



Energy Management Department 2017 Value Report

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INTRODUCTION

The Energy Management Department for CFISD is working hard helping to provide a safe and comfortable learning environment that supports the high quality educational needs of the CFISD students and staff, while conserving our natural resources and being good stewards of the tax payers' money. This Value Report shows some highlights of what we have accomplished this year and some initiatives for moving forward. Other departments in the Facility and Maintenance Department have also contributed greatly, namely the Planning Dept. led by Dillon Brady and Roy Sprague who have installed energy efficient LED lights and HVAC mechanical equipment in their new and renovation 2014 bond projects. We have also been assisted greatly by Archie Hayes' Maintenance Department including: HVAC department led by David Tooker, and the Electrical Department led by Carey Ramsey and Shawn Grimm.

UTILITY BILL AUDITING

Sonia DeSouza pays and tracks all District utility bills (Water, Gas and Electric) and finds billing errors, overcharges, line items that shouldn't be charges (such as taxes), and other problems. She is the liaison to the utility companies to oversee that those charges are removed and not repeated. She also keeps a close eye on the due dates (the MUDs have only a 20-day window). When one accounts for the mail, to and from, and then the delay in getting the checks cut, there are many instances when the billing office would not get our payment in on time. In those instances, she has Cindy Dodds and Yvonne Sacky hand-deliver the payments to the MUD's billing offices; doing so avoids a 10-15% late fee. If a bill was \$10K that would be a \$1,000-\$1,500 late fee! Sonia tracks these savings (cost avoidances). **For the 2017 school year they totaled \$312,983!** Please see spreadsheet screen-shot posted below in Fig 1.

She inputs billing data into SchoolDude UtilityDirect; this tool allows Jay a quick way to monitor energy costs, view year-to-year energy spend comparisons, increase ENERGY STAR ratings and improve building performance.

Figure 1: Utility Bill Auditing Savings

Utility Savings by Month						
2017			Electric	Gas	Water	Yearly Total
Jan					\$ 30,664.68	
Feb			\$ 285.78	\$ 357.22	\$ 1,075.94	
Mar			\$ 85.91		\$ 7,262.21	
Apr			\$ 3,171.32	\$ 2.62	\$ 2,698.88	
May			\$ 378.49		\$ 2,089.16	
Jun			\$ 416.91	\$ 1.33	\$ 14,174.83	
July					\$ 6,742.33	
Aug					\$ 24.00	
Sep					\$ 30,622.49	
Oct					\$ 27,244.85	
Nov					\$ 177,803.12	
Dec					\$ 7,880.85	
TOTALS			\$ 4,338.41	\$ 361.17	\$ 308,283.34	\$ 312,982.92

LOAD FACTOR SAVINGS

Load Factor is a way to determine how well our schools are being scheduled. It is common knowledge that Cypress Fairbanks schedules the HVAC and Lighting OFF at the end of the school day (these are “Normal Hours”). Then, “After-Hour” events are scheduled individually (up to 10,000 events a month in the entire district). The principal’s secretary or other on-campus designees submit each After-Hour event in the SchoolDude program; then the Energy Management Department schedules them on the building automation systems (eight different EMS’s) and schedules are automatically downloaded into the school’s building controls (via internet). Nation-wide, many school districts only schedule the HVAC OFF when the last custodian leaves, and don’t control the lighting at all (it’s only left up to the teachers and staff to individually turn OFF their own lights).

