintenance Frequency Daily	Weekly	Monthly	Annually
Perform water quality test	Check water quality for proper chemical balance			X	
Clean waterside surfaces	Follow manufacturer's recommendation on cleaning and preparing waterside surfaces				X
Clean fireside	Follow manufacturer's recommendation on cleaning and preparing fireside surfaces				X
Inspect and repair refractories on fireside	Use recommended material and procedures				X
Relief valve	Remove and recondition or replace				X
Feedwater system	Clean and recondition feedwater pumps. Clean condensate receivers and deaeration system				X
Fuel system	Clean and recondition system pumps, filters, pilot, oil preheaters, oil storage tanks, etc.				X
Electrical systems	Clean all electrical terminals. Check electronic controls and replace any defective parts.				X
Hydraulic and pneumatic valves	Check operation and repair as necessary				X
Flue gases	Make adjustments to give optimal flue gas composition. Record composition, firing position, and temperature.				X
Eddy current test	As required, conduct eddy current test to assess tube wall thickness				X

9.4.8 Chillers Checklist

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Semi-Annually	Annually
Chiller use/sequencing	Turn off/sequence unnecessary chillers	X			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Check setpoints	Check all setpoints for proper setting and function	X			
Evaporator and condenser coil fouling	Assess evaporator and condenser coil fouling as required		X		
Compressor motor temperature	Check temperature per manufacturer's specifications		X		
Perform water quality test	Check water quality for proper chemical balance		X		
Leak testing	Conduct leak testing on all compressor fittings, oil pump joints and fittings, and relief valves		X		
Check all insulation	Check insulation for condition and appropriateness		X		
Control operation	Verify proper control function including: • Hot gas bypass • Liquid injection		X		
Check vane control settings	Check settings per manufacturer's specification			X	
Verify motor load limit control	Check settings per manufacturer's specification			X	
Verify load balance operation	Check settings per manufacturer's specification			X	
Check chilled water reset settings and function	Check settings per manufacturer's specification			X	
Check chiller lockout setpoint	Check settings per manufacturer's specification				X
Clean condenser tubes	Clean tubes at least annually as part of shutdown procedure				X

Pumps Checklist

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
Pump use/sequencing	Turn off/sequence unnecessary pumps	X			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Check lubrication	Assure that all bearings are lubricated per the manufacture's recommendation			X	
Check packing	Check packing for wear and repack as necessary. Consider replacing packing with mechanical seals.			X	
Motor/pump alignment	Aligning the pump/motor coupling allows for efficient torque transfer to the pump			X	
Check mountings	Check and secure all pump mountings			X	
Check bearings	Inspect bearings and drive belts for wear. Adjust, repair, or replace as necessary.				X
Motor condition	Checking the condition of the motor through temperature or vibration analysis assures long life				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

BUILDING COMMISSIONG INFORMATON

BUILDING COMMISSIONING GENERAL INFORMATION

Commissioning is common in all types of building systems, including heating, ventilating, and air-conditioning (HVAC), lighting, electric, and safety controls such as fire protection and security.

Commissioning is available in many forms, the first of which is new construction commissioning. This type aims to construct a facility that obtains the performance and operation requirements of its occupants and owner, and begins during the pre-design portion of the project. If it is comprehensive commissioning, the process starts with the criteria for the facility's functionality, and constantly verifies this in all parts of the facility's creation, including design, construction, and building operation. Construction phase commissioning occurs when the Owner does not include commissioning requirements in the original design, and begins when construction is already underway.

The second form is existing building commissioning, which is identified by two types. Retro-commissioning involves buildings that have never before been commissioned, and involves documenting methods to improve the building's systems and reach the original design intentions. It is an involved process starting with obtaining utility bills, talking to the building's occupants, performing diagnostic tests on the building, and preparing the information for the owner. The second type is re-commissioning, which is different from retro-commissioning in that the building's systems have previously had commissioning performed at some point, whether in the design or construction phases. However, it is similar to retro-commissioning because it arises from system performance problems or inadequacies.

