LOCAL GOVERNMENTS
ENERGY MANAGEMENT PROGRAM REPORT

For

The City of
PASADENA, TEXAS

1211 E. Southmore Avenue / PO Box 762
Pasadena, Texas 77502
(713) 477-1511

Administered By:

SECO
State Energy Conservation Office

COMPTROLLER OF PUBLIC ACCOUNTS
STATE ENERGY CONSERVATION OFFICE (SECO)
LBJ State Office Building
111 E. 17th Street, Room 1114
Austin, Texas 78774
www.seco.cpa.state.tx.us

Prepared By:

Texas Energy Engineering Services, Inc. (TEESI)
1301 Capital of Texas Hwy, B-325
Austin, Texas 78746

TBPE: F-003502

www.teesi.com

ENERGY STAR PARTNER

July 2009

T8.05.46

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Local Governments Energy Management Program

City of Pasadena
1211 E. Southmore Avenue / PO Box 762
Pasadena, Texas 77502
Contact Person: Robin S. Green, Director of Public Works
Phone: (713) 475-7836

1.0 EXECUTIVE SUMMARY

A preliminary, on-site analysis of the City of Pasadena was conducted for the purpose of identifying cost effective energy system retrofit projects. This report documents that analysis.

This service was provided at no cost to the City of Pasadena through the Local Government Energy Management 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 Local Governments for the purpose of planning, funding, and implementing energy saving measures, which will ultimately reduce facility energy bills.

The annual cost savings, implementation cost estimate and simple payback for all building energy retrofit projects identified in this preliminary analysis are summarized below. Individual building projects are summarized in Section 7.0 of this report.

Implementation Cost Estimate:	$1,180,600
Annual Energy Cost Savings:	$111,100
Simple Payback:	10.6 years

Recommendations and information of interest to the City of Pasadena is provided in this report regarding Energy Consumption and Performance (Section 3.0), Energy Accounting (Section 4.0), Senate Bill 12 and House Bill 3693 Overview (Section 5.0), Recommended Maintenance and Operations Procedures (Section 6.0), Retrofit Opportunities (Section 7.0), Funding Options (Section 8.0), and Energy Management Policy (Section 9.0). A follow-up visit to the City of Pasadena 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 City of Pasadena may require in planning, funding and implementing the recommendations of this report. The City of Pasadena is encouraged to direct any questions or concerns to of the following contact persons:

SECO / Stephen Ross	TEESI / Saleem Khan
(512) 463-1770	(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.

1. City Hall

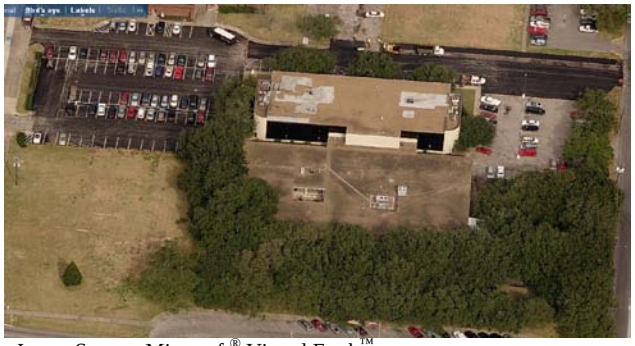


Image Source: Microsoft® Virtual Earth™

Stories:	Single and Two story buildings
Area:	54,500 SF
Bldg. Components:	Brick exterior, flat modified bitumen and built-up roof, slab on grade
Typical Lighting Fixtures:	T12 fluorescent fixtures with magnetic ballasts and T8 fluorescent fixtures with electronic ballasts
HVAC:	Split-DX systems
Controls:	Standard thermostats

2. Pasadena Convention Center

Image Source: Microsoft® Virtual Earth™

Stories:	Two story building
Area:	43,500 SF
Bldg. Components:	Brick exterior, flat modified bitumen roof, slab on grade
Typical Lighting Fixtures:	T12 fluorescent fixtures with magnetic ballasts
HVAC:	Packaged roof top units
Controls:	Energy Management System (EMS), Manufacturer JENEsys

3. Old PD Building

Image Source: Microsoft® Virtual Earth™

Stories:	Three story building
Area:	46,060 SF
Bldg. Components:	Masonry exterior, flat single ply roof, slab on grade
Typical Lighting Fixtures:	T12 fluorescent fixtures with magnetic ballasts and T8 fluorescent fixtures with electronic ballasts
HVAC:	Air cooled chillers
Controls:	Pneumatic controls

4. Fairmont Branch Library


Image Source: Microsoft® Virtual Earth™

Stories:	Single story building
Area:	10,320 SF
Bldg. Components:	Brick exterior, flat built-up tar and gravel roof, slab on grade
Typical Lighting Fixtures:	T12 fluorescent fixtures with magnetic ballasts
HVAC:	Split-DX systems
Controls:	Standard Thermostats

5. Corrigan Center

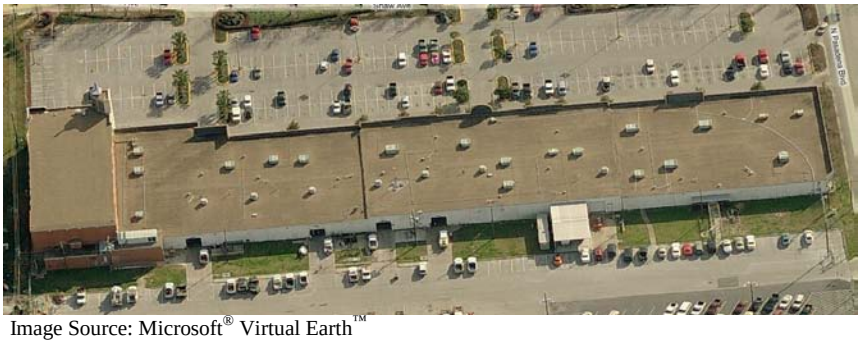


Image Source: Microsoft® Virtual Earth™

Stories:	Single story building
Area:	59,500 SF
Bldg. Components:	Brick exterior, flat built-up tar and gravel roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts and T12 fluorescent fixtures with magnetic ballasts
HVAC:	Packaged roof top units
Controls:	Standard thermostats

6. Main Library

Image Source: Microsoft® Virtual Earth™

Stories:	Single story building
Area:	43,000 SF
Bldg. Components:	Brick exterior, flat single ply roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts
HVAC:	Air cooled chiller
Controls:	EMS, Manufacturer Andover

7. Madison Jobe Center

Image Source: Microsoft® Virtual Earth™

Stories:	Single story building
Area:	10,200 SF
Bldg. Components:	Masonry exterior walls, flat modified bitumen roof, slab on grade
Typical Lighting Fixtures:	T12 fluorescent fixtures with magnetic ballasts
HVAC:	Packaged roof top units
Controls:	Standard thermostats

8. Warehouse/Main Facility

Image Source: Microsoft® Virtual Earth™

Stories:	Single story building
Area:	Warehouse: 43,000SF
	Main Facility: 28,000 SF
Bldg. Components:	Metal wall panel exterior, pitched metal roof, slab on grade
Typical Lighting Fixtures:	T12 fluorescent fixtures with magnetic ballasts
HVAC:	Split-DX systems
Controls:	Standard thermostats

9. New Police Department *

Image Source: Microsoft® Virtual Earth™

Stories:	Two story building
Area:	85,000 SF (estimated)
Bldg. Components:	Brick exterior, flat modified bitumen roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts
HVAC:	Chilled Water System
Controls:	Energy Management System

* An onsite walkthrough was not conducted for this building, building descriptions and recommendations presented in this report were abased conversations with City officials and general observations.

3.0 ENERGY CONSUMPTION AND PERFORMANCE

During this assessment, 12 months of utility data was compiled to assess the energy consumption and performance of several of the City of Pasadena facilities. Please see Appendix C for a complete summary of each account's monthly usage and their calculated energy performance.

The City facilities studied in this report comprised a total gross area of approximately 338,000 square feet. Annual electric and natural gas invoices for the building surveyed were $2,003,875 for the 12-month period ending June 2008. A summary of annual utility costs is provided in Appendix C, Base Year Consumption History.

ENERGY PERFORMANCE INDICES

To help the City of Pasadena evaluate the overall energy performance of its building(s) 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 as thousand BTU's 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 performance for the selected facilities is listed below.

Energy Cost and Consumption Benchmarks

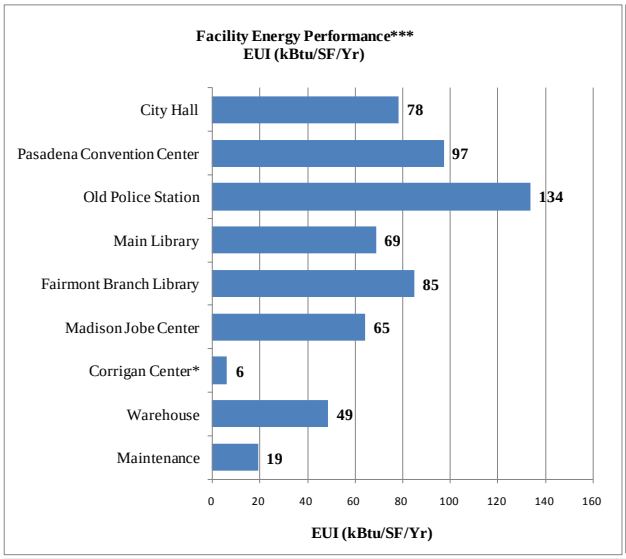
		Electric			Natural Gas***			Total	Total	EUI	ECI	
	Building	KWH/Yr	MMBTU/Yr	$Cost/Yr	MCF/Yr	MMBTU/Yr	$Cost/Yr	$Cost/Yr	MMBTU/Yr	kBTU/SF/Yr	$/SF/Yr	SF
1	City Hall	1,252,800	4,276	122,410	0	0	0	122,410	4,276	78	2.25	54,500
2	Pasadena Convention Center	1,241,472	4,237	135,105	0	0	0	135,105	4,237	97	3.11	43,500
3	Old Police Station	1,805,184	6,161	166,938	0	0	0	166,938	6,161	134	3.62	46,060
4	Main Library	868,704	2,965	82,120	0	0	0	82,120	2,965	69	1.91	43,000
5	Fairmont Branch Library	257,136	878	25,853	0	0	0	25,853	878	85	2.51	10,320
6	Madison Jobe Center	192,768	658	20,419	0	0	0	20,419	658	65	2.00	10,200
7	Corrigan Center*	110,085	376	12,395	0	0	0	12,395	376	6	0.21	59,500
8	Warehouse	616,224	2,103	61,683	0	0	0	61,683	2,103	49	1.43	43,000
9	Maintenance	158,580	541	15,684	0	0	0	15,684	541	19	0.56	28,000
10	Thomas Lift Station	525,312	1,793	62,148	0	0	0	62,148	1,793	N/A	N/A	N/A
11	West Pitts Lift Station**	402,336	1,373	50,889	0	0	0	50,889	1,373	N/A	N/A	N/A
12	North Main Lift Station	323,232	1,103	40,010	0	0	0	40,010	1,103	N/A	N/A	N/A
13	Vista Lift Station	88,704	303	15,383	0	0	0	15,383	303	N/A	N/A	N/A
14	Jana Lift Station	85,631	292	11,471	0	0	0	11,471	292	N/A	N/A	N/A
15	Gold Acres WWTP	5,013,850	17,112	473,358	0	0	0	473,358	17,112	N/A	N/A	N/A
16	Vince Bayou WWTP	7,416,047	25,311	708,011	0	0	0	708,011	25,311	N/A	N/A	N/A
		KWH/Yr	MMBTU/Yr	$Cost/Yr	MCF/Yr	MMBTU/Yr	$Cost/Yr	$Cost/Yr	MMBTU/Yr	kBTU/SF/Yr	$/SF/Yr	SF
		20,358,064	69,482	2,003,875	0	0	0	2,003,875	69,482	66	1.90	338,080

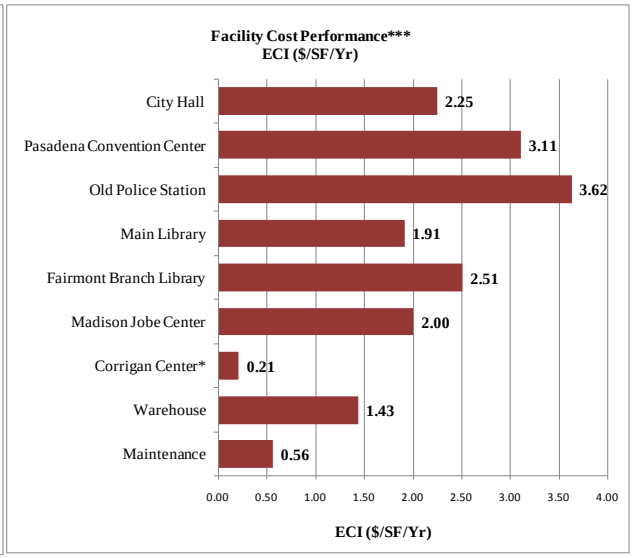
* Corrigan Center energy consumption and EUI does not accurately represent the buildings actual energy performace, due to incomplete utility data.
** Includes estimated data.
*** Natural gas data not included above, energy performance indices may increase upon inclusion.

