June 2010

SUMMARY
ENERGY EFFICIENT
TECHNICAL ASSISTANCE REPORT
NORTHWEST ISD
JUSTIN, TEXAS

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1.0 EXECUTIVE SUMMARY

The Technical Assistance is provided by the State Energy Conservation Office (SECO), a division of the Comptroller of Public Accounts of the State of Texas. This service assists school Districts in taking basic steps toward energy-efficient facility operation. Active involvement by the District in the partnership is critical in developing a customized blueprint for energy efficiency.

One of the first steps toward energy-efficient school operation is identifying the current energy performance of District facilities. An energy performance summary is included in Section 2 and more detailed data by month for each school is in the Appendix of this report.

Successful school energy management programs include the following:

- Identify the Need – District Energy Evaluation
- Appoint an Energy Manager & Provide Training
- Adopt a District Energy Policy
- Write an Energy Management Plan & Present to the School Board
- Implement Energy Accounting System
- Conduct Energy Audits
- Establish Energy Committees
- Adopt Building Operating Procedures & Guidelines
- Involve School Personnel & Students
- Obtain Publicity
- Create Competition & Incentives
- Communicate Success
- Give Personal Contact and Feedback from Energy Accounting
- Energy Procurement

This Technical Assistance Report addresses the following specific requirements:

- Preventative Maintenance Schedules (HVAC) (Section 4)
- HVAC Description and Replacement Projects (Section 5)
- Prioritized HVAC Schedule for Replacement (Section 6)
- Guidelines to Assist in Developing Long-Range Energy Plans (per SB300) for Public Entities (Section 7)
- Energy Technical Services Review of Potential Bond (Section 8)
- Renewable Energy Sources (Section 9)
- LED Lighting (Section 10)
- Funding Options (Section 11)

James D. McClure, P.E. visited the District and met with Mr. Charles Ashby, Energy Manager. Mr. Ashby also monitors and operates the Central Energy Management Controls. Katrina Blankenship provided utility information. Mr. Rick Gomez, NISD HVAC Maintenance provided information on HVAC. Scott Clendenin, P.E., David Fisher, P.E., and James D. McClure, P.E. of EMA provided analysis and evaluation. Your personal contact at SECO is Ms. Juline Ferris (Phone: (512) 936-9283); your contact at Estes, McClure & Associates, Inc. is James McClure, P.E., Scott Clendenin, P.E., and Gary Bristow, P.E. (Phone: (903) 581-2677). Please call us if you have any questions or comments about this report or other energy management issues.

Northwest ISD is in a growing area and has responded by constructing new campuses and renovating the older campuses. The district covers 234 square miles and serves 14 communities in parts of three counties. Energy efficiency is incorporated in all of NISD projects including some projects specifically to increase efficiency.

The following are examples of projects Northwest ISD have implemented to improve efficiency, environment (indoor and outdoor), learning environment, and maintenance.

- Full-time energy manager which was recommended in SECO report dated May 16, 2007.
- Lakeview Elementary HVAC
- Northwest High School HVAC & Lighting
- Performing Arts Center HVAC
- Pike Middle Schools HVAC
- Occupancy sensor to control lighting at 6 older Elementary campuses
- Five gyms converted from metal halide to T5 fluorescent lighting
- Purchased T5 fluorescent lighting to retrofit all remaining gyms
- Energy efficiency incorporated into all new construction and renovation
- Energy manager operates EMCS, audited every campus, and re-set control schedules
- Manages Kw electrical demand by scheduling gym and cafeteria HVAC
- Conducts energy meetings with principals
- Outdoor lighting control at most campuses on EMCS
- Energy web-site in planning
- Buildings audited at various times
- Training obtained in advance for new high efficiency HVAC
- Most vending machines delamped
- Energy monitoring and tracking system set-up

The following are additional infrastructure and energy projects planned.

- Justin Elementary, Summer 2010 – New HVAC, Lighting and Gym T5 Lighting, New Roof
- Special Programs Center, Summer – 2010 New HVAC and Lighting
- Northwest High School, 2010 – T5 Lighting for Gym
- Maintenance Office Building, Summer 2010 - New HVAC, Lighting, and Roof
- Haslet Elementary, Summer 2010 – New HVAC, Lighting and Roof
- Complete the retrofit of all gyms with T5 fluorescent lighting

NISD has been very aggressive in building and managing energy efficiency into all aspects of construction, procurement, maintenance, and operations.

Review of the Energy Use Index (EUI) for 2009 shown in Section 2 table of this report indicates the District is efficient. In 1978 the EUI or BTU/Ft^2-Yr Index for a new efficient school in the area was 36,000 for elementary and 48,000 for secondary schools. This is before the large scale implementation of computers and extended use of facilities by students and community.

The data EMA has for 2008-2009 averages for schools in North and East Texas shows 53,440 for elementary and 60,173 for secondary schools.

Every NISD elementary school except one is below the North and East Texas average EUI and the one is at the average. NISD secondary schools are near or below the average EUI.

Considering the extended hours of student use, computer and technology load in today's modern schools, and community use (e.g. Church, etc.), the EUI's for NISD are reasonable and indicate efficiency.

NISD energy management has saved 2,879,085 kw-hrs the past 12 months (May 2009-April 2010) compared to the previous 12 months (May 2008-April 2009). This is a 13.7% reduction. This is an outstanding achievement.

This 13.7% reduction in kw-hrs was achieved by retrofits and the in-district formulated energy management plan that included a full time energy manager for the past year. NISD is commended for creating their own in-house energy plan and successful implementation.

The following is a brief summary of specific technical assistance requested by the district and approved by SECO.