A more specific form of HVAC systems commissioning for existing building is Continuous Commissioning® (CC®). Unlike the other forms, Continuous Commissioning ensures the optimization of HVAC systems for the building's existing conditions. It also works to improve the building air quality, increase comfort levels, and resolve any operating problems. When implemented, Continuous Commissioning can decrease energy usage by 20% on average[2]. It is a joint effort 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.

All of these forms of commissioning can be used to meet several of the requirements under the United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) rating system. The LEED rating system considers building commissioning to be an essential step towards sustainability. This is evident by the fact that many of the LEED rating systems (LEED-EB, LEED-NC, etc) require building commissioning as a pre-requisite.

The scope of commissioning can involve a wide range of building systems, selectable by the building owner. Mechanical systems including HVAC systems, plumbing, piping, boilers, heaters, and valves can be commissioned. Electrical systems such as lighting, transformers, and lighting control is often included, as well as other systems like fire safety, security, and standby power systems.

The costs of commissioning to the owner vary between forms, as well as from building to building. The cost per square foot (SF) of the facility to be commissioned may vary from $.40/SF to $2.00/SF. However, there are general estimates in place. The following lists the percentages of the commissioning costs for each system.

- 2% to 3% of mechanical cost for Mechanical Systems (HVAC and controls)[3]
- 1% to 2% of electrical cost for Electrical Systems[4]

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[2] *Continuous Commissioning Guidebook for Federal Energy Managers* (Energy Systems Laboratory at Texas A&M University)
[3] Wilkison, R. (2000) Establishing Commissioning Fees, ASHRAE Journal 42 (4): 41-47
[4] PECI, 2000. The National Conference of Building Commissioning Proceedings, Portland Energy

- 0.5% to 1.5% of construction cost for HVAC, controls, and light electrical

There are many benefits to commissioning for the designer, the building's owner, and its occupants.

- HVAC systems simultaneously operate adequately, resulting in less expense during construction and after occupancy. Satisfied occupants also lead to increased productivity.
- Commissioning reviews decrease errors in the design phase, which ultimately reduces callbacks for the engineer.
- More efficient scheduling and design coordination reduce construction errors for the contractor, and thus reduces cost and keeps the project on schedule.
- Documentation helps prevent assumptions made during design, which reduces unnecessary expenditures.

Selecting a commissioning service provider is a vital step in the process. First, the provider should be a certified commissioning professional by an industry accepted certification body (see sample certification bodies below). Next, the owner makes a formal request of the provider's qualifications in commissioning. An independent, third party commissioning provider is mostly recommended because they can objectively perform the work using practical experience. Other requirements for the provider include documentation, communication, and organization skills. This ensures the commissioning process is performed effectively. In addition, the earlier the commissioning authority can be implemented into the facility's construction or design, the more effective the process will be.

Sample list of Building Commissioning Certifications and Organizations:

AABC Commissioning Group (ACG) - "Certified Commissioning Authority (CxA)"
www.commissioning.org

Building Commissioning Association (BCA) - "Certified Cx Professional (CxP)"
www.bcxa.org

Association of Energy Engineers (AEE) - "Certified Building Cx Professional"
www.aeecenter.org

National Environmental Balancing Bureau (NEBB) - "Systems Cx Administrator"
www.nebb.org

Testing Adjusting and Balancing Bureau - "Certified Commissioning Contractor"
www.tabbcertified.org

For more information on building commissioning, you may contact any of the above. Below is contact info for two of organizations listed above:

Building Commissioning Association
1400 SW 5th Ave, Suite 700
Portland, OR 97201
Phone: (877) 666-2292
Fax: (503) 227-8954
info@bcxa.org

AABC Commissioning Group
1518 K Street KW
Washing, DC 20005
Phone: (202) 737-7775
Fax: (202) 638-4833
info@commissioning.org