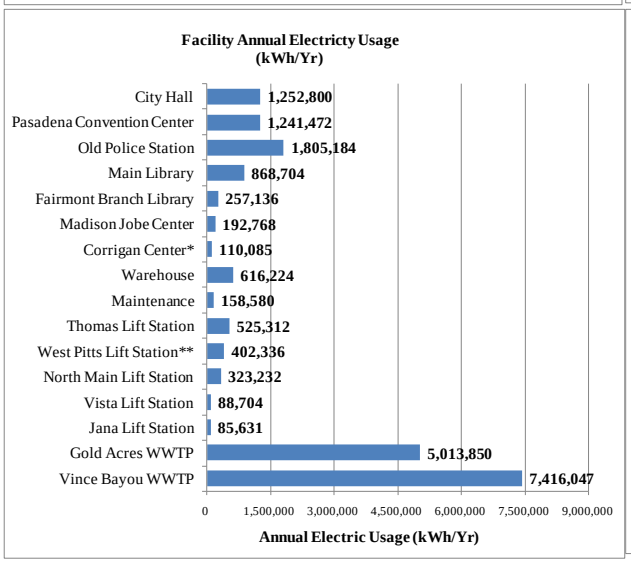
Knowing the EUI and ECI is useful to help determine the overall energy performance of the facilities surveyed. The City's EUI of 66 indicates the city's overall energy performance can be improved. Considering the no cost energy conservation measures and retrofits discussed in this report will help meet the City's annual energy reduction goals.

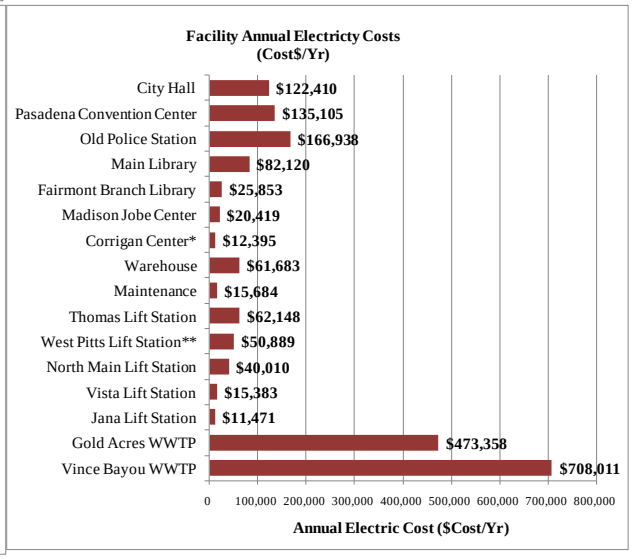
In addition, the City's EUI was compared to TEESI's database of Texas local government facilities. See Appendix D to determine how each facility ranked.

The following charts summarize the data presented in Table 1 above. See appendix C for further detail.









* Corrigan Center energy consumption and EUI does not accurately represent the buildings actual energy performance, due to incomplete utility data.

** Includes estimated data.

*** Natural gas data not included above, energy performance indices may increase upon inclusion.

4.0 ENERGY ACCOUNTING

UTILITY PROVIDERS

The CenterPoint Energy provides electric service to the City.

MONITORING AND TRACKING

An effective energy tracking system is an essential tool by which an energy management program's activities are monitored. Electronic spreadsheets are an effective tool to help establish an energy tracking system. These spreadsheet can be used to track all utilities consumption and cost (i.e., Electric kWh & Cost$, Gas MCF & Cost$) on a monthly basis. The City can use this data to track utility consumption patterns and budget utility expenses. Having this historical data improves the City'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. Utility Meter Mapping: Develop a working document identifying meters, account numbers, and associated buildings served by the utility service. Due to large number of accounts and buildings served this step is recommended.

2. Bill Rate Analysis: Periodic spot checks of the applicable utility rates (TDSP Charges, demand ratchet clauses, power factor charges, etc.) to identify any abnormal situation.

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

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

5. 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 Bill 3693** and **Senate Bill 12** reporting requirements. Please see Section 5.0 for additional information regarding these requirements.

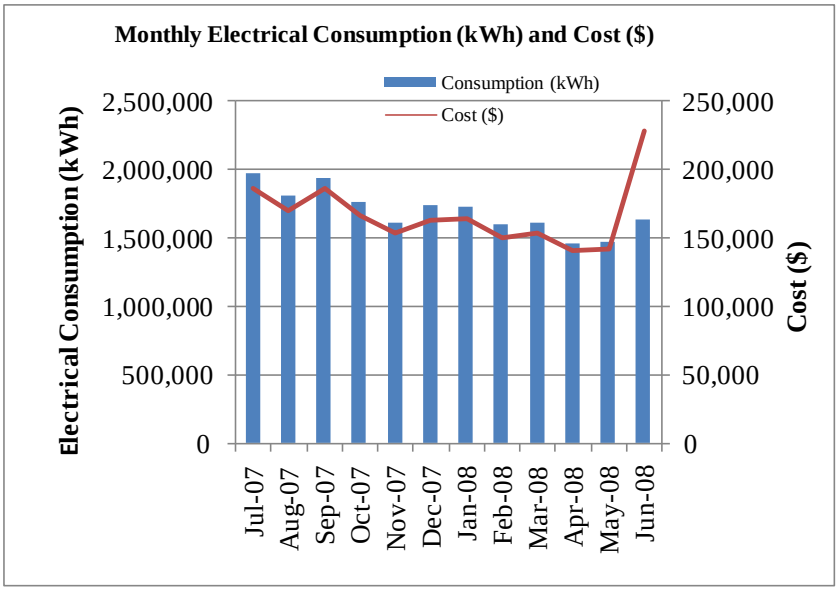
Furthermore, on the following page is a sample format the City can customize to help summarize their overall utility usage and costs.

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

CITY OF PASADENA, TX - SAMPLE UTILITY INPUT FORM

MONTH	ELECTRICITY			NATURAL GAS			WATER		
	KWH	COST $	$/KWH	MCF	COST $	$/MCF	GAL	COST $	$/GAL
Jul-07	1,975,339	185,977	$0.0941						
Aug-07	1,808,668	169,600	$0.0938						
Sep-07	1,934,728	185,740	$0.0960						
Oct-07	1,761,836	166,603	$0.0946						
Nov-07	1,614,067	153,791	$0.0953						
Dec-07	1,735,814	162,825	$0.0938						
Jan-08	1,734,696	163,754	$0.0944						
Feb-08	1,599,932	150,450	$0.0940						
Mar-08	1,616,322	153,772	$0.0951						
Apr-08	1,461,782	141,019	$0.0965						
May-08	1,477,745	142,322	$0.0963						
Jun-08	1,637,137	228,023	$0.1393						
Total	20,358,064	$2,003,875	$0.0984						

Gross Building Area:	338,080	SF



5.0 SENATE BILL 12 AND HOUSE BILL 3693 OVERVIEW

In 2001, the 77th Texas Legislature passed Senate Bill 5 (SB5), also known as the Texas Emissions Reduction Plan, to amend the Texas Health and Safety Code. The legislation required ambitious, fundamental changes in energy use to help the state comply with federal Clean Air Act standards. It applied to all political subdivisions within 38 designated counties, later expanded to 41 counties.

In 2007, the 80th Texas Legislature passed Senate Bill 12 (SB 12) which among other things extended the timeline set in SB 5 for emission reductions. In the same period, the 80th Texas Legislature passed House Bill 3693 (HB 3693) which amended provisions of several codes relating primarily to energy efficiency.

The Bill requirements that are most relevant to this program are as follows:

Establish a goal of reducing electric consumption by five percent (5%) each state fiscal year for six (6) years, beginning on September 1, 2007.

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.

Energy-efficient light bulbs for buildings, requires an institution to purchase commercially available light bulbs using the lowest wattages for the required illumination levels.

Installation of energy saving devices in Vending Machines with non-perishable food products.

A summary description of SB 12 and HB 3693 is available in Appendix A. Further detail regarding each bill can be found in the Texas Legislature website (http://www.capitol.state.tx.us/Home.aspx).

6.0 RECOMMENDED MAINTENANCE & OPERATION PROCEDURES

Sound Maintenance and Operation procedures significantly improve annual utility costs, 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. Please note that some of the recommendations noted below are currently being practiced by the City. With this in mind, the following maintenance and operation procedures should be encouraged/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.

OPTIMIZE SCHEDULING AND SETTING OF HVAC SYSTEMS

It is strongly recommended that persistent monitoring of occupancy patterns and scheduling thermostats accordingly will help reduce the equipment runtime. In addition, establishing a uniform temperature set-point throughout buildings will help reduce the HVAC energy usage. An established uniform building set-point will help remind staff members of their role to help reduce the overall annual energy consumption.

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 City should establish a goal to reduce the number of small appliances and to limit their usage. For example, the use small space heaters should be discouraged; hence, all space heating should be accomplished by the building'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.

REPLACE INCANDESCENT LAMPS WITH COMPACT FLUORESCENTS

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

INSTALL ENERGY SAVING DEVICES ON VENDING MACHINE

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 typically have a motion sensor which powers down the equipment after periods of inactivity. For example, if the motion sensor does not sense activity within 15 minutes, the device will shutdown the vending machine and turn on once motion is sensed. These devices range in price from $100 to $250 and have a typical annual savings of $20 to $150 per vending machine.

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 hibernation after 30 to 60 minutes of inactivity. Simply touching the mouse or keyboard "wakes" the computer and monitor in seconds. Activating sleep features saves energy, money, and helps protect the environment. Additional Energy Star information can be found in Appendix F.

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.

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, shorter equipment life, and occupant discomfort.

HAIL GUARDS ON CONDENSING UNITS

When an HVAC unit is replaced the City 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. During the preliminary walk-through, it was noted that several of units showed signs of hail damage. It is recommended that unit(s) with damaged condensing fins be straightened using a fin comb.

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, boilers, chillers, building controls, pumps, fans, and electric motors, are provided in Appendix E. These checklists from the Federal Energy Management Program (FEMP), a branch of the Department of Energy (DOE), are based on industry standards and should supplement, not replace those provided by the manufacturer.

IMPROVE CONTROL OF INTERIOR & EXTERIOR LIGHTING

The City has taken several active steps to control unnecessary lighting use. For example, the first picture on the left below is of a motion sensor controlling lights at a City Hall restroom. Devices such as these are effective tools that limit unnecessary lighting use and help reduce energy waste. The City should encourage/continue implementing devices such as these in future buildings and renovation projects (in accordance with applicable codes). To maximize the effectiveness of these devices the City should establish procedures to monitor use of lighting at times and places of possible/probable unnecessary use: Offices at lunchtime, closets, parking lots during daylight hours, etc.

The picture on the top right is of exterior lighting left on during daylight hours at the Pasadena Convention Center. Exterior lights are typically controlled using photocell sensors or timeclock controls. It is recommended these exterior lighting control devices be properly adjusted.