Preventive Maintenance Schedule (HVAC)

- ASHRAE has published standards for inspection and maintenance of commercial building HVAC systems. Charts are included for each NISD HVAC system type and have specific tasks and frequency.
- Charts included look at system as a whole and not just equipment components as manufacture's operating and maintenance manual includes.
- NISD has a significant amount of relatively new HVAC equipment. Therefore a PM program may not show dramatic immediate cost savings especially since much of the equipment is new and the aggressive in-district energy management program NISD developed. However, PM should help maintain the system performance and extend the median service life. Extending the equipment life is a sustainable practice as well as resource conservation (e.g. dollars, energy, materials, etc.)
- Recent EMA survey shows 75.0% of North and East Texas ISD's have PM programs.

HVAC Description and Replacement Projects

- Section 5 provides a table showing facility, year of HVAC, type system, age system, refrigerant, and ASHRAE median equipment life estimate.
- Estimated budgets are provided for equipment anticipated needing replacement in the reasonable future.
- Section 5 also includes EMA equipment life observations compared to ASHRAE. Typically EMA has observed longer practical useful life for maintained equipment than ASHRAE data.
- Nine facilities with older equipment identified. Energy savings and budgets are provided.
    - Budget $8,750,000
    - Energy savings $121,144/year

Prioritized HVAC Schedule for Replacement

- Priorities are based on equipment age.
- Other district factors may be considered
- Steele Accelerated High School #1 priority
- See Section 6 for other priorities and comments.

Guidelines to Assist In Developing Long-Range Energy Plans (Per SB 300) for Public Entities

- The 2009 Texas Legislature passed SB 300 that required a school district to reduce electrical consumption by 5%. Also repealed requirement to reduce 5% per year for 6 years. Energy reporting and posting of previous legislation left intact.
- Helpful hints for complying included in Section 7.0.

- Based on observation made in this work NISD is in compliance with SB 300. There may be some

needed documentation.
- NISD reduced electrical consumption by 13.7% in the past 12 months.

Energy Technical Service Review of Potential Bond

- If and when NISD decides to hold another bond issue for capital projects, Section 8 provides a few recommendations to consider.
- Power factor correction. Nine campuses were identified that have been assessed surcharges for power factor less than 0.95 in the previous 12 months. See Section 8.
- Remote computer management software. Special software allows remote turn off of computers at night and central override as needed by IT for updates, etc. Estimate cost about $50,000 and short payback. NISD Energy Manger and IT are working together now to manage after hours. Several districts have found this central software successful in saving costs especially during times like spring break, weekends, etc.
- Natural gas to Nance and Hughes (all electric schools)
    - At original construction natural gas not within distance close enough to even consider
    - Nance savings est. net $31,038/yr.
    - Hughes savings est. net $14,622/yr.
    - See section 8 for cost estimate and discussion
    - Recommend for future consideration as HVAC equipment ages and natural gas gets closer to schools.
- Install occupancy sensors in remaining schools without control to turn off lights in spaces when no one is detected after pre-set time. Typically saves 20% more on lighting cost.
- Replace remaining T12 fluorescent lighting with T8 fluorescent systems and electronic ballasts.
- HVAC projects (see Section 5)
- Renewable energy sources
    - See Section 9
    - Consider domestic solar hot water or photovoltaic system for Nance Elementary
    - Request rebates from Oncor
    - Investigate stimulus grants
    - Renewable energy has longer paybacks

Monitor LED Lighting Technology

- Current technology suitable for exit lights
- LED lighting technology is rapidly advancing
- Today, uniform standards, lighting, and testing not defined
- Department of Energy working with manufacturers and standards groups to develop and test
- New LED fixtures cost more and produce less light than comparable fluorescent or HID fixtures.
- Potential future benefit of much longer life there-by reducing maintenance cost
- Recommend installing few test fixtures for monitoring. Procure from established manufacturers with good reputation.

Other Potential Items

- Will provide as develop and discuss with District.

Preliminary Estimated Benefit for NISD

- HVAC projects, bond projects, and renewable energy projects at Nance Elementary are estimated to save about 2,000,000 Kwhrs and $200,000/year. Cost is estimated to be about $9,700,000. Rebates and stimulus grants may reduce renewable energy cost. Paybacks on this

work package are longer because of infrastructure nature (older equipment replacement) and renewable cost. Natural gas to Nance and Hughes not included in estimates.

- The costs and benefits of Preventive Maintenance are additional. With all the new equipment in NISD, quantifying the benefits is difficult. One approach sometimes used is evaluating benefit of extending equipment life 5 years past the rated ASHRAE median life while maintaining energy and performance efficiency.

<u>Appreciation</u>

EMA appreciates the opportunity to provide the information in this report. Our intent is to be helpful and responsive to questions that were asked. SECO is commended for sponsoring and providing this assistance program for NISD and other school districts.

Please call to discuss or ask questions. Thank you.

2.0 DISTRICT ENERGY AND COST PERFORMANCE

The District has two high schools, four middle schools, 14 elementary schools, a special programs center, agriculture center, maintenance, administration and performing arts center. The table below is a summary of one year of energy and cost performance. Existing Roanoke Elementary, 1980's construction, will be converted to Steele Accelerated High School in summer 2010. A new Roanoke Elementary will open fall 2010.

The energy use performance or energy use index (EUI) and the energy cost performance or energy cost index (ECI) is provided below. Other detailed data is shown on the Base Year Energy Consumption History table provided in Appendix of this report.