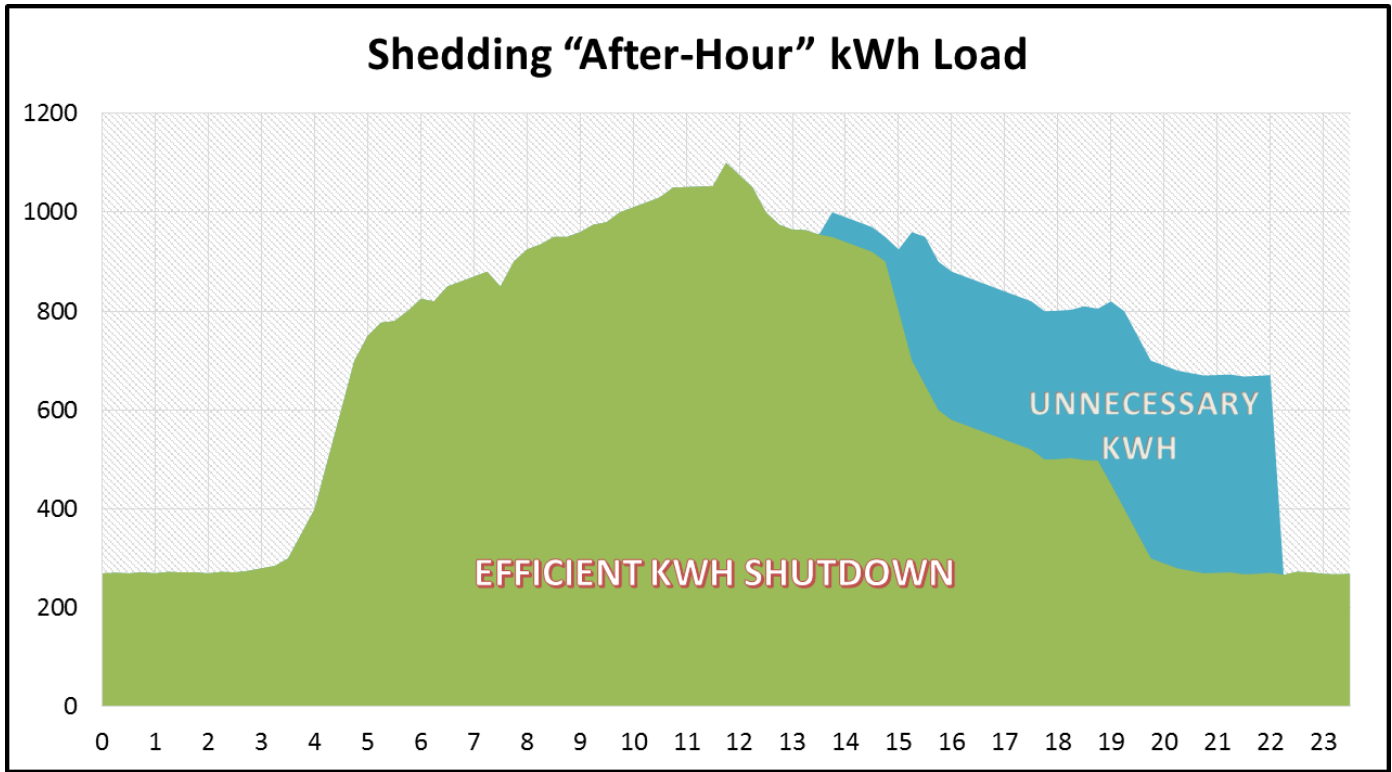
Load factor is the ratio of kWh’s used vs. potential kWh based on kW capacity; it’s a way to determine how well a school is shutting down their lighting and HVAC (and plug loads). Using load factor to compare Cypress Fairbanks School District to a large school district in south Florida (where I was previously involved in performance contracting) shows that Cypress Fairbanks saves **four to five million dollars annually** (Fig 2), by individually scheduling each “After-Hour” event!! This is the result of the hard work of our Energy Coordinators (Cindy, Leah, Yvonne); these ladies utilize first-rate controls in ALC & Watt Stopper and the SchoolDude scheduling program.

Also, the HVAC department (David Tooker and his team) does an outstanding job in keeping the controls in working order and “backing-off” during off-peak periods. A lot of large school districts have their controls bypassed or put in HAND (or Manual position) and they do not throttle down during off-peak periods. After travelling to every high school and middle school and various elementary schools, I’ve seen very few controls in bypass! Keeping the energy management system in automatic also controls the Indoor Air Quality (IAQ) to be at acceptable levels (that is Temperature, RH% and CO2 levels). For example, several school districts in South Florida have had substantial lawsuits over poor IAQ in the millions of dollars.

We are working towards automating the HVAC after-hour event scheduling through the integration of SchoolDude and the controllers; we are 90% completed with this task. After we are integrated, the Energy Coordinators will still review the requests and try to tighten them up further (after their review). The integration will also help free up the Energy Coordinators somewhat, to be involved in labor intensive programs such as Behavior Modification (instead of CFISD paying for an outside vendor), SCORE program, and also have more time in the way of high bill drill-downs, through doing trend reports, failed-relay reports, investigating night load (kW profiles), security cameras etc.