The bottom pictures were taken at the Main Library. During the preliminary walkthrough it was observed the library had potential for daylighting opportunities since certain areas have sufficient natural light from skylight and windows. In addition several areas of the library appeared to have more than sufficient lighting levels (above 100 foot candles). It is recommended occupancy sensors with daylighting controls be considered in applicable areas of the library as well as low wattage T8 fluorescent lamp replacements. See Section 7.0 for lighting retrofit opportunities.

Wall-mounted motion sensor controlling restroom lights at City Hall

Exterior Lights On at Pasadena Convention Center

Daylighting Opportunities near windows

Foot Candle levels above 100 near windows at the Main Library

WATER AND WASTEWATER PROCESSING FACILITIES

The following recommendations are general recommendations specific to Water and Wastewater processing facilities.

UTILIZE HIGH EFFICIENCY PUMPS AND MOTORS

When replacing pumping units, procure high efficiency pumps and motors. Energy savings could account for 10-15% difference when compared to existing units.

EVALUATE PIPE SIZING WITHIN SERVICE AREA TO REDUCE FRICTION LOSSES

Performing a water distribution system analysis can recommend the most efficient piping size for the service area. Constructing non-restrictive piping would reduce system head requirements and save power.

ADD VFD OR "SOFT-START" TO PUMPING UNITS 50 HP AND GREATER

A soft-start feature would reduce start-up amperage surcharge saving money when rate structures take start-up amperage draw into account.

DETAILED ENERGY ASSESSMENT FOR WATER AND WASTEWATER FACILITIES

The City should consider implementing a comprehensive detailed energy assessment of its water and wastewater treatment facilities to identify cost effective energy reduction opportunities. Due to the level of complexity of these systems and the level of resources required to effectively perform such a study, a detailed energy assessment is highly recommended. The City may retain technical consultant services to assist in the development of an energy efficiency/conservation program and help identify strategies to increase energy efficiency through capital investments or by encouraging behavioral changes. For example, the following are some of the items a detailed energy assessment could help address:

1. Estimating Baseline Energy Consumption
2. Utilize EnergySTAR Portfolio Manager for benchmarking Wastewater Treatment Facilities
3. Identification of energy cost reduction measures of water and wastewater distribution systems.
4. Identify water conservation strategies.
5. Provide recommendations of behavioral and operational changes that have energy implications.

7.0 RETROFIT OPPORTUNITIES

Energy retrofit projects identified during the preliminary analysis are detailed below. Project cost estimates include complete design and construction management services.

T12 TO T8 LIGHTING RETROFIT

Replace T-12 fluorescent lamps and magnetic ballasts with high efficiency T-8 fluorescent lamps and electronic ballasts at the City's facilities listed below. 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. Several of the facilities listed below have a mix of T8 and T12 fluorescent fixtures. The cost and savings noted below are based on preliminary observations. Exact cost and quantities can be identified through a detailed energy audit.

T12 TO T8 LIGHTING RETROFIT			
Building	**Estimated Implementation Cost**	**Estimated Annual Savings**	**Payback (years)**
City Hall	$27,000	$6,000	4.5
Pasadena Convention Center	$42,000	$9,300	4.5
Old Police Station	$30,000	$6,000	5.0
Fairmont Branch Library	$7,000	$1,600	4.4
Madison Jobe Center	$7,000	$1,600	4.4
Corrigan Center	$39,000	$8,700	4.5
Warehouse	$17,000	$3,400	5.0
Maintenance	$4,000	$800	5.0
TOTAL	**$173,000**	**$37,400**	**4.6**

REPLACE EXISTING T8 FLUORESCENT LAMPS WITH LOWER WATTAGE LAMPS

Low-wattage T8 fluorescent lamps are available in 30, 28 and 25-watt versions. It is recommended replacing existing 32-watt T8 Fluorescent lamps with lower wattage lamps at the Main Library. Changing to a lower wattage T8 Lamp is a relatively straightforward process however, lower wattage T8 lamps do have limitations and are only suitable for certain applications. Lower wattage T8 lamps have reduced lighting levels therefore, it is important to ensure recommended lighting levels are maintained. Lighting levels should be verified prior to and after lamp replacement. In addition, compatibility with existing ballasts, local codes and other requirements must be verified prior to retrofitting. Nevertheless, if suitable for the application, switching to lower wattage T8 lamps will have sustainable energy savings with minimal impact. The estimated costs and savings noted below are based on preliminary observations. Exact cost and quantities can be identified through a detailed energy audit.

LOW WATTAGE T8 LAMP REPLACEMENT			
Building	**Estimated Implementation Cost**	**Estimated Annual Savings**	**Payback (years)**
Main Library	$9,000	$3,600	2.5
TOTAL	**$9,000**	**$3,600**	**2.5**

INSTALLATION OF OCCUPANCY SENSORS FOR INDOOR LIGHTING CONTROL

It is recommended the City consider installing occupancy sensors to improve control of interior lighting. Several of the City's buildings will benefit with the installation of these devices. Occupancy sensors will help ensure lights are only on when the space is occupied. The table below provides an estimated cost and energy savings for the installation of these types of sensors, at selected facilities. Please note this estimation is based on a preliminary assessment exact sensor location, 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 (i.e. restrooms, conference rooms, break rooms, etc.).

MOTION SENSOR INSTALLATION			
Building	**Estimated Implementation Cost**	**Estimated Annual Savings**	**Payback (years)**
City Hall	$2,000	$400	5.0
Pasadena Convention Center	$4,000	$800	5.0
Old Police Station	$2,500	$500	5.0
Main Library	$2,000	$400	5.0
Fairmont Branch Library	$500	$100	5.0
Madison Jobe Center	$500	$100	5.0
Corrigan Center	$2,500	$500	5.0
TOTAL	**$14,000**	**$2,800**	**5.0**

REPLACE HVAC SYSTEMS

This section describes the replacement of existing HVAC equipment at the facilities listed below. During the preliminary walkthrough, these systems were identified to be inefficient, beyond their economical life and required extensive maintenance. The following descriptions and table below summarize the estimated cost and savings for replacing the units at each facility.

City Hall – Replace three (3) Split-DX systems serving the City Hall addition. The total combined cooling capacity is approximately sixteen (16) tons. The existing units are over fifteen (15) years old, are inefficient and require extensive maintenance. It is recommended the existing units be replaced with new high efficiency units. See table below for an estimated cost and energy savings for replacing these units.

City Hall – Replace two (2) Multi-zone Air Handling Units (AHUs) serving the original City Hall building. The total combined cooling capacity is approximately fifty (50) tons. The existing units are over twenty five (25) years old, are inefficient and require extensive maintenance. It is recommended the existing units be replaced with new high efficiency units. See table below for an estimated cost and energy savings for replacing these units.

Old Police Station - Replace existing Gas Fired Boiler (approx. 800 MBH) serving the building's HVAC heating system. The existing boiler requires extensive maintenance, is inefficient and beyond its useful life. Replace the boiler with a new high efficiency boiler will improve the heating systems operations and reliability.

Old Police Station – Replace four (4) Air Handling Units (AHUs) serving the Old Police Station. The total combined cooling capacity is approximately one hundred forty (140) tons. The existing units are over twenty five (25) years old, are inefficient and require extensive maintenance. It is recommended the existing units be replaced with new high efficiency units. See table below for an estimated cost and energy savings for replacing these units.

Old Police Station – Replace Chilled and Hot water pumps with new premium efficiency pumps. The existing pumps are inefficient and require extensive maintenance. See table below for an estimated cost and energy savings for replacing these units.

HVAC REPLACEMENT			
Building	**Estimated Implementation Cost**	**Estimated Annual Savings**	**Payback (years)**
City Hall - Replace SDXs	$32,000	$2,000	16.0
City Hall - Replace AHUs	$150,000	$8,300	18.1
Old Police Station - Replace Boiler	$54,000	$3,400	15.9
Old Police Station - Replace AHUs	$420,000	$21,000	20.0
Old Police Station - CH & HW Pumps	$28,800	$2,100	13.7
TOTAL	**$684,800**	**$36,800**	**18.6**

INSTALL ENERGY MANAGEMENT SYSTEM (EMS)

Upgrade existing Energy Management System (EMS) to provide optimum scheduling and precise temperature supervision for the HVAC systems throughout each facility listed below. 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.

Exact implementation cost and savings can be identified during a Detailed Energy Assessment. For example additional cost implication such as deferred maintenance items must be investigated to determine actual system cost and savings. The EMS system proposed in the estimation below will have basic functions such as remote access capabilities, multiple scheduling, and optimum start/stop features. The table below summarizes the estimated cost and saving for these projects.

EMS UPGRADES AND INSTALLATION			
Building	**Estimated Implementation Cost**	**Estimated Annual Savings**	**Payback (years)**
City Hall	$78,000	$5,600	13.9
Old Police Station	$97,500	$7,000	13.9
Fairmont Branch Library	$14,300	$1,000	14.3
Corrigan Center	$50,000	$3,600	13.9
TOTAL	**$239,800**	**$17,200**	**13.9**

BUILDING COMMISSIONING (Cx)

Detailed HVAC commissioning in an existing building involves analysis of existing systems to ensure compliance with original set-up/design conditions and where feasible adjusting operating parameters to enhance comfort and reduce energy consumption. Retro Commissioning (RCx) is a type of commissioning process that can be applied to existing buildings that have never been commissioned to restore them to optimal performance. If the original construction project of the New Police Department building did not encompass a comprehensive commissioning program the City may consider implementing RCx. Implementing RCx at the New Police Building will help ensure the building is optimized and operates at its peak performance.

Based on industry sources as stated in the General Service Administration (GSA) Building Commissioning Guide, the average annual operating costs of a commissioned building range from 8% to 20% lower than a non-commissioning building. The City may benefit from the implementation of commissioning at the New Police Department primarily in the HVAC systems operations.

There are various degrees and types of commissioning programs. The cost and savings estimates presented here are for a detailed commissioning program and are based on preliminary observations. 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.

The following Commissioning estimates are based on preliminary observations. In order to define a project scope and provide accurate project cost and savings a detailed energy assessment may be required.

BUILDING COMMISSIONING (Cx)			
Building	**Estimated Implementation Cost**	**Estimated Annual Savings**	**Payback (years)**
New Police Department	$60,000	$13,300	4.5
TOTAL	**$60,000**	**$13,300**	**4.5**

The following table is a complete summary of the implementation costs, annual savings and payback for the above mentioned projects:

SUMMARY OF ENERGY COST REDUCTION MEASURES			
Project Description	**Estimated Implementation Cost**	**Estimated Annual Savings**	**Payback (years)**
T12 TO T8 LIGHTING RETROFIT	$173,000	$37,400	4.6
LOW WATTAGE T8 LAMP REPLACEMENT	$9,000	$3,600	2.5
MOTION SENSOR INSTALLATION	$14,000	$2,800	5.0
HVAC REPLACEMENT	$684,800	$36,800	18.6
EMS UPGRADES AND INSTALLATION	$239,800	$17,200	13.9
BUILDING COMMISSIONING (Cx)	$60,000	$13,300	4.5
TOTAL:	**$1,180,600**	**$111,100**	**10.6**

The above project implementation costs and annual savings are estimated based on a preliminary examination of the facilities. 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 City requirements, and construction management would be provided by the engineering group who prepared the drawings and specifications.

8.0 FUNDING OPTIONS FOR CAPITAL ENERGY PROJECTS

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

TEXAS LOANSTAR PROGRAM

The LoanSTAR (Saving Taxes and Resources) Program, which is administered by the State Energy Conservation Office, finances energy-efficient building retrofits with a typical interest rate of 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 City proceeds to implement funded projects through the traditional bid/specification process. Contact: Theresa Sifuentes (512/463-1896).

INTERNAL FINANCING

Improvements can be paid for by direct allocations of revenues from an organization's currently available operating or capital funds. 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 City 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.

CENTERPOINT ENERGY RETRO-COMMISSIONING (RCx) INCENTIVE PROGRAM

The Retro-Commissioning is a energy efficiency program offered by CenterPoint Energy. The Retro-Commissioning Program is designed to achieve energy and peak demand savings in the CenterPoint Energy service territory. Savings are realized through the systematic evaluation of electric energy-using systems and subsequent implementation of low-cost measures. These measures target system operation and maintenance opportunities. This program was designed to comply with Senate Bill 7 (SB7) passed by the Texas Legislature in 1999 which restructured the state's electric utility industry. Under this law, each investor-owned utility is to meet a 10% reduction in its annual system demand growth.