The energy cost index is a valuable tool for comparing the energy cost ($) of different schools and campuses in a given area. The energy use index allows for comparison of schools on a quantity (BTU) basis. Since the cost of electricity varies by school and natural gas is so much less than the cost of electricity, this index is a true value of the actual energy use on a square foot basis. The energy cost index (ECI) and the energy use index (EUI) are determined by the following formulas.

$$ECI = \frac{\text{Annual Electrical Cost + Annual Natural Gas Cost}}{\text{Total Area of School}}$$

$$EUI = \frac{\text{Annual Electrical BTUs + Annual Natural Gas BTUs}}{\text{Total Area of School}}$$

ENERGY COST & PERFORMANCE: 2009

SCHOOL	ECI	EUI	KWH per sq. Ft.	1000 MCF per Sq. Ft.	Total Utility Cost	Area (Sq. Ft.)	ELECT. PROVIDER
Beck E.S.	$0.84	39,830	10.0	5.6	$58,904	70,344	TriCounty (Elec)
Granger E.S.	$1.17	45,011	10.4	9.1	$94,711	80,736	TriCounty (Elec)
Haslet E.S.	$1.34	42,242	9.2	10.5	$93,328	69,600	Suez/Oncor (Elec)
Hatfield E.S.	$1.60	54,348	13.7	7.4	$112,865	70,344	CoServ (Elec)
Hughes E.S.	$1.13	37,830	11.1	0.0	$89,018	79,040	TriCounty (Elec)
Justin E.S.	$1.47	45,318	10.1	10.7	$105,473	71,746	Suez/Oncor (Elec)
Lakeview E.S.	$1.97	47,559	13.9	0.0	$107,821	54,744	Suez/Oncor (Elec)
Love E.S. – New	----------	----------	----------	----------	----------	----------	----------
Nance E.S.	$1.97	39,414	11.5	0.0	$155,623	79,040	Suez/Oncor (Elec)
Peterson E.S.	$0.68	29,919	6.0	9.1	$55,401	81,191	TriCounty (Elec)
Prairie View E.S.	$1.66	47,792	12.2	5.9	$116,807	70,344	Suez/Oncor (Elec)
Roanoke E.S. – Old	$1.75	52,013	12.3	9.8	$97,177	55,416	Suez/Oncor (Elec)
Roanoke E.S. – New	----------	----------	----------	----------	----------	----------	----------
Sendera Ranch E.S.	$1.41	46,775	9.5	14.0	$114,227	81,191	Suez/Oncor (Elec)
Seven Hills E.S.	$2.00	41,472	12.2	0.0	$109,015	54,389	Suez/Oncor (Elec)
Chisholm Trail M.S.	$1.55	43,420	11.5	4.1	$221,091	142,448	Suez/Oncor (Elec)
Medlin M.S.	$0.89	42,588	10.7	5.8	$126,997	142,448	TriCounty (Elec)
Pike M.S.	$1.73	65,842	15.2	13.6	$252,410	146,267	CoServ (Elec)
Tidwell M.S. – New	----------	----------	----------	----------	----------	----------	----------
Bryon Nelson H.S. – New	----------	----------	----------	----------	----------	----------	----------
Northwest H.S.	$1.66	66,266	14.3	17.1	$688,150	414,498	CoServ (Elec)
Steele Accelerated H.S. – Old Roanoke E.S.	----------	----------	----------	----------	----------	----------	Suez/Oncor (Elec.)
Special Programs Center	$0.83	26,407	7.7	0.0	$32,375	39,094	CoServ (Elec)
AG Center	$0.64	20,351	6.0	0.0	$21,910	34,317	CoServ (Elec)
Maintenance	$0.88	26,161	7.7	0.0	$24,412	27,626	CoServ (Elec)
New Administration	$2.05	73,733	18.7	9.5	$126,079	61,652	CoServ (Elec)
Performing Arts Center	$2.75	138,160	21.6	62.4	$118,344	42,970	CoServ (Elec)

3.0 ENERGY ACCOUNTING

3.1 Monitoring and Tracking

The District has “School Dude”, a computer based energy monitoring and tracking system.

3.2 Utility Providers and Rates

Northwest ISD is provided electricity by CoServe, Tri-County and Suez/Oncor. Atmos Energy provides the natural gas. Not all campuses have natural gas available (Nance E.S. and Hughes E.S.).

4.0 PREVENTIVE MAINTENANCE SCHEDULE (HVAC)

Preventive maintenance (PM) is a sequence of planned and budgeted time-based actions designed to detect, preclude, or mitigate degradation of a system or its components. Routine inspection and subsequent adjustment or maintenance of system components is beneficial in keeping the system operating within its optimum performance parameters. Preventative maintenance also helps retain the ability to provide the energy efficiency, thermal comfort, and indoor air quality intended. Maintaining the system in new or nearly new condition may extend component/equipment life as well as keep energy efficiency in control. Reduction of down time has been shown to be a benefit of PM. The return on PM varies and savings, if any, are dependent in part on existing conditions and equipment age.

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE) has developed ASHRAE Standard 180, Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems. The intent of the ASHRAE standard is to guide maintenance of HVAC systems because the maintenance information often provided by manufacturers applies only to the specific component that they provide rather than to the entire system. The ASHRAE Standard provides their recommended minimum level of preventive maintenance. Other standards, guidance documents, manufacturer's instructions, local conditions, applications, etc. may establish more specific or rigorous requirements. Manufacturer's instructions should be used in conjunction with ASHRAE.

The following are some of the tasks or actions needed to implement a PM program.

- Establish Goal: Preserve the condition of the HVAC to maintain or extend median life, provide intended thermal comfort, energy efficiency, and indoor air quality.
- Inventory of Equipment and Systems: Make detail list of components. Use this initial detail list to establish any unacceptable system conditions or indicators, maintenance tasks needs, and future inspection frequencies.
- Develop Preventive Maintenance Plan: Include required tasks, identify party responsible for performing these tasks, the authorizing party, documentation of the completed tasks and subsequently monitor the results. The PM plan should also develop budgets for the work and obtain approval from responsible authority and sources. Review time and skill level needed.

  Establish indicators of conditions that indicate or could eventually result in performance degradation or failure.

  Establish tasks to include on-site inspection and physical assessment of components and system. This may also measurement of operating parameters from the central control or energy management control system. Maintenance tasks should include adjustment, service or replacement.

  Frequency of inspection, monitoring, and PM tasks need to be established. It is critical to be able to predict when a task should be done and not make the time-based work an absolute. The ASHRAE Standard 180, manufacturer's recommendations, local conditions, climate related and operational conditions, local experience and observations may be used to determine frequency.

  Determine if equipment has been in service beyond useful life.