Figure 2: Load Factor Savings (through HVAC/Lighting Scheduling)

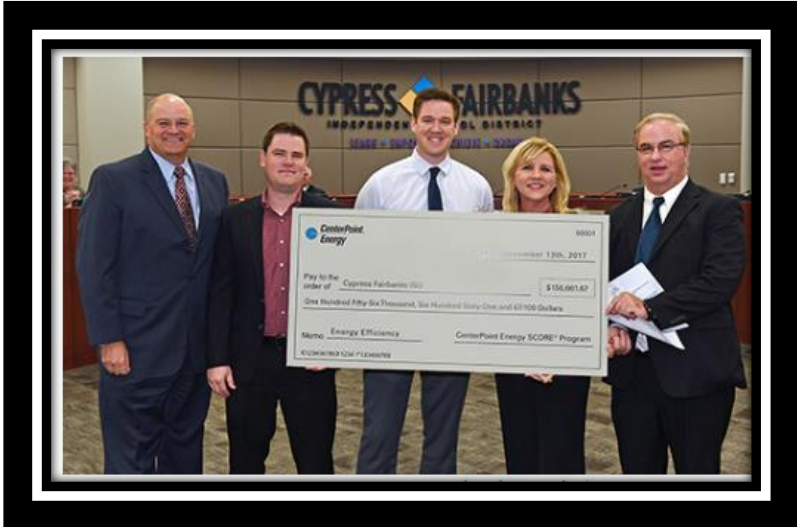
Elementary Schools	\$ 1,512,937
Middle Schools	\$ 1,077,380
High Schools	\$ 1,965,452
	\$ 4,555,769



CENTERPOINT/CLEARRESULT/TXU INCENTIVES

The CenterPoint SCORE program provides energy incentives for various energy conservation measures. CLEARResult is the facilitator of their program. After applying for the incentives, and then obtaining and sending in drawings/submittals, conducting pre/post inspections with CLEARResult; and also doing our own retrofit projects using unused rebate money from our energy rebate account, we obtained a total of **\$202,531.94** in incentives for the 2017 year! We anticipate larger CenterPoint/SCORE incentives for the 2018 year. Thanks to the CFISD Facilities Project Coordinators and Project Managers assistance in gathering drawings/submittals and with pre inspections.

Figure 3: School Board Check Presentation –CenterPoint Energy



ALC OUTDOOR AIR CONTROL

Using rebate money, the CFISD Energy Management Department paid for ALC to change their scheduling software so we could also schedule the outside air (OA) – previously the outside air was provided during precool periods and dehumidification periods (even though it was not needed). Using TMY3 (Typical Meteorological Year) data for the city of Houston, the typical annual savings were calculated to be over **\$66,890.86** annually (See Fig 4). The programming change was done on twenty-three schools. The ALC representative also made sure that the exhaust fans were interlocked, so to make sure the schools were not negative air-balanced when the OA was closed OFF. More schools will have this change implemented this year.

Figure 4: ALC OA Scheduling Savings

Cooling	
1,858,079.58	ton-hrs
0.80	kw/ton
1,486,464	kwh
\$ 66,890.86	OA Savings
\$66,890.86	

GYM AND AUDITORIUM LED LIGHTING

High-bay gym and auditorium lighting was converted from metal halide and compact fluorescent to LED in the following gyms and warehouses (see Fig 5). Rebate money was used to pay for the projects. After getting height, length and width dimensions and doing photo-metrics, the Energy Management Department asked Carey Ramsey, Shawn Grimm and their team to install the high-bay lighting during the summer months. A couple of sample fixtures were ordered and tested for light output and robustness. The schools were happy to get the new lighting (See example Fig 6); a side-benefit was the foot-candles were more than double post retrofit than pre, at some of the schools! Carey and Shawn’s team did an excellent job installing almost 600 fixtures!

Also, in the end, the maintenance savings will be far greater than the annual energy savings of **\$77,194**. The life on the new fixtures is a 100,000 hours verses 30,000 hours for the existing. The previous compact fluorescent fixtures had some lamps and ballasts that had to be replaced every summer, which required a scissors-lift and a lot of man-hours.