The CenterPoint Energy Retro-commissioning program involves a two-step process (Evaluation and Implementation):

Evaluation - The program subsidizes the costs to have a qualified RCx agent to evaluate the condition of the energy-using systems in a facility and identify opportunities to improve performance. The resulting recommendations are presented in a written report that details how to best improve the efficiency of the facility's systems.

Implementation – The City will review the evaluation and determine which RCx measures will be implemented. CenterPoint Energy's RCx Program will help offset the cost to have a qualified commissioning agent implement the RCx measures. In order to proceed with implementing the measures, the City will need to make a commitment to invest a minimum of $10,000 and have the project completed by year end.

For further information regarding this program please visit the following web address http://www.centerpointefficiency.com/recx/index.htm

9.0 ENERGY MANAGEMENT POLICY

At present, the City has not adopted a comprehensive City-wide energy management policy. The City is committed to improving their energy performance and this is evident by the request to perform a Preliminary Energy Assessment. However, in order to ensure and sustain long-term energy efficient practices a comprehensive Energy Management Policy should be adopted by the City.

A City-wide energy management plan adopted by the governing board sends a strong signal that energy management is an institutional priority. At a minimum, the energy management plan should address the following:

- Establish an energy steering committee to review energy cost and consumption on a regular basis.
- Outline energy cost reduction measures and implementation strategies.
- Assign energy manager duties to existing staff positions, with defined roles and responsibilities.
- Establish acceptable equipment operating parameters and schedules, such as HVAC space heating and cooling set points, availability and duration of overrides, etc.
- Promote awareness of energy conservation by publishing goals and progress of energy conservation measures.
- Establishment of a tracking method for utility cost and consumption.

10.0 ANALYST IDENTIFICATION

Texas Energy Engineering Services, Inc.
Capital View Center, Suite B-325
1301 Capital of Texas Highway
Austin, Texas 78746
(512) 328-2533
TBPE: F-003502

M. Saleem Khan, P.E., CxA
David Rocha, LEED-AP

APPENDICES

APPENDIX A

SENATE BILL 12 AND HOUSE BILL 3693 SUMMARY

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:

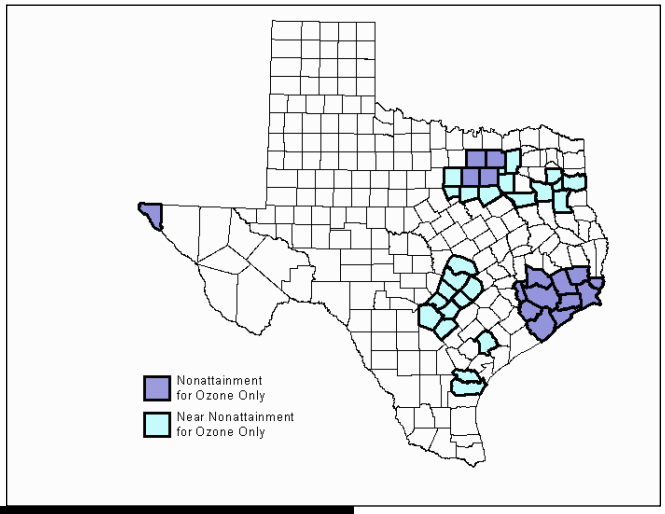
• installation of insulation and high-efficiency windows and doors • modifications or replacement of HVAC systems, lighting fixtures and electrical systems • installation of automatic energy control systems • installation of energy recovery systems or renewable energy generation equipment • building 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:
Theresa Sifuentes - 512-463-1896
Theresa.Sifuentes@cpa.state.tx.us

Schools Partnership Program:
Glenda Baldwin - 512-463-1731
Glenda.Baldwin@cpa.state.tx.us

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

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

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

Alternate Fuels / Transportation:
Mary-Jo Rowan - 512-463-2637
Mary-Jo.Rowan@cpa.state.tx.us

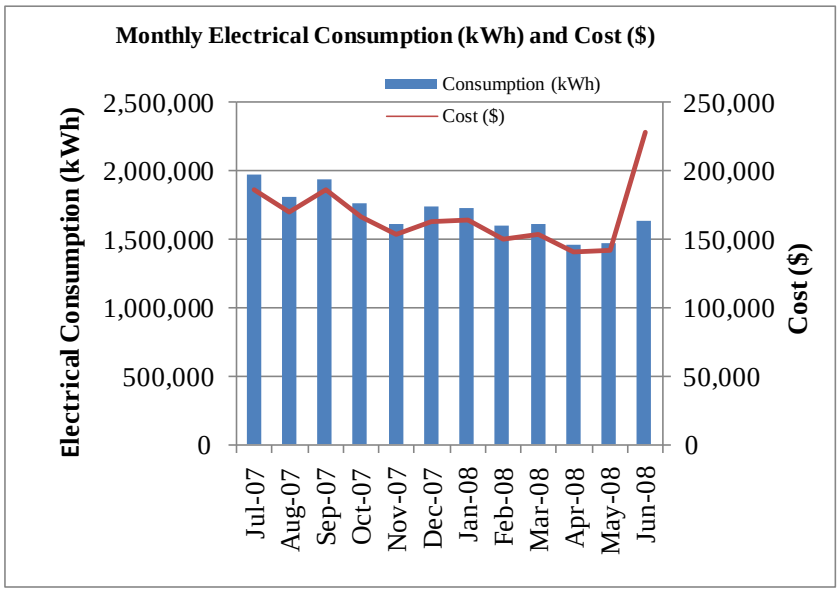
APPENDIX B

SAMPLE UTILITY INPUT FORM

CITY OF PASADENA, TX - SAMPLE UTILITY INPUT FORM

MONTH	ELECTRICITY			NATURAL GAS			WATER		
	KWH	COST $	$/KWH	MCF	COST $	$/MCF	GAL	COST $	$/GAL
Jul-07	1,975,339	185,977	$0.0941						
Aug-07	1,808,668	169,600	$0.0938						
Sep-07	1,934,728	185,740	$0.0960						
Oct-07	1,761,836	166,603	$0.0946						
Nov-07	1,614,067	153,791	$0.0953						
Dec-07	1,735,814	162,825	$0.0938						
Jan-08	1,734,696	163,754	$0.0944						
Feb-08	1,599,932	150,450	$0.0940						
Mar-08	1,616,322	153,772	$0.0951						
Apr-08	1,461,782	141,019	$0.0965						
May-08	1,477,745	142,322	$0.0963						
Jun-08	1,637,137	228,023	$0.1393						
Total	20,358,064	$2,003,875	$0.0984						

Gross Building Area:	338,080	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	City Hall	1,252,800	4,276	122,410	0	0	0	122,410	4,276	78	2.25	54,500
2	Pasadena Convention Center	1,241,472	4,237	135,105	0	0	0	135,105	4,237	97	3.11	43,500
3	Old Police Station	1,805,184	6,161	166,938	0	0	0	166,938	6,161	134	3.62	46,060
4	Main Library	868,704	2,965	82,120	0	0	0	82,120	2,965	69	1.91	43,000
5	Fairmont Branch Library	257,136	878	25,853	0	0	0	25,853	878	85	2.51	10,320
6	Madison Jobe Center	192,768	658	20,419	0	0	0	20,419	658	65	2.00	10,200
7	Corrigan Center*	110,085	376	12,395	0	0	0	12,395	376	6	0.21	59,500
8	Warehouse	616,224	2,103	61,683	0	0	0	61,683	2,103	49	1.43	43,000
9	Maintenance	158,580	541	15,684	0	0	0	15,684	541	19	0.56	28,000
10	Thomas Lift Station	525,312	1,793	62,148	0	0	0	62,148	1,793	N/A	N/A	N/A
11	West Pitts Lift Station**	402,336	1,373	50,889	0	0	0	50,889	1,373	N/A	N/A	N/A
12	North Main Lift Station	323,232	1,103	40,010	0	0	0	40,010	1,103	N/A	N/A	N/A
13	Vista Lift Station	88,704	303	15,383	0	0	0	15,383	303	N/A	N/A	N/A
14	Jana Lift Station	85,631	292	11,471	0	0	0	11,471	292	N/A	N/A	N/A
15	Gold Acres WWTP	5,013,850	17,112	473,358	0	0	0	473,358	17,112	N/A	N/A	N/A
16	Vince Bayou WWTP	7,416,047	25,311	708,011	0	0	0	708,011	25,311	N/A	N/A	N/A
		KWH/Yr	MMBTU/Yr	$Cost/Yr	MCF/Yr	MMBTU/Yr	$Cost/Yr	$Cost/Yr	MMBTU/Yr	kBTU/SF/Yr	$/SF/Yr	SF
		20,358,064	69,482	2,003,875	0	0	0	2,003,875	69,482	66	1.90	338,080

* Corrigan Center energy consumption and EUI does not accurately represent the buildings actual energy performace, due to incomplete utility data.

** Includes estimated data.

*** Natural gas data not included above, energy performance indices may increase upon inclusion.

Version 1

Location: City of Pasadena

ACCOUNT# 1008901009130052160100 Electric

Gas

BUILDING: City Hall FLOOR AREA: 54,500

		Electrical					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July	2007	122,688				11,189	0	0
August	2007	112,320				10,435	0	0
September	2007	120,576				11,030	0	0
October	2007	115,392				10,656	0	0
November	2007	82,368				7,989	0	0
December	2007	108,672				10,074	0	0
January	2008	87,168				8,258	0	0
February	2008	75,264				7,109	0	0
March	2008	96,768				8,985	0	0
April	2008	93,888				8,795	0	0
May	2008	105,024				9,791	0	0
June	2008	132,672				18,100	0	0
TOTAL		1,252,800				122,410	0.0	0

Energy Use Index:

Annual Total Energy Cost = 122,410 $/year

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

Total KWH/yr x 0.003413 = 4,275.81 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 4,276 MMBTU/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 2.25 $/SF/year

Electric Utility: CenterPoint Energy

Gas Utility: N/A

Location: City of Pasadena

ACCOUNT# 100890102019452202 4100 Electric

Gas

BUILDING: Pasadena Convention Center FLOOR AREA: 43,500

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July	2007	117,504				11,605	0	0
August	2007	135,168				13,194	0	0
September	2007	140,544				13,655	0	0
October	2007	128,256				13,050	0	0
November	2007	91,008				9,727	0	0
December	2007	94,080				9,974	0	0
January	2008	85,248				9,257	0	0
February	2008	72,192				8,113	0	0
March	2008	73,344				8,274	0	0
April	2008	82,176				8,964	0	0
May	2008	81,024				8,874	0	0
June	2008	140,928				20,418	0	0
TOTAL		1,241,472				135,105	0.0	0

Energy Use Index:

Annual Total Energy Cost = 135,105 $/year

Total site BTU's/Yr ÷ Total Area (SF) = 97 kBTU/SF/year

Total KWH/yr x 0.003413 = 4,237.14 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 4,237 MMBTU/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 3.11 $/SF/year

Electric Utility: CenterPoint Energy

Gas Utility: N/A

Location: City of Pasadena

ACCOUNT# 10089010091300522011 00 Electric

Gas

BUILDING: Old Police Station FLOOR AREA: 46,060

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July	2007	166,848				14,754	0	0
August	2007	168,576				14,955	0	0
September	2007	145,344				13,084	0	0
October	2007	146,304				13,089	0	0
November	2007	126,336				11,514	0	0
December	2007	173,760				15,287	0	0
January	2008	158,784				14,170	0	0
February	2008	137,856				12,105	0	0
March	2008	159,168				14,013	0	0
April	2008	145,728				12,848	0	0
May	2008	136,128				12,185	0	0
June	2008	140,352				18,934	0	0
TOTAL		1,805,184				166,938	0.0	0

Energy Use Index:

Annual Total Energy Cost = 166,938 $/year

Total site BTU's/Yr ÷ Total Area (SF) = 134 kBTU/SF/year

Total KWH/yr x 0.003413 = 6,161.09 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 6,161 MMBTU/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 3.62 $/SF/year