  Observe for conditions outside of HVAC that are resulting in failure, performance decrease, or increased maintenance frequency. For example some outside HVAC conditions to look for include vandalism, significant dust or contaminants coming onto the property from other sources, etc.

Documentation and record keeping for tracking.

Include periodic review and revision of the PM plan.

One of the goals of today's PM programs needs to be getting energy savings standardized as part of maintenance. Getting energy efficiency into maintenance job planning criteria and standards is helpful.

Northwest Independent School District has constructed many new facilities and renovations in the past ten years with other work in progress and planned. Energy efficiency has been a key factor in the new construction, renovations, and maintenance.

The above comments and following ASHRAE recommended maintenance activities and frequencies are provided in response to questions from NISD and intended to be helpful in the District's planning.

Feedback From EMA Survey

EMA recently conducted a survey to get feedback from Texas ISD's on EMCS and Preventive Maintenance. The following is the response so far from 16 school districts. It is provided for informational purposes.

	Survey Question	Response Percent	
		Yes	No
1.	Does your district utilize EMCS?	100%	0%
2.	If yes to question 1, does your district have more than one brand (mfg) of EMCS in use?	73.3%	26.7%
	If yes, does it create any problems (10 responded)	7 Yes	
3.			
	How are the EMCS in your district operated/who operates them?		
	Central (one person)	68.8%	
	Maintenance, Technician	25.0%	
	Energy Manager	68.8%	
4.	How does your district handle repairs, etc. of the EMCS and components?		
	In house staff	56.3%	
	Outside contractor	43.8%	
5.			
	Does your district have a preventive maintenance program (PM)?	75.0%	25.0%
6.	If answer yet to above question, do you subcontract any parts of preventive maintenance?	33.3%	66.7%
7.	If you answered yes to having a PM program, is you PM;		
	A regular part of maintenance	36.4%	
	Handled separately	63.6%	
8.	If you answered yes a PM program, does your district have a written PM plan defining tasks, frequencies, and assignments?	58.3%	41.7%
9.	Has your district standardized on one type of HVAC system?	26.7%	73.3%
10.	Does your district have an HVAC master plan with needs, priorities, and budgets?	60.0%	40.0%

Gas/Electric RTU's	
Maintenance Activities	**Frequency**
Change air filter	Every 60 days
Check control system and devices for improper operation. Repair, adjust, or replace components to maintain proper operation.	Twice yearly
Check drain line. Clean as necessary to maintain proper operation	Twice yearly
Check wiring and connections for tightness, signs of overheating or discoloration. Tighten as necessary.	Twice yearly
Check gas piping past gas stop for leaks and loose connections. Tighten or repair as necessary.	Twice yearly
Check motor contactor for pitting or other signs of damage.	Before beginning of cooling season.
Check fan blades for balance and particulate buildup and fan motor for proper operation. Clean, repair, adjust, or replace as needed.	Twice yearly
Check refrigerant system pressure and oil levels using manufacturer approved subcooling methods. If outside recommended levels, find and repair cause, and then adjust to achieve proper levels.	Before beginning of cooling season.
Check Integrity of panels and fasteners. Replace fasteners as needed to maintain equipment integrity.	Twice yearly
Lubricate field serviceable bearings.	Twice yearly
Check combustion chamber, burner, and flue for deterioration, moisture problems, condensation, and combustion products. Clean, test, and adjust combustion process for proper operation.	Before beginning of cooling season.
Check coil for dirt or evidence of biological growth. Clean as necessary.	Before beginning of cooling season.
Check evaporator coil fins for damage. Restore, if possible, or replace to maintain proper function.	Before beginning of cooling season.
Check damper for proper operation. Repair, adjust, or replace as needed.	Twice yearly
Inspect air-cooled condenser surfaces. Repair or clean as needed.	Before beginning of cooling season.
Check belts for tension, wear, cracks, or glazing. Replace as needed.	Twice yearly
Visually inspect internal ductwork for integrity and, if applicable, ensure insulation has not degraded. Correct as needed.	Twice yearly

Electric RTUs	
Maintenance Activities	**Frequency**
Change air filter	Every 60 days
Check control system and devices for improper operation. Repair, adjust, or replace components to maintain proper operation.	Twice yearly
Check drain line. Clean as necessary to maintain proper operation.	Twice yearly
Check wiring and connections for tightness, signs of overheating, or discoloration. Tighten as necessary.	Twice yearly
Check motor contactor for pitting or other signs of damage.	Before beginning of cooling season
Check fan blades for balance and particulate buildup and fan motor for proper operation. Clean, repair, adjust, or replace as needed.	Twice yearly
Check refrigerant system pressure and oil levels using manufacturer approved subcooling methods. If outside recommended levels, find and repair cause, and then adjust to achieve proper levels.	Before beginning of cooling season
Check integrity of panels and fasteners. Replace fasteners as needed to maintain equipment integrity.	Twice yearly
lubricate field serviceable bearings.	Twice yearly
Check coil for dirt or evidence of biological growth. Clean as necessary.	Before beginning of cooling season
Check evaporator coil fins for damage. Restore, if possible, or replace to maintain proper function.	Before beginning of cooling season
Check damper for proper operation. Repair, adjust, or replace as needed.	Twice yearly
Inspect air-cooled condenser surfaces. Repair or clean as needed.	Before beginning of cooling season
Check belts for tension, wear, cracks, or glazing. Replace as needed.	Twice yearly
Visually inspect internal ductwork for integrity and, if applicable, ensure insulation has not degraded. Correct as needed.	Twice yearly
Check heating coil for proper operation. Repair or replace as needed.	Before beginning of cooling season