Figure 5: Annual High-Bay LED Savings (2017)

School	Gym	Count	Watts Pre	Watts Post	Lamp kWh Savings	HVAC kWh Savings	Total kWh Savings
Hopper	Aux Gym	30	400	150	32,550	7,404	39,954
Hopper	Perf Gym	35	400	150	37,975	8,638	46,613
JVHS	Perf Gym	52	420	150	64,428	14,655	79,083
JVHS	Weight	18	400	150	19,530	4,442	23,972
JVHS	Aux Gym	24	400	150	26,040	5,923	31,963
JVHS	Middle Gym	25	400	150	27,125	6,170	33,295
Bleyl	Perf Gym	40	420	150	49,560	11,273	60,833
Bleyl	Aux Gym	30	400	150	32,550	7,404	39,954
Bleyl	Swim Pool	38	400	150	41,230	9,378	50,608
Windfern	Warehouse	45	400	131	51,818	-	51,818
Windfern	Warehouse	48	1000	245	152,040	-	152,040
Windfern	Warehouse	56	1000	179	190,316	-	190,316
Cy Ridge	MP Gym	42	420	150	48,951	11,135	60,086
Cy Ridge	Perf Gym	48	400	150	52,080	11,846	63,926
Cy Ridge	Aux Gym	35	400	150	37,975	8,638	46,613
ALC West	Gym	18	560	150	31,122	7,079	38,201
Francone	Gym	15	400	150	16,275	3,702	19,977
		599			911,565	117,689	1,029,254
							\$77,194

Figure 6 Cy Ridge Performance Gym



M2G NATURAL GAS CONTROLLERS

M2G gas controllers (installed in early November at Bleyl MS, Cy-Lakes HS, Cy-Woods HS, and Spillane MS) were evaluated; the natural gas savings were better than expected (29% - see below). CLEAResult also verified the savings. Based on these savings, financial evaluations were calculated for the schools where the controllers were installed. The NPV was calculated to be \$203,000 and the IRR was calculated to be 61%.

	Heating	HDD	
	Coef	TMY	
Pre	5.4887	1686	92,539.48
Post	3.892	1686	65,619.12
		Savings	26,920.36
			29.1%

	Cy-Lakes	Cy-Woods	Bleyl	KAHLA MS	Spillane	Total
Jul	169	90	23	230	15	527
Aug	254	51	31	280	1	617
Sep	312	113	50	420	72	967
Oct	336	201	168	1620	200	2,525
Nov	400	295	219	3100	307	4,321
Dec	725	751	539	4680	633	7,328
Jan	937	833	674	6670	772	9,886
Feb	748	1141	576	6410	877	9,752
Mar	296	636	331	2900	580	4,743
Apr	188	445	195	2930	390	4,148
May	122	258	124	2350	233	3,087
Jun	32	72	30	690	90	914
Total Usage	45190	48860	29600	32280	37530	193,460
Nat Gas Rate	0.541	0.541	0.541	0.541	0.541	
\$ Nat Gas Costs	\$ 24,447.79	\$ 26,433.26	\$ 16,013.60	\$ 17,463.48	\$ 20,303.73	
Savings%	0.291	0.291	0.291	0.291	0.291	
Install Costs	\$(14,256.00)	\$(14,256.00)	\$(7,128.00)	\$(7,128.00)	\$(7,128.00)	\$ (49,896)
Yr 1	\$ 7,114.31	\$ 7,692.08	\$ 4,659.96	\$ 5,081.87	\$ 5,908.39	\$ 30,457
Yr 2	\$ 7,114.31	\$ 7,692.08	\$ 4,659.96	\$ 5,081.87	\$ 5,908.39	\$ 30,457
Yr 3	\$ 7,114.31	\$ 7,692.08	\$ 4,659.96	\$ 5,081.87	\$ 5,908.39	\$ 30,457
Yr 4	\$ 7,114.31	\$ 7,692.08	\$ 4,659.96	\$ 5,081.87	\$ 5,908.39	\$ 30,457
Yr 5	\$ 7,114.31	\$ 7,692.08	\$ 4,659.96	\$ 5,081.87	\$ 5,908.39	\$ 30,457
Yr 6	\$ 7,114.31	\$ 7,692.08	\$ 4,659.96	\$ 5,081.87	\$ 5,908.39	\$ 30,457
Yr 7	\$ 7,114.31	\$ 7,692.08	\$ 4,659.96	\$ 5,081.87	\$ 5,908.39	\$ 30,457
Yr 8	\$ 7,114.31	\$ 7,692.08	\$ 4,659.96	\$ 5,081.87	\$ 5,908.39	\$ 30,457
Yr 9	\$ 7,114.31	\$ 7,692.08	\$ 4,659.96	\$ 5,081.87	\$ 5,908.39	\$ 30,457
Yr 10	\$ 7,114.31	\$ 7,692.08	\$ 4,659.96	\$ 5,081.87	\$ 5,908.39	\$ 30,457
Total Net PV	\$45,078.14	\$49,863.10	\$31,672.22	\$35,166.41	\$42,011.38	\$ 203,791
# of Boilers	2	2	1	1	1	7
IRR	41%	46%	59%	66%	78%	61%
				Simple Payback	1.64	
				Net present Value (10 Yr.)	\$203,791.25	
				IRR	61%	