Electric Utility: CenterPoint Energy

Gas Utility: N/A

Location: City of Pasadena

ACCOUNT# 10089010091300521851 00 Electric

Gas

BUILDING: Main Library FLOOR AREA: 43,000

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July	2007	105,792				9,487	0	0
August	2007	89,280				8,250	0	0
September	2007	96,960				8,877	0	0
October	2007	102,528				9,417	0	0
November	2007	75,072				6,985	0	0
December	2007	76,992				7,127	0	0
January	2008	87,744				7,992	0	0
February	2008	65,664				6,026	0	0
March	2008	89,856				8,097	0	0
April	2008	36,864				4,421	0	0
May	2008	30,144				3,238	0	0
June	2008	11,808				2,202	0	0
TOTAL		868,704				82,120	0.0	0

Energy Use Index:

Annual Total Energy Cost = 82,120 $/year

Total site BTU's/Yr ÷ Total Area (SF) = 69 kBTU/SF/year

Total KWH/yr x 0.003413 = 2,964.89 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 2,965 MMBTU/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 1.91 $/SF/year

Electric Utility: CenterPoint Energy

Gas Utility: N/A

Location: City of Pasadena

ACCOUNT# 100890102380243843010 0 Electric

Gas

BUILDING: Fairmont Branch Library FLOOR AREA: 10,320

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July	2007	22,608				2,164	0	0
August	2007	21,072				2,027	0	0
September	2007	24,528				2,306	0	0
October	2007	21,120				2,035	0	0
November	2007	19,104				1,868	0	0
December	2007	20,304				1,963	0	0
January	2008	18,672				1,817	0	0
February	2008	16,560				1,605	0	0
March	2008	18,288				1,785	0	0
April	2008	22,800				2,169	0	0
May	2008	26,160				2,434	0	0
June	2008	25,920				3,679	0	0
TOTAL		257,136				25,853	0.0	0

Energy Use Index:

Annual Total Energy Cost = 25,853 $/year

Total site BTU's/Yr ÷ Total Area (SF) = 85 kBTU/SF/year

Total KWH/yr x 0.003413 = 877.61 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 878 MMBTU/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 2.51 $/SF/year

Electric Utility: CenterPoint Energy

Gas Utility: N/A

Location: City of Pasadena

ACCOUNT# 100890102115361039710 0 Electric

Gas

BUILDING: Madison Jobe Center FLOOR AREA: 10,200

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July	2007	21,120				1,988	0	0
August	2007	20,160				1,624	0	0
September	2007	18,720				2,294	0	0
October	2007	17,760				1,826	0	0
November	2007	13,920				1,499	0	0
December	2007	15,120				1,570	0	0
January	2008	13,728				1,482	0	0
February	2008	13,344				1,455	0	0
March	2008	14,544				1,483	0	0
April	2008	14,112				1,431	0	0
May	2008	14,112				1,440	0	0
June	2008	16,128				2,327	0	0
TOTAL		192,768				20,419	0.0	0

Energy Use Index:

Annual Total Energy Cost = 20,419 $/year

Total site BTU's/Yr ÷ Total Area (SF) = 65 kBTU/SF/year

Total KWH/yr x 0.003413 = 657.92 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 658 MMBTU/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 2.00 $/SF/year

Electric Utility: CenterPoint Energy

Gas Utility: N/A

ACCOUNT# 10089010238054698901000
10089010238133120101020
10089010238051828001000
10089010238080190001000 Electric

Gas

Location: City of Pasadena

BUILDING: Corrigan Center

FLOOR AREA: 59,500

		ELECTRICAL**					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR**	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July*	2007	9,129				1,055		
August*	2007	9,129				1,055		
September*	2007	9,129				1,055		
October*	2007	9,129				1,055		
November*	2007	9,129				1,055		
December*	2007	9,129				1,055		
January	2008	9,129				1,055		
February	2008	9,506				1,071		
March	2008	12,573				1,360		
April	2008	12,946				1,382		
May	2008	5,578				598		
June*	2008	5,578				598		
TOTAL		110,085				12,395		

* Electric Cost and Consumption from Jul - Dec 2008 was estimated based on January 2009 and May data was estimated based on June 2009 Data.

** Please note total utility consumption may not include all applicable usage therefore the EUI may be higher.

Energy Use Index:

Annual Total Energy Cost = 12,395 $/year

Total site BTU's/Yr ÷ Total Area (SF) = 6 kBTU/SF/year

Total KWH/yr x 0.003413 = 375.72 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 376 MMBTU/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 0.21 $/SF/year

Electric Utility: CenterPoint Energy

Gas Utility: N/A

Location: City of Pasadena

ACCOUNT# 1008901021194702270100 Electric

Gas

BUILDING: Warehouse FLOOR AREA: 43,000

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July	2007	53,280				5,062	0	0
August	2007	55,008				5,247	0	0
September	2007	51,648				4,942	0	0
October	2007	45,792				4,476	0	0
November	2007	43,296				4,285	0	0
December	2007	50,784				4,837	0	0
January	2008	54,144				4,998	0	0
February	2008	47,712				4,517	0	0
March	2008	46,176				4,438	0	0
April	2008	50,592				4,876	0	0
May	2008	52,320				5,012	0	0
June	2008	65,472				8,993	0	0
TOTAL		616,224				61,683	0.0	0

Annual Total Energy Cost = 61,683 $/year

Energy Use Index:

Total site BTU's/Yr ÷ Total Area (SF) = 49 kBTU/SF/year

Total KWH/yr x 0.003413 = 2,103.17 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 2,103 MMBTU/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 1.43 $/SF/year

Electric Utility: CenterPoint Energy

Gas Utility: N/A

Location: City of Pasadena

ACCOUNT# 1008901021194702276100 Electric

Gas

BUILDING: Maintenance FLOOR AREA: 28,000

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July	2007	13,860				1,295	0	0
August	2007	14,200				1,324	0	0
September	2007	15,100				1,404	0	0
October	2007	14,460				1,363	0	0
November	2007	10,560				1,035	0	0
December	2007	12,240				1,178	0	0
January	2008	12,920				1,198	0	0
February	2008	11,160				1,035	0	0
March	2008	10,800				1,027	0	0
April	2008	11,960				1,137	0	0
May	2008	13,400				1,241	0	0
June	2008	17,920				2,446	0	0
TOTAL		158,580				15,684	0.0	0

Energy Use Index:

Annual Total Energy Cost = 15,684 $/year

Total site BTU's/Yr ÷ Total Area (SF) = 19 kBTU/SF/year

Total KWH/yr x 0.003413 = 541.23 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 541 MMBTU/year

Energy Cost Index:

Total Energy Cost/Yr ÷ Total Area (SF) = 0.56 $/SF/year

Electric Utility: CenterPoint Energy

Gas Utility: N/A

Location: City of Pasadena

ACCOUNT# 1008901023814913710104 Electric

Gas

BUILDING: Thomas Lift Station FLOOR AREA: N/A

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July	2007	61,248				4,780	0	0
August	2007	68,928				7,337	0	0
September	2007	54,912				8,203	0	0
October	2007	38,016				4,482	0	0
November	2007	30,912				3,679	0	0
December	2007	42,816				4,898	0	0
January	2008	35,520				4,264	0	0
February	2008	44,352				4,920	0	0
March	2008	53,184				5,930	0	0
April	2008	30,528				4,019	0	0
May	2008	31,296				4,224	0	0
June	2008	33,600				5,412	0	0
TOTAL		525,312				62,148	0.0	0

Energy Use Index:

Annual Total Energy Cost = 62,148 $/year

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

Total KWH/yr x 0.003413 = 1,792.89 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 1,793 MMBTU/year

Energy Cost Index:

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

Electric Utility: CenterPoint Energy

Gas Utility: N/A

ACCOUNT# 10089010238147442401 04, 10089010238139364201 03 Electric
Gas

Location: City of Pasadena

BUILDING: West Pitts Lift Station

FLOOR AREA: N/A

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July*	2007	30,144				3,841	0	0
August*	2007	30,144				3,841	0	0
September*	2007	30,144				3,841	0	0
October*	2007	30,144				3,841	0	0
November*	2007	30,144				3,841	0	0
December**	2007	29,184				4,028	0	0
January**	2008	43,200				5,112	0	0
February**	2008	38,784				4,750	0	0
March**	2008	40,512				4,949	0	0
April**	2008	34,944				4,493	0	0
May**	2008	34,848				4,509	0	0
June**	2008	30,144				3,841	0	0
TOTAL		402,336				50,889	0.0	0

* Electric Cost and Consumption estimated based on June 2008 Data.

** Electric Cost and Consumption estimated based on December 2006 - June 2007 data.

Annual Total Energy Cost = 50,889 $/year

Total KWH/yr x 0.003413 = 1,373.17 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 1,373 MMBTU/year

Energy Use Index:

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

Energy Cost Index:

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

Electric Utility: CenterPoint Energy

Gas Utility: N/A

Location: City of Pasadena

ACCOUNT# 10089010211535654551 00 Electric

Gas

BUILDING: North Main Lift Station FLOOR AREA: N/A

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July	2007	28,704				3,042	0	0
August	2007	30,048				3,042	0	0
September	2007	18,624				4,529	0	0
October	2007	20,544				3,914	0	0
November	2007	19,584				3,155	0	0
December	2007	27,360				2,952	0	0
January	2008	29,952				3,154	0	0
February	2008	30,432				3,120	0	0
March	2008	37,728				3,732	0	0
April	2008	25,728				2,615	0	0
May	2008	26,400				2,668	0	0
June	2008	28,128				4,090	0	0
TOTAL		323,232				40,010	0.0	0

Energy Use Index:

Annual Total Energy Cost = 40,010 $/year

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

Total KWH/yr x 0.003413 = 1,103.19 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 1,103 MMBTU/year

Energy Cost Index:

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

Electric Utility: CenterPoint Energy

Gas Utility: N/A

Location: City of Pasadena

ACCOUNT# 100890102380747600010 0 Electric

Gas

BUILDING: Vista Lift Station FLOOR AREA: N/A

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July	2007	10,176				1,557	0	0
August	2007	9,792				1,376	0	0
September	2007	12,192				1,732	0	0
October	2007	6,816				1,304	0	0
November	2007	6,720				1,301	0	0
December	2007	9,504				1,510	0	0
January	2008	8,736				1,422	0	0
February	2008	6,624				1,233	0	0
March	2008	4,224				1,024	0	0
April	2008	4,416				951	0	0
May	2008	4,608				877	0	0
June	2008	4,896				1,098	0	0
TOTAL		88,704				15,383	0.0	0

Energy Use Index:

Annual Total Energy Cost = 15,383 $/year

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

Total KWH/yr x 0.003413 = 302.75 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 303 MMBTU/year

Energy Cost Index:

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

Electric Utility: CenterPoint Energy

Gas Utility: N/A

Location: City of Pasadena

ACCOUNT# 10089010238140213801O3 Electric

Gas

BUILDING: Jana Lift Station FLOOR AREA: N/A

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July	2007	7,937				986	0	0
August	2007	7,925				1,004	0	0
September	2007	7,900				914	0	0
October	2007	6,728				889	0	0
November	2007	5,900				825	0	0
December	2007	9,162				1,066	0	0
January	2008	7,748				991	0	0
February	2008	7,680				955	0	0
March	2008	7,171				923	0	0
April	2008	9,837				1,108	0	0
May	2008	5,020				905	0	0
June	2008	2,623				905	0	0
TOTAL		85,631				11,471	0.0	0

Energy Use Index:

Annual Total Energy Cost = 11,471 $/year

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

Total KWH/yr x 0.003413 = 292.26 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 292 MMBTU/year

Energy Cost Index:

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

Electric Utility: CenterPoint Energy

Gas Utility: N/A

Location: City of Pasadena

ACCOUNT# 10089010000147500011100 Electric

Gas

BUILDING: Gold Acres WWTP FLOOR AREA: N/A

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July	2007	431,555				43,443	0	0
August	2007	395,659				36,241	0	0
September	2007	431,404				38,876	0	0
October	2007	453,003				39,875	0	0
November	2007	448,744				39,875	0	0
December	2007	447,176				39,479	0	0
January	2008	450,462				41,043	0	0
February	2008	433,958				38,866	0	0
March	2008	396,835				36,397	0	0
April	2008	355,785				32,585	0	0
May	2008	396,303				35,758	0	0
June	2008	372,966				50,920	0	0
TOTAL		5,013,850				473,358	0.0	0