Heat Pumps, Split System	
Maintenance Activities	**Frequency**
Air Handlers	
Change air filters	Every 60 days
Check wiring and connections for tightness, signs of overheating, or discoloration. Tighten as necessary.	Twice yearly
Check p-trap and drain line. Clean as necessary to maintain proper operation.	Twice yearly
Check fan blades for particulate buildup and fan motor for proper operation. Clean, repair, adjust, or replace as needed.	Twice yearly
Check integrity of all panels and fasteners.	Twice yearly
Lubricate field serviceable bearings.	Annually
Check coil for dirt or evidence of biological growth. Clean as necessary.	Before beginning of cooling season
Visually inspect exposed ductwork for integrity and, if applicable, ensure insulation has not degraded. Correct as needed.	Twice yearly
Check heating coil for proper operation. Repair or replace as needed.	Before beginning of cooling season
Check control system for evidence of improper operation. Adjust, repair, or replace components as required.	Twice yearly
Condensing Units	
Check wiring and connections for tightness, signs of overheating, or discoloration. Tighten as necessary.	Twice yearly
Check motor contactor for pitting or other signs of damage. Repair or replace as needed.	Annually
Check condenser fan blades and motor for proper operation. Clean, repair, or replace as needed.	Annually
Inspect air-cooled condenser surfaces. Repair or clean as needed.	Annually
Check refrigerant system pressure and oil levels using manufacturer approved subcooling methods. If outside recommended levels, find and repair cause, and then adjust to achieve proper levels.	Before beginning of cooling season

Water Source Heat Pumps	
Maintenance Activities	**Frequency**
Change air filters	Every 60 days
Check control system and devices for evidence of improper operation. Repair, adjust, or replace components to achieve proper operation.	Twice yearly
Check integrity of panels and fasteners. Replace fasteners as needed to maintain equipment integrity.	Twice yearly
Check for proper operation of heating/cooling coil. Clean, restore, or replace as required.	Twice yearly
Lubricate field serviceable bearings.	Annually
Check p-trap and drain line. Clean as necessary.	Twice yearly
Check motor connector for pitting or other signs of damage. Repair or replace as needed.	Annually
Check refrigerant system pressure and oil levels using manufacturer approved subcooling methods. If outside recommended levels, find and repair cause, and then adjust to achieve proper levels.	Before the beginning of cooling season
Inspect for unwanted moisture accumulation and biological growth. Repair and clean as needed.	Annually
Check control system for evidence of improper operation. Adjust, repair, or replace components as required.	Twice yearly

Condensing Units	
Maintenance Activities	**Frequency**
Check control system and devices for improper operation. Repair, adjust, or replace components to maintain proper operation.	Before the beginning of cooling season
Check power terminals for loose connections. Tighten as necessary.	Before the beginning of cooling season
Check motor contactor for pitting or other signs of damage.	Before the beginning of cooling season
Check fan blades for balance and particulate buildup and fan motor for proper operation. Clean, repair, adjust, or replace as needed.	Before the beginning of cooling season
Check refrigerant system pressure and oil levels, using manufacturer approved subcooling methods. If outside recommended levels, find and repair cause, and then adjust to achieve proper levels.	Before the beginning of cooling season
Check integrity of panels and fasteners. Replace fasteners as needed to maintain equipment integrity.	Before the beginning of cooling season

Air Handlers/Gas Fired Furnaces	
Maintenance Activities	**Frequency**
Change air filter	Every 60 days
Check control system and devices for improper operation. Repair, adjust, or replace components to maintain proper operation.	Twice yearly
Check drain line and drain pan. Clean as necessary to maintain proper operation.	Twice yearly
Check oil for dirt or evidence of biological growth. Clean as necessary.	Twice yearly
Check wiring and connections for tightness, signs of overheating, or discoloration. Tighten as necessary.	Twice yearly
Check blower motor for proper operation. Clean, adjust, or repair to maintain proper operation.	Twice yearly
Check belts for tension, wear, cracks, or glazing. Replace as needed.	Twice yearly
Check integrity of panels and fasteners. Replace fasteners as needed to maintain equipment integrity.	Twice yearly
Lubricate field serviceable bearings.	Twice yearly
Check combustion chamber, burner, and flue for deterioration, moisture problems, condensation, and combustion products. Clean, test, and adjust combustion process for proper operation, if applicable.	Before the beginning of cooling season
Check heat exchanger. Clean as necessary to ensure proper operation and remove scale and sediment. Check for leaks, if applicable.	Before the beginning of cooling season

Air Distribution Systems	
Maintenance Activities	**Frequency**
Visually inspect grilles, registers, and diffusers for dirt accumulation. Clean as needed to remove dirt.	Annually
Lubricate field serviceable bearings and linkages.	Annually
Check for proper damper operation. Adjust, repair, or replace as necessary.	Annually
Inspect for area of moisture accumulation and biological growth. If present, clean or disinfect as required.	Annually
Visually inspect accessible ductwork for insulation integrity. Repair or replace as needed.	Annually
Visually inspect internal ductwork until the first turn. Verify insulation is not soiled or degraded.	Annually

Air Handlers	
Maintenance Activities	**Frequency**
Change air filter	Every 60 days
Check p-trap and drain lines. Clean as necessary.	Twice yearly
Check belt tension, wear, and alignment. Adjust or replace as required.	Twice yearly
Check VFD, if applicable, for proper operation. Correct as needed.	Twice yearly
Check for proper operation of heating and/or cooling coil. Clean, repair, or replace as required.	Twice yearly
Check fan blades. Clean, repair, or replace as needed.	Annually
Check refrigerant system pressure using manufacturers approved subcooling methods. If outside recommended levels, find and repair cause, and then adjust to achieve proper levels.	Annually
Check for general failing, corrosion, or degradation. Clean or repair as needed.	Annually
Check drive alignment, wear, seating, and operation. Adjust, repair, or replace as needed.	Annually
Check integrity of all panels and fasteners.	Annually
Lubricate field serviceable bearings and linkage.	Annually
Check coil for buildup or failing. Restore or replace as needed.	Annually
Check for proper damper operation.	Annually
Inspect for areas of moisture accumulation and biological growth. If present, clean or disinfect as required.	Annually
Visually inspect exposed ductwork and external piping for insulation integrity. Repair or replace as needed.	Annually
Check control system for evidence of improper operation. Adjust, repair, or replace components as required.	Twice yearly