CONDENSER WATER RESET USING A FLOATING REAL-TIME WET-BULB TEMPERATURE

Using the rebate money, CFISD hired ALC to install a floating wet-bulb control set-point for our condenser water return temperature (entering condensers temperature); this was implemented at twenty schools that have centrifugal chillers. Also, many of these chiller plants did have existing humidity sensors which were not working properly. CFISD contracted ALC to use a weather service as our primary outdoor temperature and humidity for many schools; the weather service uses local airports. It’s best to keep the condenser water set-point “floating” rather than fixed. Many times if it is a fixed set-point, it is too high (wasting a lot of energy - 1% per degree waste). Also in the summer, a fixed set point may be too low, again wasting a lot of energy (the VFD fan will try to have it reach a temperature that can never be reached). Calculating the total chiller kWh from the schools where the program was installed; a savings calculation was estimated to be 7% of the total chiller load, or \$63,640. This program works best for centrifugal chillers; but we’ll also research to putting it in for a rotary screw chiller (with a pilot school). I have used this in past performance contracts in FL with great success - it is a very common chiller optimization algorithm.

Building Desc	Grand Total
ANTHONY MS	2,160,902
BLEYL MS	3,442,474
CAMPBELL MS	2,629,588
CY-CREEK HS	4,722,468
CY-RANCH HS	7,495,330
CY-RIDGE HS	5,677,110
CY-SPRINGS HS	5,593,682
CY-WOODS HS	3,715,403
DEAN MS	2,454,660
GOODSON MS	2,053,953
JERSEY VILLAGE HS	4,909,453
KAHLA MS	2,207,013
LABAY MS	1,644,062
LANGHAM CREEK HS	4,743,876
ROBINSON ES	889,536
SPILLANE MS	1,858,736
TRUITT MS	1,815,373
Total kwh	58,013,619
%Chiller Load	36%
Chiller kWh	20,662,625.48
%Savings	7%
kWh Savings	1,446,383.78
Rate	\$ 0.04
	\$ 63,640.89

CENTERPOINT GAS TRANSPORT RATE

The Energy Management Department transferred 3 more qualifying natural gas accounts from the CenterPoint General Service Rate to a new CenterPoint Transport Rate. It's also a win for CenterPoint when they make their rate case before the PUC (helps them with their MCF/customer ratio). The savings are in the following accounts total to approximately **\$22,324 annually**, depending on the current natural gas prices. (See Fig 10) This rate change was approved by Roy Sprague and Dillon Brady. These rate contracts are for one year and are set up for auto-renewal.

Figure 10: CenterPoint Gas Transport Rate Savings

Cy Park	46,895.35
Bridgeland	49,363.53
Natatorium	102,180.00
CCF	198,438.88
Savings (\$)	\$22,324.37

ENERGY STAR: SECO (STATE ENERGY CONSERVATION OFFICE)

State Energy Conservation Office can help CFISD acquire the Energy Star label by getting the qualifying Energy Star schools PE stamped. They will visit the schools; look over the benchmark facility data; and then PE stamp the portfolio. After the school achieves its Energy Star award, a decal is placed in the front window. This is great for public relations for showing that CFISD is spending its bond money efficiently. CLEAResult benchmarking got the accounts set up and Sonia gathers the data from PEIMS (Public Education Information Management System), our District technology inventory database and SchoolDude Utility Direct.