Energy Use Index:

Annual Total Energy Cost = 473,358 $/year

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

Total KWH/yr x 0.003413 = 17,112.27 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 17,112 MMBTU/year

Energy Cost Index:

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

Electric Utility: CenterPoint Energy

Gas Utility: N/A

ACCOUNT# 100890102115351822510 0
100890102381301516010 2 Electric
Gas

Location: City of Pasadena

BUILDING: Vince Bayou WWTP

FLOOR AREA: N/A

		ELECTRICAL					NATURAL GAS / FUEL	
			DEMAND			TOTAL ALL		
		CONSUMPTION	METERED	CHARGED	COST OF	ELECTRIC	CONSUMPTION	TOTAL
MONTH	YEAR	KWH	KW	KW	DEMAND ($)	COSTS ($)	MCF	COSTS ($)
July	2007	772,746				69,730	0	0
August	2007	641,258				58,649	0	0
September	2007	757,004				68,998	0	0
October	2007	605,843				55,332	0	0
November	2007	601,270				55,159	0	0
December	2007	609,530				55,824	0	0
January	2008	631,541				57,540	0	0
February	2008	588,844				53,569	0	0
March	2008	555,151				51,356	0	0
April	2008	529,479				49,225	0	0
May	2008	515,380				48,571	0	0
June	2008	608,002				84,058	0	0
TOTAL		7,416,047				708,011	0.0	0

Annual Total Energy Cost = 708,011 $/year

Energy Use Index:

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

Total KWH/yr x 0.003413 = 25,310.97 MMBTU/year

Total MCF/yr x 1.03 = 0.00 MMBTU/year

Total Other x _____ = 0.0 MMBTU/year

Total Site MMBTU's/yr = 25,311 MMBTU/year

Energy Cost Index:

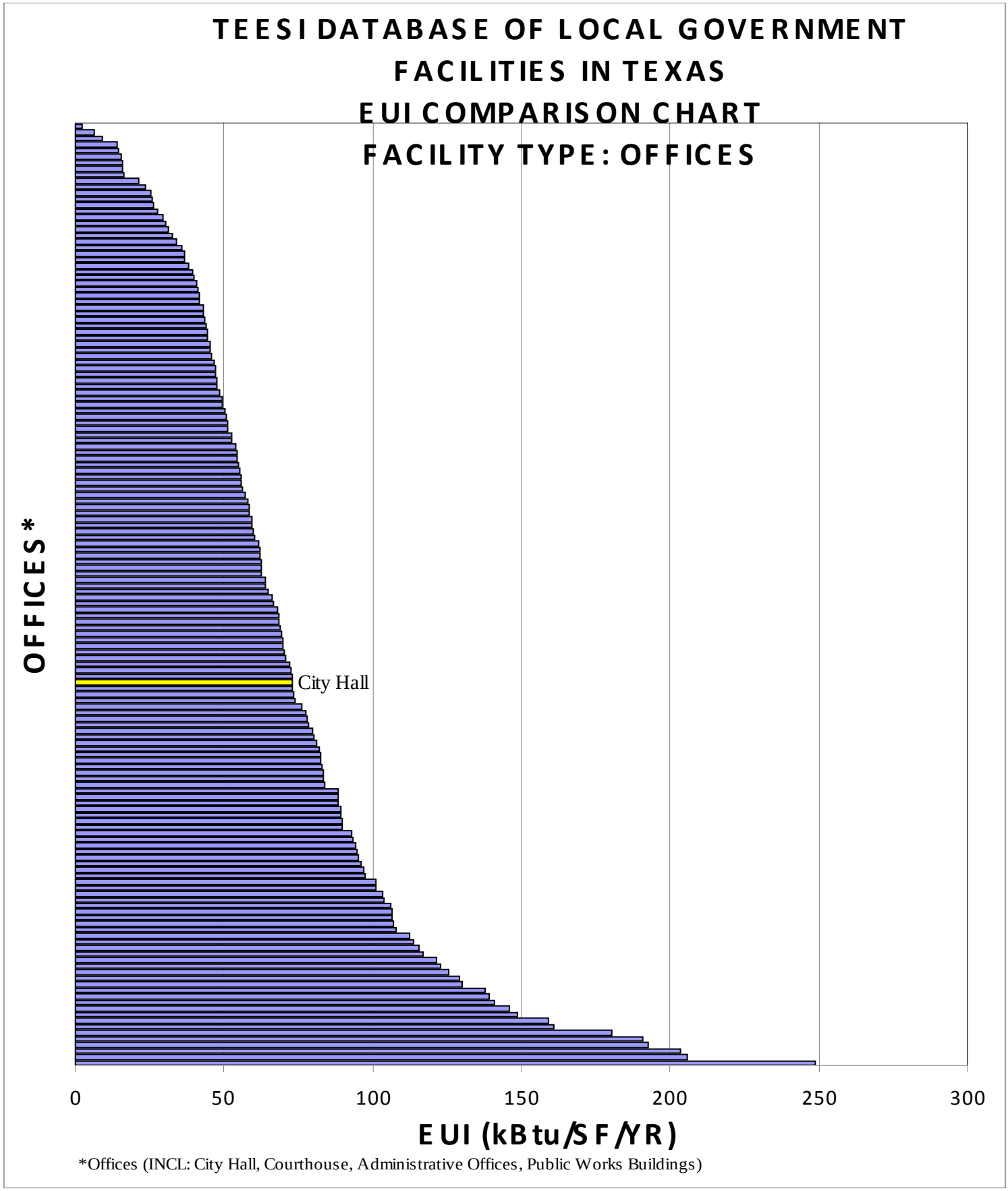
Total Energy Cost/Yr ÷ Total Area (SF) = N/A $/SF/year

Electric Utility: CenterPoint Energy

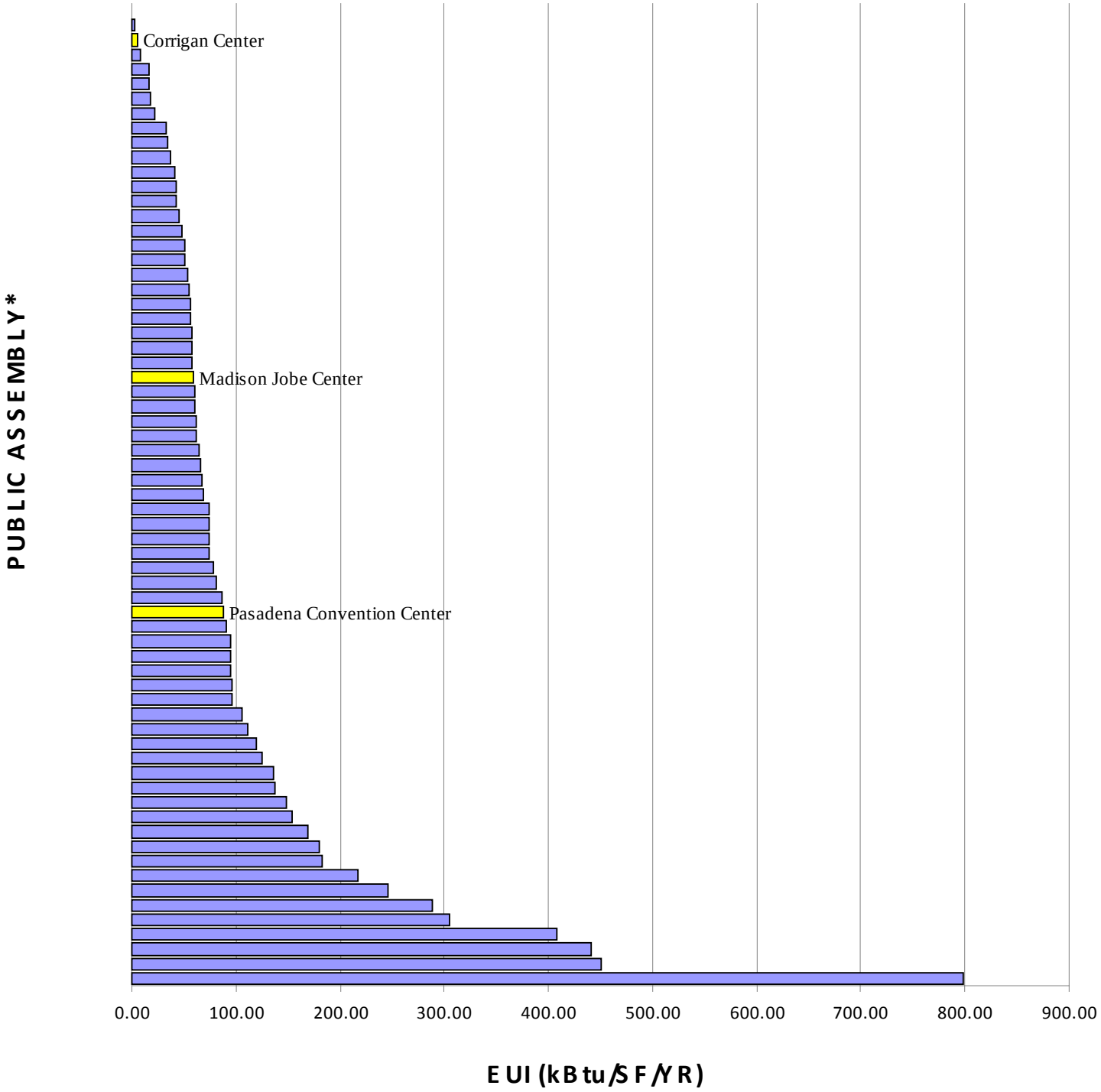
Gas Utility: N/A

APPENDIX D

ENERGY PERFORMANCE COMPARISON

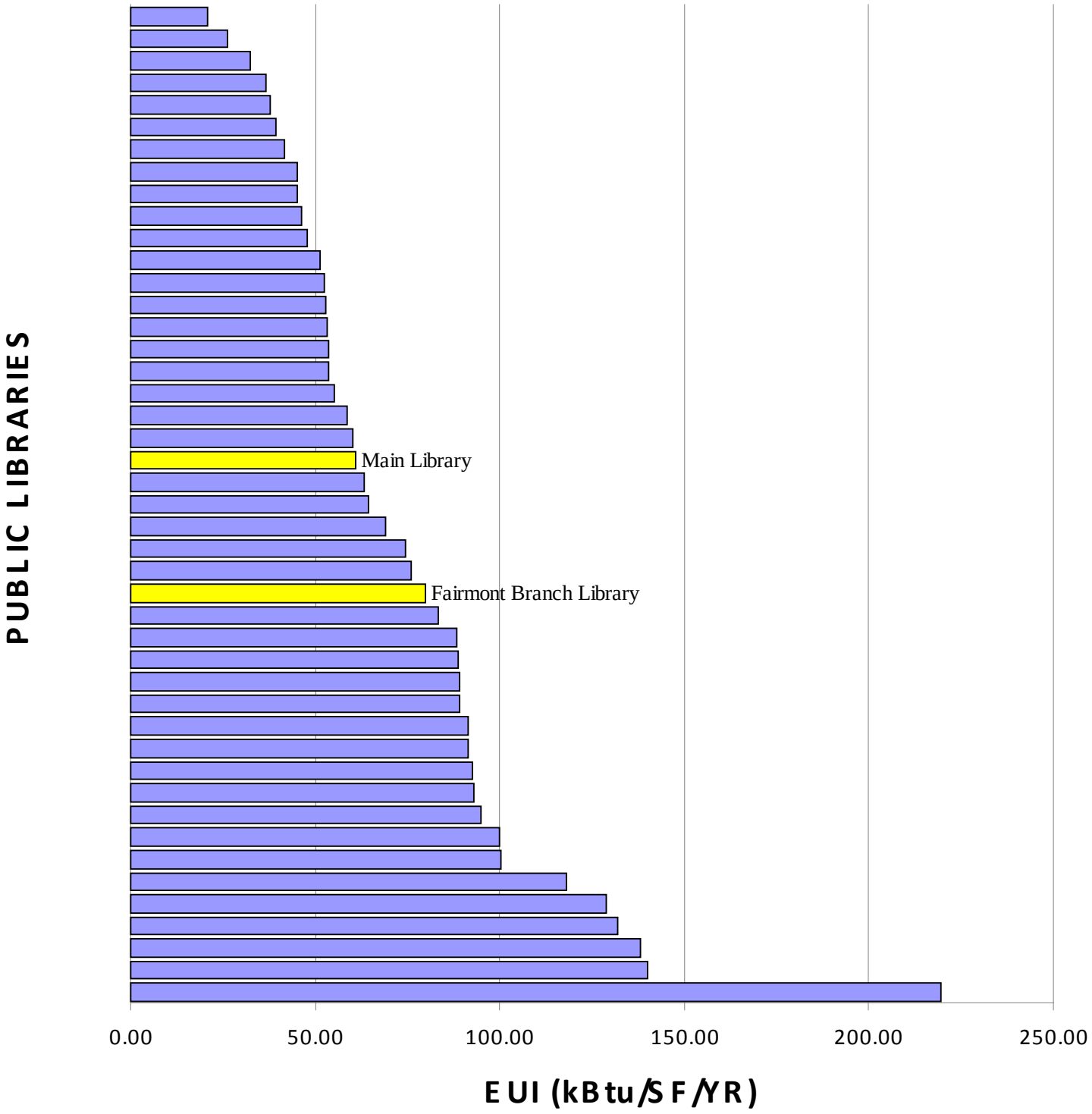

TEESI DATABASE OF LOCAL GOVERNMENT FACILITIES IN TEXAS
EUI COMPARISON CHART
FACILITY TYPE: OFFICES
OFFICES*
City Hall
0
50
100
150
200
250
300
EUI (kBtu/SF/YR)
*Offices (INCL: City Hall, Courthouse, Administrative Offices, Public Works Buildings)