Fan Coils	
Maintenance Activities	**Frequency**
Check p-trap and drain levels. Clean as necessary.	Twice yearly
Check fan belt tension, wear, and alignment, if applicable. Adjust or replace as required.	Twice yearly
Check fan blades, if applicable. Clean, repair, or replace as needed.	Annually
Check for general failing, corrosion, or degradation. Clean or repair as needed.	Annually
Check integrity of all panels and fasteners.	Annually
Lubricate field serviceable bearings.	Annually
Check for proper operation of heating and/or cooling coils. Clean, repair, or replace as needed.	Annually
Check coil fins. Restore or replace as necessary.	Annually
Check for proper damper operation. Adjust, repair, or replace as needed.	Annually
Visually inspect for areas of moisture accumulation and biological growth. If present, clean or disinfect as required.	Annually
Check control system for evidence of improper operation. Adjust, repair, or replace components as needed.	Twice yearly

Terminal and Control Boxes (VAV, Fan Powered)	
Maintenance Activities	**Frequency**
Check fan blades. Clean, repair, or replace as needed.	Annually
Check integrity of all panels and fasteners.	Annually
Check for proper operation of cooling and/or heating coils. Clean, restore, or replace as needed.	Twice yearly
Check for proper damper operation. Repair, replace, or adjust as needed.	Annually
Inspect for areas of moisture accumulation or biological growth. If present, clean or disinfect as needed.	Annually
Inspect exposed ductwork and external piping for insulation integrity. Repair or replace as needed.	Annually
Check control system for evidence of improper operation. Adjust, repair or replace components as required.	Twice yearly

Furnaces, Unit Heaters	
Maintenance Activities	**Frequency**
Change air filter	Every 60 days
Check fan belt tension, wear, and alignment, if applicable. Adjust or replace as needed.	Twice yearly
Check wiring and connections for tightness, signs of overheating, or discoloration. Tighten as necessary.	Twice yearly
Check fan blades. Clean, repair, or replace as needed.	Annually
Check integrity of all panels and fasteners.	Annually
Lubricate field serviceable bearings.	Annually
Check combustion chamber, burner, and flue for deterioration, moisture problems, condensation, and combustion products. Clean, Test, and adjust for proper operation as needed.	Annually
Check heat exchanger for scale and sediment. Clean as necessary. Check for the possibility of leaks.	Annually
Check control system for evidence of improper operation. Adjust, repair, or replace components are required.	Twice yearly

Water Distribution Systems	
Maintenance Activities	**Frequency**
Perform chemical testing of system water. Treat as needed.	Quarterly
Check chemical injector device. Clean if needed.	Quarterly
Visually inspect pumps. Repair or replace as needed to insure proper operation.	Twice yearly
Visually inspect associated electrical components. Repair or replace as necessary.	Twice yearly
Check for evidence of buildup or failing on heat exchange surfaces. Clean as needed.	Annually
Check for proper fluid flow. Clean, adjust, or repair as needed to maintain proper flow.	Annually
Check strainers. Clean as needed.	Annually
Visually inspect piping insulation for integrity. Repair or replace as needed.	Annually
Check all freeze stats, relief valves, flow and float switches, low water cutoffs and other devices for proper operation. Adjust, repair, or replace as needed.	Annually

Boilers	
Maintenance Activities	**Frequency**
Perform chemical testing of system water. Treat as needed.	Quarterly
Inspect blow down or drain valve. Clear any debris. Repair or replace as needed.	Quarterly
Check wiring and connections for tightness, signs of overheating, or discoloration. Tighten as necessary.	Twice yearly
Check for leaks and general failing, corrosion, or degradation. Clean or repair as needed.	Annually
Check for evidence of build-up or failing on heat exchange surfaces. Clean as needed.	Annually
Check combustion chamber, burner, and flue for deterioration, moisture problems, condensation, and combustion products. Clean, test, and adjust for proper operation as needed.	Annually
Check control system for evidence of improper operation. Adjust, repair, or replace components as required.	Twice yearly

Pumps	
Maintenance Activities	**Frequency**
Check VFD, if applicable, for proper operation. Correct as needed.	Twice yearly
Visually inspect pumps. Repair or replace as needed to ensure proper operation.	Twice yearly
Check wiring and connections for tightness, signs of overheating, or discoloration. Tighten as necessary.	Twice yearly
Visually inspect associated electrical components. Repair or replace as necessary.	Twice yearly
Check drive alignment, wear, bearing, and coupling seating and operations. Adjust or repair as needed.	Annually
Check for proper fluid flow. Clean, adjust, or repair as needed to maintain proper flow.	Annually
Lubricate field serviceable bearings.	Annually
Check control system for evidence of improper operation. Adjust, repair, or replace component as required.	Twice yearly

Cooling Towers*	
Maintenance Activities	**Frequency**
Perform chemical testing of system water. Treat as needed.	Quarterly
Inspect blow-down or drain valve. Clear any debris. Repair or replace if needed.	Quarterly
Check chemical injector device. Clean as needed.	Quarterly
Check fans for proper operation. Adjust, repair, or replace as needed.	Quarterly
Inspect sump. Clean as needed.	Quarterly
Check VFD, if applicable, for proper operation. Correct as needed.	Quarterly
Check wiring and connections for tightness, signs of overheating, or discoloration. Tighten as necessary.	Twice yearly
Check fan blades. Clean or repair as needed.	Annually
Check for general failing, corrosion, or degradation. Clean or repair as needed.	Annually
Lubricate field serviceable bearings.	Annually
Check for proper fluid flow. Clean, adjust, or repair as needed.	Annually
Check for dirt and debris. Clean as needed.	Annually
Check motors and pumps for proper operation. Repair or replace as needed.	Annually
Check nozzles. Clean as needed.	Annually
Check control system for evidence of improper operation. Adjust, repair, or replace components as required.	Twice yearly