In 2017, eight CFISD elementary schools earned the U.S. (EPA) ENERGY STAR certification for superior energy efficiency performance. This is the first year the District has earned the EPA ENERGY STAR label: Black, Duryea, Fiest, Hemmenway, Keith, Pope, Postma and Swenke Elementary Schools earned the Energy Star certification, which is awarded to buildings that out-perform 75 percent of similar buildings across the nation. Energy Management presented each of these campuses with the Energy Star award mounted to a plaque. We planned on working toward obtaining the awards for more schools this year.

Figure 11: Award presented to Fiest ES Principal, Jeanette Gerault and AP, Wendy Suddendorf



New for 2018: We have several new initiatives which we are planning this year:

BEHAVIOR MODIFICATION PROGRAM:

This will entail restarting the Energy Committee and rolling out a Behavior Modification program to the schools. Leah Spurlock will head up this initiative and I would really like the Energy Coordinators to be heavily involved with this once we have the HVAC scheduling integration installed and they have more time. The students will be part of conservation efforts for the District as well as learning about HVAC, lighting and new technologies. These can be in the way of patrols finding out if lights are ON in unoccupied areas; if space heaters or mini refrigerators are being used; reporting when computer monitors are left ON, controlling plug load, and if areas are too cold, or doors left open, etc.

DEMAND RESPONSE:

CFISD officially signed up for a pilot Demand Response contract with C-Power (see the facility list below). Keep in mind, in case anyone has second thoughts, we can always bid zero kW on any of these buildings (and exclude them from the DR “event”). However, bidding to zero kW, means that we’ll not receive any payment for those facilities. The bids are due at the beginning of three 4-month seasons: Spring (Feb), Summer (May), and Winter (Oct). With this small list, we should receive approximately \$50,000 per year – it’s just a start for our District (our goal is to receive an **annual check of several hundred thousand dollars, annually**); these funds will be repurposed for other energy efficient conservation measures such as retro-commissioning and LED lights.

- Demand Response HVAC: Some work is being done by ALC, so that we’ll just have to press a button during a test or event for the buildings. At the press of the button, the OA dampers will close, and the temperature will be set-back 4 degrees. Remember that the test is only for 30 minutes and the teachers will probably not even notice, everything should be back to normal again. Any STAAR testing days will be exempt.
- Demand Response Emergency Generators: A piece of hardware may be installed to automatically activate the transfer switch and start up the generator sequence. We’ll have to have data drops installed and 120V power to these devices. This program (CenterPoint SOP Program) doesn’t start until June, so we have some time to install the hardware and utilities.

Demand Response Pilot Facilities

School	Load	Program
Bleyl MS	HVAC	ERS
JVHS	HVAC	ERS
Bleyl MS	Emergency Gen	SOP
Berry Center	Emergency Gen	SOP
Food Production	Emergency Gen	SOP
Satellite Cold Storage Warehouse	Emergency Gen	SOP

BUILDING OPTIMIZATION TECHNOLOGIES (RMS SOFTWARE):

We are utilizing real-time monitoring software that takes advantage of the Smart-Meter of Texas website. The software is called “RMS”. This is software that takes the Texas Smart Meter data and makes it easy to use (the actual on-line Texas Smart Meter website is intuitive). This software makes it easy and quick to analyze if a building is being overridden and/or if something is out of whack, (we don’t have to wait until the bill comes in two months later). RMS makes “heat maps” that allows us to quickly see if our buildings are being overridden (see below). The blue indicates when the building is off: the rows are hours, and the columns are days. RMS also provide regressions of kWh vs. temperature that overlays our current usage on; this will alert us if there is something amiss at the school (if it’s not running efficiently).