TEESI DATABASE OF LOCAL GOVERNMENT FACILITIES IN TEXAS
EUI COMPARISON CHART
FACILITY TYPE: PUBLIC ASSEMBLY

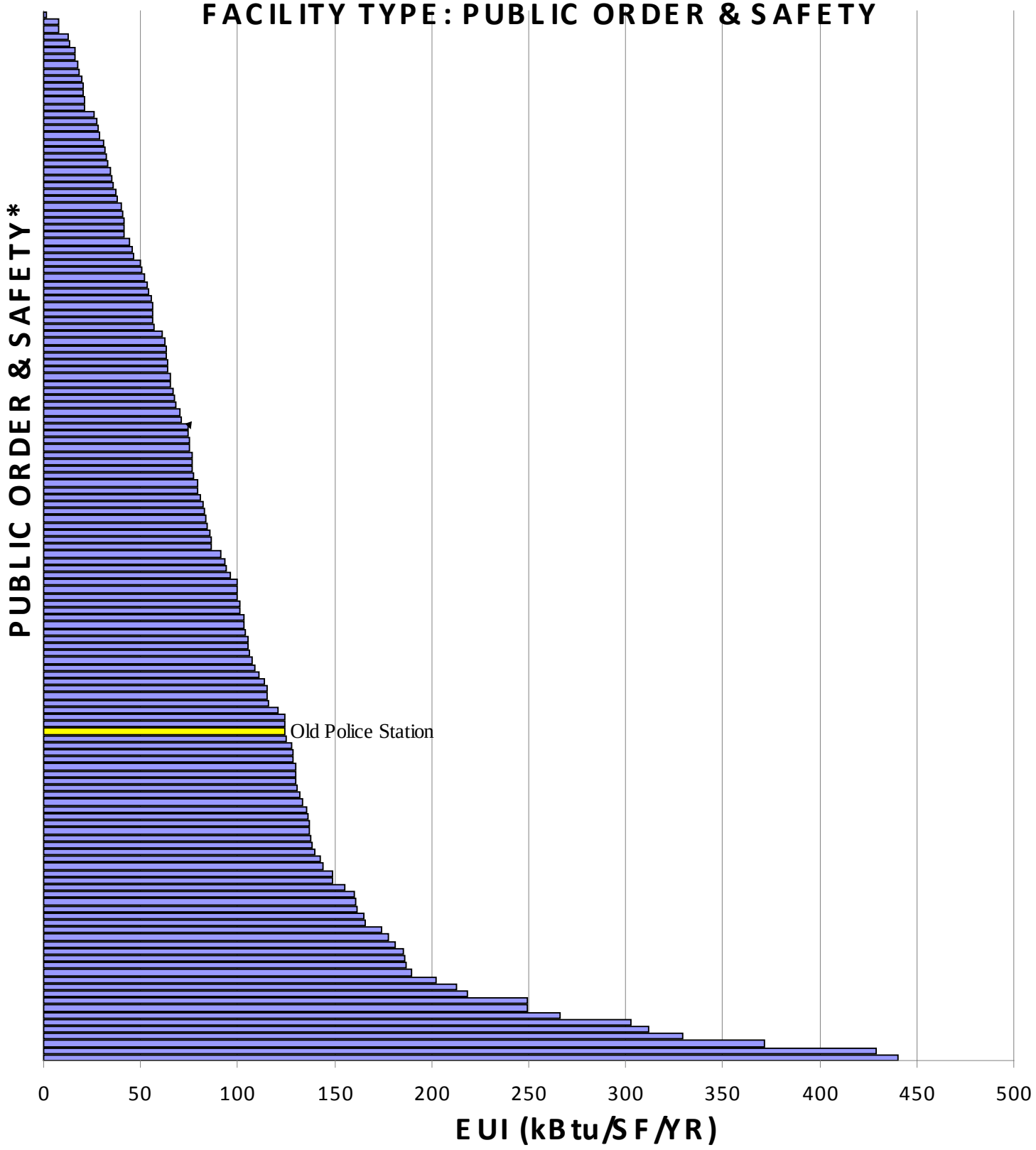


*Public Assembly (INCL: Convention Centers, Community Centers, Assembly Buildings)

TEESI DATABASE OF LOCAL GOVERNMENT FACILITIES IN TEXAS
EUI COMPARISON CHART
FACILITY TYPE: PUBLIC LIBRARY

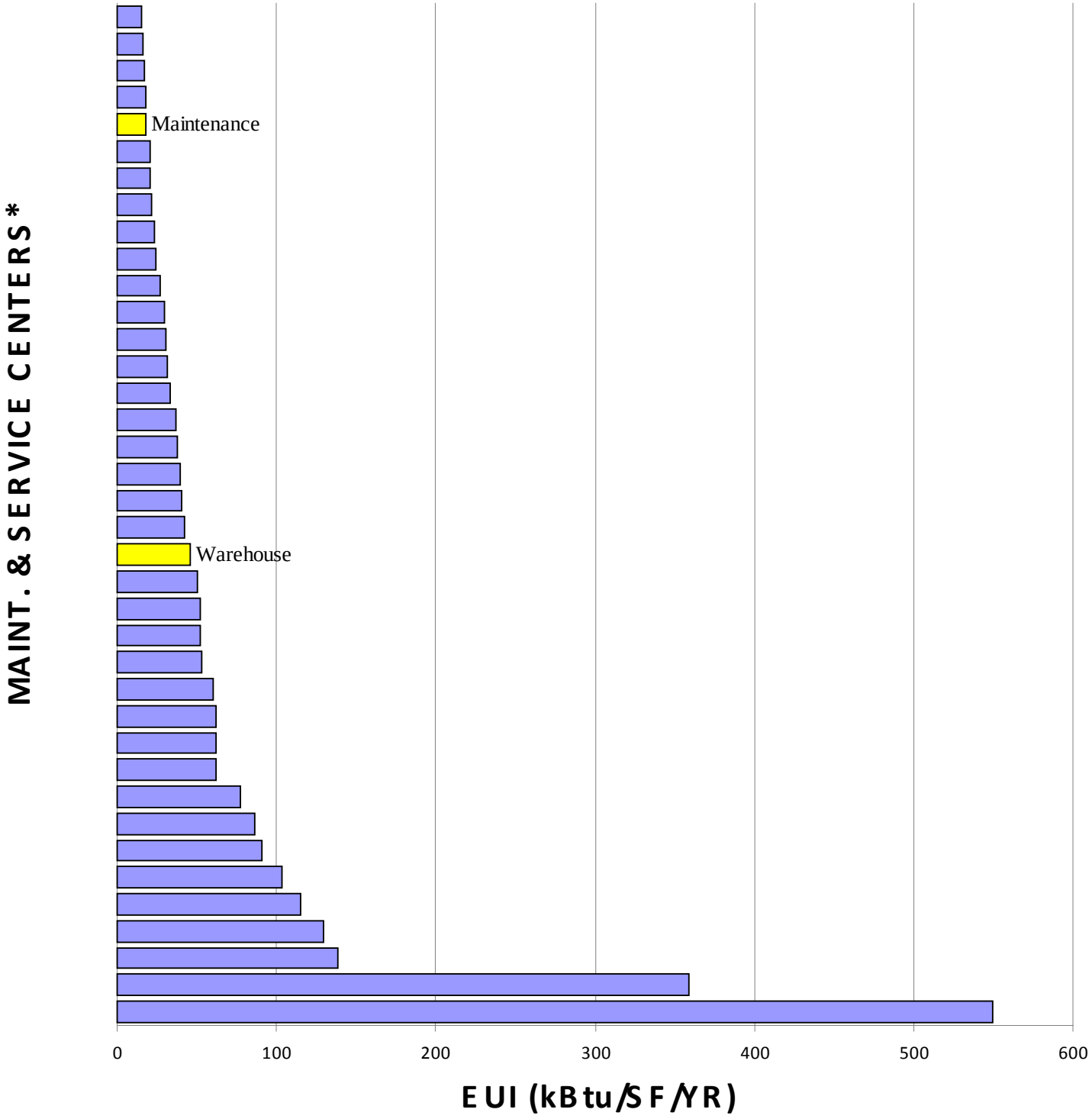


TEESI DATABASE OF LOCAL GOVERNMENT FACILITIES IN TEXAS
EUI COMPARISON CHART
FACILITY TYPE: PUBLIC ORDER & SAFETY



*Facility Type: Public Order and Safety (Police Dept, Fire Dept, EMS, Correctional Facilities, etc.)

TEESI DATABASE OF LOCAL GOVERNMENT FACILITIES IN TEXAS
EUI COMPARISON CHART
FACILITY TYPE: MAINT. & SERVICE CENTER



*Maint. And Service Centers (Service Center, Maint Bldg, Warehouses, etc)

APPENDIX E

TYPICAL EQUIPMENT MAINTENANCE CHECKLISTS

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 manufacturer'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 refrac-tories 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

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

Building Controls Checklist

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

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

Electric Motors Checklist

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
Motor use/sequencing	Turn off/sequence unnecessary motors	X			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Motor condition	Check the condition of the motor through temperature or vibration analysis and compare to baseline values		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 alignment	Aligning the motor coupling allows for efficient torque transfer to the pump			X	
Check mountings	Check and secure all motor mountings			X	
Check terminal tightness	Tighten connection terminals as necessary			X	
Cleaning	Remove dust and dirt from motor to facilitate cooling			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
Check for balanced three-phase power	Unbalanced power can shorten the motor life through excessive heat build up				X
Check for over-voltage or under-voltage conditions	Over- or under-voltage situations can shorten the motor life through excessive heat build up				X

APPENDIX F

ENERGY STAR INFORMATION

The ENERGY STAR® Challenge:
Build a Better World 10% at a Time

Many of us are taking steps to improve the energy efficiency of our homes with ENERGY STAR qualified lighting, appliances, electronics, and heating and cooling systems. But what we may not realize is that the buildings in which we work, shop, play, and educate our children use about $200 billion worth of electricity and natural gas each year.

The U.S. Environmental Protection Agency (EPA) estimates that if the energy efficiency of commercial and industrial buildings in the U.S. improved 10 percent, Americans would save about $20 billion and reduce greenhouse gases equal to the emissions from about 30 million vehicles. You can join us and help reach this goal!

When lights are left on and the heating and cooling system runs in an unoccupied commercial building, energy is wasted. When this happens, a power plant down the road burns fossil fuels to generate that energy and sends emissions into our environment.