*None in district at this time

Control System	
Maintenance Activities	**Frequency**
Check control system and devices for evidence of improper operation. Repair, adjust, or replace components to ensure proper operation.	Semi-annually
Check wiring and connections for tightness, signs of overheating, or discoloration. Tighten as necessary.	Twice yearly
Check battery backup and verify proper operation.	Annually

Water Cooled Chillers*	
Maintenance Activities	**Frequency**
Perform chemical testing of system water. Treat as necessary	Quarterly
Check VFD, if applicable, for proper operation. Adjust as needed.	Annually
Check refrigerant system pressure using manufacture approved subcooling methods. If outside recommended levels, find and repair cause, and then adjust to achieve proper levels.	Before the beginning of the cooling season
Check for evidence of buildup or failing on heat exchange surfaces. Clean as needed.	Annually
Check wiring and connections for tightness, signs of overheating or discoloration. Tighten as necessary.	Twice yearly
Inspect gearbox for excessive wear. Repair or replace as needed.	Quarterly
Check control system for evidence of improper operation. Adjust, repair or replace components as required.	Twice yearly

*None in district at this time

Air Cooled Chillers	
Maintenance Activities	**Frequency**
Perform chemical testing of system water. Treat as necessary.	Quarterly
Check VFD, if applicable, for proper operation. Adjust as needed.	Annually
Check fan blades. Clean, repair, adjust, or replace as needed.	Annually
Check refrigerant system pressure and oil levels using manufacturers approved subcooling methods. If outside recommended levels, find and repair cause, and then adjust to achieve proper levels.	Before the beginning of cooling season
Lubricate field serviceable bearings.	Annually
Inspect air cooled condenser surfaces. Repair or clean as needed.	Annually
Check for evidence of buildup or failing on heat exchange surfaces. Clean as needed.	Annually
Check for general failing or corrosion. Clean or repair as needed.	Annually
Check fan belts. Replace if needed.	Twice yearly
Check wiring and connections for tightness, signs of overheating or discoloration. Tighten as necessary.	Twice yearly
Inspect gear box for excessive wear. Repair or replace as needed.	Quarterly
Check control system for evidence of improper operation. Adjust, repair, or replace components as required.	Twice yearly

5.0 HVAC DESCRIPTION AND REPLACEMENT PROJECTS

HVAC Description Table

The attached table, Northwest ISD HVAC Description and Replacement Projects, are provided to assist in evaluation and planning of energy efficient HVAC and intended to be helpful for NISD. The district has been constructing new campuses, additions, renovations, and upgrade projects for several years. Energy efficiency has been and continues to be included. Also the table is intended to be a value in maintenance, energy, budgeting, and bond planning.

The "Year (HVAC)" in the table designates the approximate date of HVAC installation. In some cases this is the date of construction of the facility. In others it is the date of retrofit with new HVAC equipment.

The "Type HVAC & Description" column is a description of the system type and equipment. "Pkg. DX RTU" designates unitary direct expansion electric cooling individual unit that has all equipment components in one package and is located on the roof. Typically for this application there is one unit per classroom and several units per gym and cafeteria. The designation "natural gas heating" or "electric heating" refers to the type of space heating equipment in the package.

The "Split System DX" designation indicates unitary direct expansion electric cooling with an air-cooled condenser located outdoors. Refrigerant lines connect the outdoor condenser with the indoor air-handler assemble which includes the evaporator or (cooling coil). "Heat Pump" indicates a type of heating for these systems. Natural gas heating type units are also available for split system DX equipment.

"Geothermal Heat Pumps" designation are direct expansion electric cooling systems with the earth used as a heat sink/source instead of an outdoor air-cooled condensing unit. Wells are drilled in the earth and a "plastic type" piping connects the indoor unit (air handler, DX cooling coil compressor) with the well field. Coordination of the location of the well fields is important as with any other underground utility to ensure future earthwork does not disturb the piping.

"Central Chilled/Hot Water System" designates a central plant system. Chillers provide chilled water for larger air handlers with cooling coils or "smaller fan coil units having cooling coils. Chilled water produced by the chillers is pumped via piping to the air-handlers or fan coil units. The "Air-Cooled Chiller" indicates that the heat rejected by the chiller is air-cooled rather than having a cooling tower (water). "Hot Water System" indicates boilers are provided to produce hot water for space heating. This hot water is pumped from the central boiler location to the air-handlers and fan coil units.

"Refrigerant Type" is the type of refrigerant in the cooling equipment. R22 for the direct-expansion HVAC equipment has been the standard for many years. New unitary direct expansion equipment being installed in the district is R410A. CFC and HCFC refrigerants are being phased out due to their potential damaging effects on the earth's protective ozone layer. Several important deadlines have already passed, and others are rapidly approaching.

CFC refrigerants (e.g. R11, R12) have already been banned. HCFC refrigerants (e.g. R22, R123), replacements for CFCs, are now being eliminated. Manufacturers cannot make new equipment that uses R22 or R123 beginning in 2010 and 2030, respectively. Production of R22 must stop in 2020 and R123 in 2030. There are also intermediate dates with reductions in production limits. Refrigerants are reclaimed and recycled and this will help the supply.

Prior to the 2010 deadline for ending R22 equipment production manufacturers redesigned their products for R410A.

R410A, a non-ozone depleting refrigerant, has been introduced as an alternative for R22 in new equipment. However, it is not a direct drop-in replacement for R22 due to differences in operating characteristics. Also, since R410A operates at higher pressure than previous refrigerants, technicians

need additional training and new tools (e.g. hoses, gauges, etc.).

"ASHRAE Ventilation Standard" designates yes or no compliance with ASHRAE Ventilation Standard 62 which significantly increased the amount of outside air requirements introduced into a building.