For more information on Continuous Commissioning, you may contact:

Energy Systems Laboratory
Texas A&M University
3581 TAMU
214 Wisenbaker Engineering Research Center
Bizzel Street
College Station, Texas 77943
Phone: (979) 845-9213
Fax: (979) 862-8687

Additional Reference:

“Building Commissioning - A Golden Opportunity for Reducing Energy Costs and Greenhouse-Gas Emissions” by Even Mills, Ph.D., Lawrence Berkeley National Laboratory, July 21, 2009, http://cx.lbl.gov/2009-assessment.html

APPENDIX G

EVAPORATIVE COOLING CHARTS AND FIGURES

PERFORMANCE AND COST COMPARISONS FOR COOLING SYSTEMS

Rate.e	0.109	$/kWh	Electric Rate
Rate.w	0.00427	$/Gal	Water Rate
SEER.c	13.0	BTU/Wh	Cooling Efficiency
Rate.c	8.41	$/MBTU	(DX) Cooling Rate
Rate.ec	0.48	$/MBTU	Evapor. Cooling Rate

OVERALL SYSTEM DESCRIPTION	CIRCULATING CFM	ONCE-THRU CFM	COOLING BLOWER HR/YR	COOLING BLOWER KW	BLOWER ENERGY (KWH/YR)	REFRIGERA'N (MBTU/YR)	REFRIGERA'N (KWH/YR)	EVAP'TIVE COOLING (MBTU/YR)	EVAPORATED WATER (GAL/YR)	COOLING & VENTILATION ($/YR)	COOLING COST REL. "BASE CASE"	ANNUAL SAVINGS ($/YR)	FIRST COST ($)	SIMPLE PAYBACK (YR)	NOTES:
DIRECT EVAPORATIVE COOLING, AS EXISTS	0	6,500	1,200	0.622	746	0.00	0	26.50	3,044	94.54	29.7%	224	2,675	-16.2	1,7
DIRECT EVAPORATIVE COOLING w/ DX BACK-UP	950	6,500	1,200	0.622	746	6.74	518	19.77	1,739	145.59	*45.7%*	173	8,975	15.4	3,4,7
DIRECT-INDIRECT EVAPORATIVE COOLING	0	2,500	1,784	0.699	1,248	0.00	0	23.50	2,504	147.06	46.1%	172	5,000	-7.6	2,7
REFRIGERATED AIR WITH RAW OA ECONOMIZER	950	1,400	1,784	0.622	1,109	23.50	1,808			318.83	100.0%	0	6,300	**BASE CASE**	4,7
REFRIGERATED AIR WITH DEC MIN. VENTILATION	950	450	1,784	0.658	1,174	10.17	783	16.33	1,739	221.32	69.4%	98	6,975	6.9	4,5,7
REFRIGERATED AIR WITH IDEC MIN. VENTILATION	950	450	1,784	0.699	1,248	3.27	252	23.23	2,475	174.43	54.7%	144	7,425	7.8	4,5,7
REFRIGERATED AIR WITH DEC ECONOMIZER	950	1,400	1,784	0.699	1,248	7.55	581	18.95	2,019	208.48	65.4%	110	7,350	9.5	4,6,7

NOTES:

1 DEC system alone does not readily provide any winter ventilation. Indoor RH exceeds 60% about 5% of the school year. Indoor RH can exceed 95% occasionally. Also, control is manual rather than thermostatic, so both comfort and economy are dependent on optimal operation each moment. In reality, such control cannot be achieved manually, especially since the fan speed is staged rather than variable, and the fraction of flow through the DEC pad is not variable. DEC does not provide design cooling conditions at all times, so its owning and operating cost cannot be compared fairly with those of a DX RTU that provides comfort conditions at all times.