Figure 12: RMS Software Heat Maps



CENTERPOINT RETRO-COMMISSIONING (RCX) PROJECT:

CenterPoint Energy, ESA Energy Systems Associates Inc. (James W. Brown, P.E) is going to be making retro-commissioning recommendations on three buildings: Langham Creek HS, Campbell MS, and Rennell ES. The surveys are free; however, we have to agree to spend \$.03 per square foot of what was surveyed. So for these three buildings, the implementation costs would be approximately \$27,000. We’re also signing up with another firm, Enhanced Professional Services LLC, to do other retro-commissioning surveys in 2018 for the following schools: Cy-Ranch HS,

Smith MS, Warner ES, Cy-Fair HS, Arnold MS, and Cy-Ridge HS. They will provide a task list in their reports which we plan on implementing. Their services are again free; paid through CenterPoint's energy efficiency programs.

FUTURE: In the future, many other energy conservation measures will be implemented or considered, possibly including solar (when solar becomes economically feasible).

LED Retrofits:

There are plenty more high-bay LED retrofits to be done, as well as LED retrofits for wall packs, gyms and auditoriums; 50-70% reductions can be easily achieved. There is rebate money available to pay for the new fixtures! CFISD could consider doing a bond for LED lighting – it would probably have a positive cash-flow (kind of like having a performance contract without the ESCO).

Metering:

Main building metering should be installed wherever possible (and if it's not already installed) to monitor load profiles and investigate what is occurring during the 24hour period. It's the first step to detecting high night-load; for example, which can be lights being left ON at night. Rebate money can be used to pay for these meters, which can be expensive to install around the main bus-barns and require a shut-down.

In addition to main metering, is the importance of metering the kW per Ton of the chillers and chiller plants. There can be quite a lot involved in doing this, but it is a very worthwhile endeavor; kW per Ton is like the MPG of a car. Once the kW per Ton is known, various changes to the programming can be made to allow the chiller plant to run more efficiently (and one can watch the improvement as the changes are made). Making these changes can easily save 10-15% in the chiller plants efficiency. Some of these changes include: running the cooling tower fans synchronously; controlling the cooling tower fans to wet-bulb temperature instead of dry-bulb and changing the building DP settings with the building load.

It would be nice to have Dashboards designed to bring all of these pieces of metering information together in the EMS's so as to find a problem before it causes a high bill.

Cooling Tower Credits:

CFISD only receives monthly credits at two schools for their cooling tower (for not using sewer during the evaporative cooling process). The Energy Management Department would like to explore increasing this credit to the remaining schools. If need be, metering would have to be added and read, also the MUDs billing software and rate orders would have to be changed. Sonia requests monthly meter reads from Nalco Water/Ecolab then forwards them to Municipal Operations Consultants who generate a revised bill reflecting the credit for each month.

Irrigation Controls:

Install automatic irrigation controls such as Water Logics irrigation water management, utilizing weather based technology to irrigate the properties.

Irrigation Meters:

We would like to split off the landscape irrigation from the water meters for the fifty-five buildings that don't have irrigation meters. This will enable us to avoid the sewer charges for watering grass, plants and trees. Once everything is separated and on a new service, we would arrange for the MUD to have a separate meter installed for irrigation (on a separate lower rate). Perhaps this can be done in the next bond issue.

Capturing Condensate:

Because of increasing water/sewer rates, we would like to investigate the feasibility of capturing condensate and returning it to the cooling tower. This would save on water and cause the chiller plants to run more efficiently.

There are definite challenges to this, but would like to consider trying it. UAB, in Birmingham Alabama, has done some successful pilot programs with capturing condensate and rainwater: (<https://www.uab.edu/news/latest/item/3902-uab-innovation-saving-millions-of-gallons-of-water-monthly>). Because this is an out of the box idea, it might be advisable to do it with university guidance (maybe it could be a research project and the results shared throughout the area and on the internet).

Financing LED Retrofits:

I think that CFISD could consider financing a lighting retrofit for the entire District (**perhaps in the next bond issue**). This could be done in phases. When I worked for Johnson Controls, we changed every light fixture in a large District to T8 with electronic ballast; it was completed in four phases. There would also be huge maintenance savings to the District as well as energy savings. I think we should consider it, being that it would likely be a large positive cash-flow. If it's just lighting, there should be close to a 100% guarantee on the savings – meaning it would be low risk. Another option is getting a 2-3% loan from SECO to do lighting and other energy efficient projects, that can provide a positive cash-flow (the energy savings far exceeds the loan payment).

Figure 13: Positive Cash Flow