In fact, the energy used by commercial and industrial buildings in the United States is responsible for nearly 50 percent of our national emissions of greenhouse gases that contribute to global climate change.

Thanks to the thousands of businesses and organizations that work with EPA's ENERGY STAR Program, we're already saving billions of dollars a year with strategic energy efficiency practices that reduce operating costs and greenhouse gas emissions without tradeoffs in performance or quality. But we're on a journey of continuous improvement — we can do more.

Take the ENERGY STAR Challenge!

Whether you're associated with a small school or a large corporation, a local government or a national association, a community hospital or a hotel group, a manufacturing plant or a retailer — you can be part of the ENERGY STAR Challenge and help improve the energy efficiency of America's commercial and industrial buildings by 10 percent or more.

Challenge participants and their members are encouraged to:

- Measure and track energy use.
- Develop a plan for energy improvements.
- Make energy efficiency upgrades.
- Help spread the energy efficiency word to others.

Now is the time to help build a better world and take many of the same steps at work that you are taking at home to protect our environment. The ENERGY STAR Challenge Toolkit can show you how.

Use the ENERGY STAR Challenge Toolkit to:

- Help you get started on the path toward energy efficiency at work and at home.
- Learn more about energy efficiency for specific building types and how to bring the ENERGY STAR Challenge to your community.
- Access ENERGY STAR brochures, public service announcements, press releases, posters, event ideas, and templates to help spread the word about energy efficiency.

ENERGY STAR® is a government-backed program helping businesses and individuals protect the environment through superior energy efficiency.

LEARN MORE AT energystar.gov

Toolkit Materials:

Get Started!

- **Quick Lists of ENERGY STAR Resources** explain how to help improve energy efficiency in commercial and industrial buildings as well as at home.
- **Create a Challenge Team** offers ideas on who can help create an organized effort in your building, town, school, or company to improve energy efficiency.
- **Bring the Challenge to Your Community** provides a model for establishing a program or campaign to accelerate energy efficiency activities in your community.

Learn More!

- **Did You Know?** provides a summary of key energy efficiency points and information about the ENERGY STAR Challenge.
- **Fast Facts** provide useful statistics to help understand the important role commercial and industrial buildings play in global climate change.
- **Work with Different Groups in the Community** offers a series of fact sheets that provide information on energy use, energy efficiency opportunities, partnership possibilities, and key leverage points for major groups including: new and existing homes, commercial real estate, healthcare, education, hospitality, supermarkets, industry, small business, congregations, and local governments.
- **Grow with ENERGY STAR** describes the different levels and benefits of participation with ENERGY STAR, beginning with taking the ENERGY STAR Challenge and moving beyond to Partner, earning the ENERGY STAR label, Leader, and then the pinnacle — Partner of the Year.

Spread the Word!

- **ENERGY STAR InfoCards** help consumers and businesses learn about energy efficiency and ENERGY STAR.
- **Sample News Releases** for the media.
- **Sample Text** provides copy for Web sites, e-mails, newsletters, and more to help you communicate with clients, constituents, employees, and business-to-business networks.
- **Energy Efficiency Presentation** you can use to talk about energy efficiency and your involvement in the ENERGY STAR Challenge.
- **Celebrate with ENERGY STAR** suggests events and ideas to promote the ENERGY STAR Challenge and celebrate energy efficiency.
- **Certificate of Participation** announces your involvement in the ENERGY STAR Challenge and can be displayed to share the good news of your efforts with others.
- **Web Banners** can be easily downloaded to use on Web sites.
- **Posters and other materials** communicate energy efficiency messages and provide information on how to get involved.

Contact Information

To take the ENERGY STAR Challenge or to access the ENERGY STAR Challenge Toolkit materials online, visit **www.energystar.gov/challenge**.

ENERGY STAR Program
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Mail Code 6202J
Washington, DC 20460

For more information
www.energystar.gov
or call **1.888.STAR.YES**
(1.888.782.7937).

United States
Environmental
Protection Agency
EPA

Office of Air and Radiation
(6202J) EPA 430-F-07-016
August 2007

Recycled/Recyclable – Printed with Vegetable Oil Based Inks on Recycled Paper (Minimum 50% Post-consumer Content)

APPENDIX G

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:

Theresa Sifuentes
SECO, LoanSTAR Program Manager
(512) 463-1896

APPENDIX H

DESCRIPTION OF SECO PROGRAMS

Texas State Energy Conservation Office (SECO)

The Texas State Energy Conservation Office (SECO) helps Texas make the most of domestic energy, reduce state and local government energy costs and promote cost-effective, clean-energy technologies. SECO's mission is to maximize energy efficiency while protecting the environment.

LoanSTAR Revolving Loan Program: has saved taxpayers more than $224.6 million through energy-efficiency projects for state agencies, institutions of higher education, school districts, county hospitals and local governments. Borrowers repay loans through cost savings generated by the projects. LoanSTAR-funded projects have also prevented the release of 7,781 tons of nitrogen oxides (NOx), 2.3 million tons of carbon dioxide (CO2) and 5,339 tons of sulfur dioxide (SO2).

Schools/Local Government Energy Program: has helped more than 3,500 schools and other units of local government set up and maintain effective energy-efficiency programs. SECO provides facility preliminary energy assessments, energy management training workshops, technical support in designing new facilities and on-site training for student energy awareness projects. Clean energy technologies are demonstrated at public facilities and school districts to increase awareness and address air quality at the community level. Texas schools also employ the computer power management software that puts monitors to "sleep" when not in use. Over 136,000 school computers now use this software, saving 42 million kWh and reducing energy costs by $3 million annually.

Energy Education Program: promotes energy conservation and efficiency through education. The program strives to lay the foundation for environmental stewardship in teachers and students through critical-thinking and problem-solving investigations in Texas Education Agency approved workshops. Over 2,500 teachers have attended these workshops and utilized the materials in their classrooms reaching over 375,000 students. The program also supports fuel cell technical training curriculum development at the college level.

State Agencies/Higher Education Program: ensures that new facilities are designed and built with energy efficiency and water conservation in mind. Projects include administration and maintenance of the Energy and Water Conservation Design Standard for new state buildings and major renovation projects. Other initiatives include development of statewide employee energy awareness through workshops on how energy efficiency and employee behavior can reduce energy use. The program provides educational materials on how to use energy more efficiently through product procurement, innovative technologies and sustainable design practices. This program also provides education and outreach on residential and commercial energy codes statewide. The goal is to demonstrate the clear benefits of energy codes and standards in improving the quality of life, the environment and the safety and health of communities.

Alternative Fuels Program: demonstrates the positive environmental impact, technical feasibility and energy efficiency of domestically-produced alternative fuels. The Alternative Fuels Program is designed to assist state agencies, school districts, local government and private fleets to operate more of their fleets on alternative fuels. Initiatives include support for the Clean Cities Program, Clean School Bus USA Program, Mechanics Education Outreach and Air Quality Demonstration Projects.

Energy Management Services: a comprehensive energy management program designed to significantly reduce energy and utility expenditures in state-owned facilities. The State of Texas spent over $216 million in energy and utility expenditures in 2006. Program components include construction of a state-of-the-art energy and utility information management system, a comprehensive analysis of historic and future utility bills, energy procurement at the lowest possible rates and best available terms, and owner's representative services on ongoing and future energy-conservation projects. Institutions of higher education, state university systems and local governments are eligible to participate in the program.

Innovative Energy Program: promotes the use of renewable energy and sustainable building practices through technology demonstration, hands-on instruction and renewable energy education. Renewable energy has significant economic, security and reliability benefits and opportunities for Texas communities and individuals as they develop and use these resources. SECO increases public awareness of Texas' vast renewable energy resources and provides the public better access to vendors, financing options, and renewable energy incentives through its educational web site, The Infinite Power of Texas, at www.infinitepower.org.

Housing Partnership Program: promotes the efficient use of energy in low-to-moderate-income housing through partnerships among nonprofit organizations, community action agencies, local governments, utility companies, public housing authorities and social service organizations. The program encourages community and residential involvement in energy-efficiency projects such as housing retrofits, model demonstration projects, technical training assistance and energy education workshops and seminars.

Pollution Mitigation Program: assists political subdivisions in the 41 non-attainment counties to reduce electric consumption in their facilities by implementing cost-effective energy efficiency projects. SECO provides technical support and guidance through the Texas Energy Partnership, a joint initiative involving SECO, the U. S. Department of Energy and ENERGY STAR®. Information, planning tools and electronic reporting are offered at www.texasenergypartnership.org.

Pantex Program: The Pantex Nuclear Weapons plant, located in Carson County, is responsible for assembling and disassembling nuclear weapons. The U.S. Department of Energy funds the Texas Agreement in Principle, which SECO has administered since 1990. SECO contracts with a variety of state and local governments to ensure that human health and safety, and the environment, are protected around the plant. The Pantex Program also administers a DOE grant to train local emergency responders along routes that have shipments of radioactive waste going to the Waste Isolation Pilot Plant near Carlsbad, New Mexico, and eventually shipments of spent fuel tentatively scheduled to go to Yucca Mountain in Nevada.

State Energy Conservation Office
111 East 17th Street
Austin, TX 78774-1440
Phone: (512) 463-1931
Fax: (512) 475-2569
www.seco.cpa.state.tx.us

APPENDIX I

ENERGY EFFICIENTY FACTSHEET

EnergyIdeas Clearinghouse

Energy Efficiency FACTSHEET

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

Building Commissioning for New Buildings

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

Photo courtesy of DOE/NREL

What is building commissioning?

The key elements in building commissioning include:

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

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

Why perform building commissioning?

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

Managed by:
Washington State University Extension Energy Program

With support from:
Northwest Energy Efficiency Alliance
www.nwalliance.org

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

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

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

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

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

Photo courtesy of DOE/NREL
Photographer: Jim Yost, 2006

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

When should building commissioning start?

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

Who should perform building commissioning?

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

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

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

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

What are the steps in a commissioning process?

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

Predesign

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

Design Phase

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

Photo courtesy of DOE/NREL, Photographer David Parsons

Construction Phase

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

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

Acceptance Phase

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

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

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

Post-Acceptance Phase

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

How much does building commissioning cost?

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

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

Where can I get more information about building commissioning?

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

Programs and Organizations

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

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

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

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

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

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

Documents

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

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

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

State and Local Resources

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

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

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

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

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

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

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

Technical Assistance

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

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

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

WSUEEP98_018, Revised October 2005

APPENDIX J

REQUEST FOR ASSISTANCE

PRELIMINARY ENERGY ASSESSMENT SERVICE AGREEMENT

SECO State Energy Conservation Office

Investing in our communities 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) through its engineering consultants will analyze electric, gas and other utility data and work with CITY OF PASADENA, 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 the Partner is ready and willing to consider implementing the energy savings recommendations.

Principals 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 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 identify no cost/low cost recommendations, Capital Retrofit Projects, potential sources of funding.
- Partner will schedule a time for SECO's contractor to make a presentation of the assessment findings and recommendations to 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: May 18, 2009

Name (Mr./~~Ms./Dr.~~): ANDY HELMS Title: DIRECTOR OF FINANCIAL PLANN

Entity: CITY OF PASADENA Phone: 713-475-7254

Street Address: 1211 E. SOUTHMORE AVE. Fax: 713-475-2221

Mailing Address: P.O. Box 762 E-mail: Ahelms@ci.pasadena-tx.us
PASADENA, TX 77502

CONTACT INFORMATION:

Name (Mr./~~Ms./Dr.~~): ROBIN S. GREEN Title: DIRECTOR OF PUBLIC WORKS

Phone: 713-475-7836 Fax: 713-475-7833

E-Mail: rgreen@ci.pasadena-tx.us

Please Sign and mail or fax to the following SECO Consultant : Texas Energy Engineering Services, Inc. (TEESI), ATTENTION: Saleem Khan, P.E., 1301 Capital Of Texas Highway #B-325, Austin, TX. 78746, Phone 512-328-2533, **Fax 512-328-2544.** If you need to contact the State Energy Conservation Office, please call **Stephen Ross 512-463-1770** or you may write to her at: Comptroller Of Public Accounts, State Energy Conservation Office, 111 E. 17th Street, Austin, Texas 78774.