2 IDEC package priced may be slightly below ideal capacity, but is expected to yeild full comfort about 95% of the year, and be close to comfort conditions all hours. Even if doubled in size, it would not provide full comfort more than about 97% of the year. IDEC with a single remote IDEC cooling tower instead of many mini-towers could have similar performance but different costs.

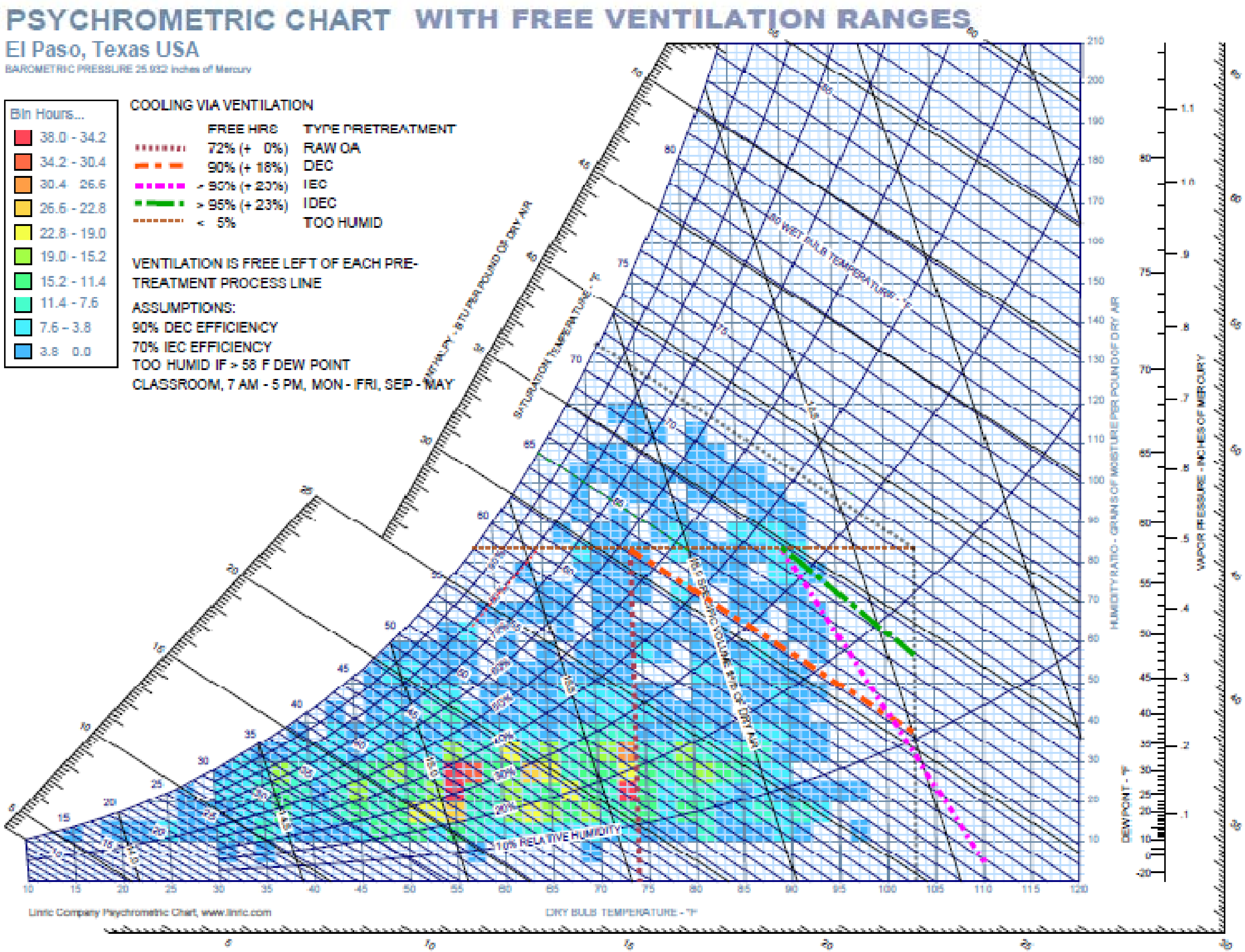
3 The RTU is only needed for about 9% of the school year, but provides nearly 25% of the required cooling, since it operates in the dampest, hottest weather. The DEC must have fully variable fan speed and fully variable pad bypass to achieve the performance indicated.

4 Pricing and efficiency of refrigerated units is based on rooftop packages. An application engineer can extrapolate data to split systems and central chillers. Pricing for all systems is based on new construction or replacement of a similar system. It does not include power, structual or water supply modifications or demolition of the existing systems that will be required in most retrofit applications. These costs will be quite variable between facilities, and should be considered when budgeting any specific building renovation.

5 Pricing of evaporatively cooled minimum OA packages is based on purchase of a package able to serve several classrooms and sharing the air (and the cost) between them.

6 Pricing of an evaporative assist kit for an economizer is only approximate. Manufacturers do not offer standard pricing for this feature.

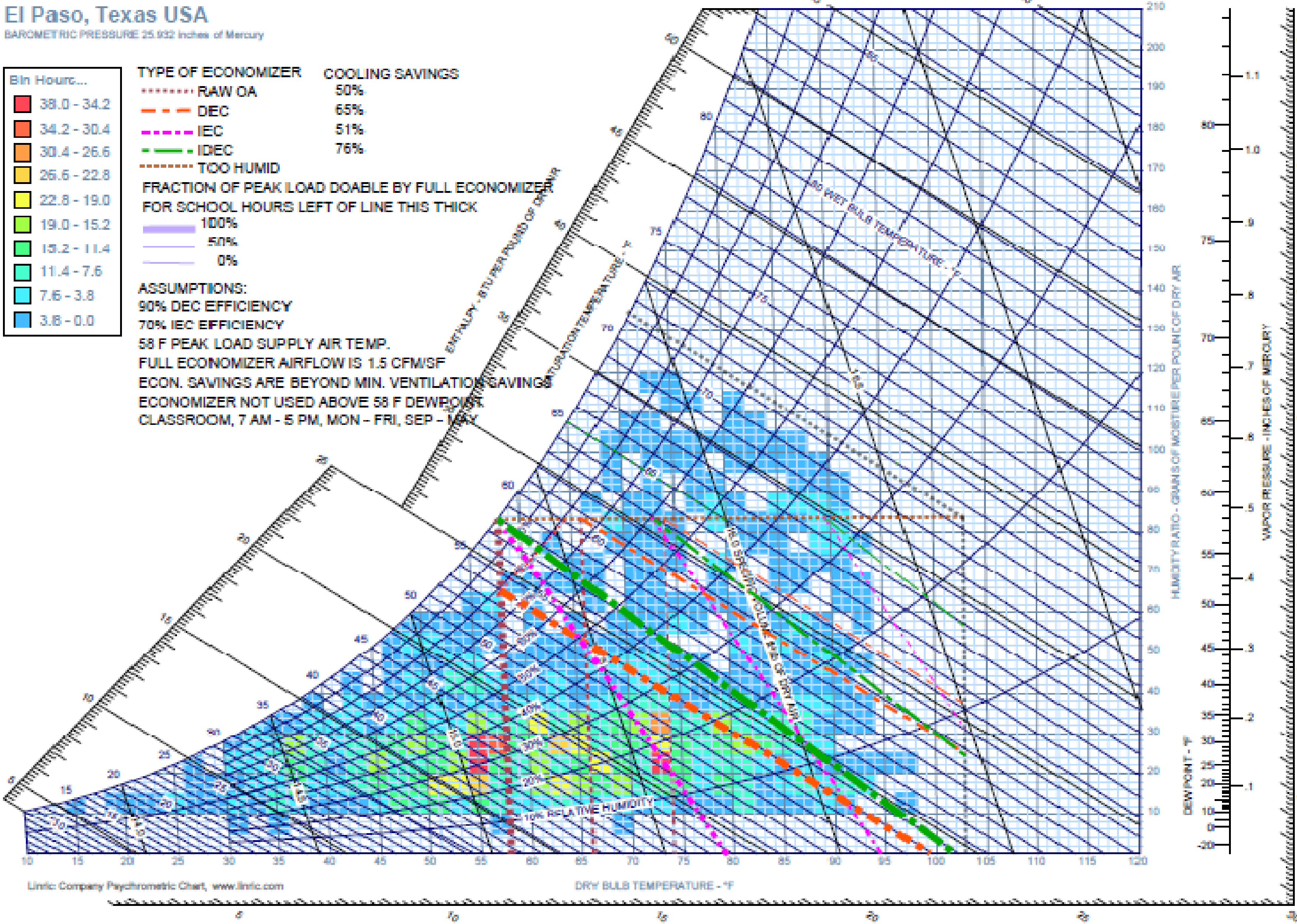
7 In addition to evaporation, systems may bleed off water to prevent mineral deposits. This water is not charged to the evaporative cooling process, as it is reusable for irrigation.


PSYCHROMETRIC CHART WITH FREE VENTILATION RANGES
El Paso, Texas USA
BAROMETRIC PRESSURE 25.932 Inches of Mercury
Bin Hours...
38.0 - 34.2
34.2 - 30.4
30.4 26.6
26.6 - 22.8
22.8 - 19.0
19.0 - 15.2
15.2 - 11.4
11.4 - 7.6
7.6 - 3.8
3.8 0.0
COOLING VIA VENTILATION
FREE HRS TYPE PRETREATMENT
72% (+ 0%) RAW OA
90% (+ 18%) DEC
> 90% (+ 20%) IEC
> 95% (+ 23%) IDEC
< 5% TOO HUMID
VENTILATION IS FREE LEFT OF EACH PRE-
TREATMENT PROCESS LINE
ASSUMPTIONS:
90% DEC EFFICIENCY
70% IEC EFFICIENCY
TOO HUMID IF > 58 F DEW POINT
CLASSROOM, 7 AM - 5 PM, MON - FRI, SEP - MAY
ENTHALPY - BTU PER POUND OF DRY AIR
SATURATION TEMPERATURE - °F
WET BULB TEMPERATURE - °F
10% RELATIVE HUMIDITY
HUMIDITY RATIO - GRAINS OF MOISTURE PER POUND OF DRY AIR
DEWPOINT - °F
VAPOR PRESSURE - INCHES OF MERCURY
DRY BULB TEMPERATURE - °F
Linric Company Psychrometric Chart, www.linric.com

PSYCHROMETRIC CHART WITH ECONOMIZER COMPARISON

El Paso, Texas USA

BAROMETRIC PRESSURE 25.932 Inches of Mercury



APPENDIX H

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 I

REQUEST FOR ENERGY ASSISTANCE

OFFICE OF THE COMPTROLLER ★ TEXAS ★

RECEIVED

APR 1 9 2010

SECO
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 Canutillo ISD, 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: [signature]	Date: 4-12-2010
Name (Mr./Ms./Dr.): DR DAMON MURPHY	Title: SUPERINTENDENT
Organization: CANUTILLO ISD	Phone: 915-877-7444
Street Address: 7965 ARTCRAFT RD	Fax: 915-877-7414
Mailing Address: EL PASO TX 79932	E-Mail: murphy@canutillo-isd.org
	County: El Paso

Contact Information:

Name (Mr./Ms./Dr.): ERNESTO ARMENDARIZ	Title: EXECUTIVE DIRECTOR FOR FACILITIES
Phone: 915-877-7712	Fax: 915-877-7740
E-Mail: earmendariz@canutillo-isd.org	County: EL PASO

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.**