ASHRAE issues industry recognized standards relating to heating, air-conditioning and ventilation that are often incorporated into building codes. ASHRAE Standard 62 with increased ventilation rates is now in the building codes. As HVAC renovation projects occur, providing outside air per the current standard/codes is recommended.

"CO2 Ventilation Control" designates yes or no if the quantity of ventilation (outside air) is automatically adjusted based on CO2 measured levels within a space. A few years ago ASHRAE introduced a strategy called demand control ventilation. This allows automatically adjusting the amount of outside air introduced into a building as CO2 concentration may be used as an indicator of occupancy or number of occupants. As the CO2 level increases more outside air up to the ASHRAE Standard 62 requirement is introduced. As the CO2 level decreases outside air quantity is moderated and this results in energy savings. A CO2 sensor is in the conditioned space with the sensor controlling room space temperature. This strategy utilizes the energy management control system for operations.

"ASHRAE Equipment Life Estimate" in the table is from 2007 ASHRAE Handbook – HVAC Application Chapter 36 (pages 36.2 and 36.3). "Years" is the median life (ASHRAE) and "Year" is the year the equipment will have been installed ASHRAE's median life. Local conditions, maintenance, preventive maintenance, vandalism, quality of original equipment and original design/construction may affect usable life of equipment and systems.

EMA Equipment Life Observations are that in non-coastal, non-marine, and non-corrosive emission industrial environments, unitary direct expansion (Dx) either packaged roof top or split-system equipment practical useful life exceeds the ASHRAE median service life. To achieve the ASHRAE median service life or EMA Equipment Life Observations, HVAC equipment must be of good quality manufacturer, suitable application, and maintained properly (per manufacturer's instructions) including good filter changing practice and good maintenance procedures.

For example EMA observations of schools are that many districts exceed the ASHRAE median life for unitary Dx HVAC equipment by 5 years or more. ASHRAE median for unitary Dx HVAC equipment is 15 years. Looking at ASHRAE dates for components they show Dx coils as 20 years, air-cooled condensers as 20 years, and electric motors 18 years.

EMA Observations are that maintaining good equipment and installations will extend the life. There may be some component replacements needed in addition to routine and preventive maintenance. Tracking work orders (frequency and type) along with reliability for occupant comfort and effective student learning environment may provide an indication of the costs and benefits. Practices to monitor and extend the life are cost effective and sustainable as long as the efficiency is reasonably maintained. Early demolition and removal of equipment is not a green or sustainable practice.

"Budget Estimate ($)" designates estimated cost to upgrade or replace the HVAC equipment. Budgets are provided for HVAC projects that may be scheduled in the next several years. Costs are based on today's estimates and do not include any inflation factor.

"Comments" provides additional information about the HVAC system or facility.

Data in the table, Northwest ISD HVAC Description and Replacement Projects, is derived from meetings, observations, plan review and other data review. Site visits and opening of equipment were beyond the scope of this work.

Continuous Updating

Periodic updating of this table is useful for maintenance or bond budgeting and planning. As retrofit projects are implemented or new campuses constructed we recommend adding to or revising the table.

Energy Management Control Systems (EMCS)

NISD has central DDC EMCS in all district facilities except the Ag Center and it only has two HVAC units. They are operated from a central location in the maintenance department. The Energy Manger has audited and set scheduling of HVAC to match local campus needs and aggressive energy efficiency. The EMCS in NISD is mostly Alerton. Some facilities have Trane EMCS.

EMCS Systems vs. Facility

Alerton EMCS
Granger Elementary School
Haslet Elementary School
Hughes Elementary School
Lakeview Elementary School
Love Elementary School
Nance Elementary School
Peterson Elementary School
Sendera Ranch Elementary School
Seven Hills Elementary School
Pike Middle School
Tidwell Middle School
Byron Nelson High School
Steele Accelerated High School
Special Program Center
Maintenance
Performing Arts Center
New Stadium

Trane EMCS
Beck Elementary School
Hatfield Elementary School
Prairie View Elementary School
Chisholm Elementary School
Medlin Elementary School
Northwest Elementary School
New Administration

Energy Savings

Energy savings are estimated for HVAC projects that based on the Table would be considered/evaluated for upgrading in the next several years. These include the following;

Energy Est. Savings HVAC Replacement
(See Table NISD HVAC Description and Replacement Projects)

Facility	Savings Estimated KW-HRS	Annual $
Steele Accelerated H.S.	106,144	10,614
Air Cooled Chiller Northwest H.S.	187,500	18,750
Beck E.S. Older Equipment	109,303	10,930
Hatfield E.S. Older Equipment	150,185	15,018
Prairie View E.S. Older Equipment	133,910	13,391
Chisholm Trail M.S. Older Equipment	254,792	25,479
Medlin M.S. Older Equipment	237,857	23,785
New Admin. Older Equipment	179,980	17,998
PAC - Boilers	575mcf	3,927

KW-HR Total Saved = 1,172,171
KW-HR Total $ Saved = $117,217
MCF Total $ Saved = $3927
MCF Total Saved = 575
Total Estimated Cost = $8,750,000
Total Energy Cost Saved = $121,144/yr

The payback is relatively long but as the equipment/infrastructure reaches its useful life it will need to be replaced and will provide opportunities for energy savings.

Nance Elementary Electric Cost

Electric costs at Nance Elementary are higher than comparable schools (Sendera Ranch Elementary, for example) due mainly to electric heat, which increases peak demand.

At Nance the metered peak monthly demand for the most recent 12 months was 1202 kw set in January 2010. The metered peak demand at Sendera Ranch (natural gas heating) was 424 kw set in September 2009. The difference is the effect of electric heat.

Oncor Electric Delivery's rate tariff includes an 80% ratchet. That is, the billing Kw for the current month is never less than 80% of the highest monthly Kw set in the preceding 11 months. In other words, the peak demand set in January will affect the wires charges at Nance for the next 11 months. When metered demand at Nance is relatively low, e.g. during the summer months, the school is still paying for a portion of the demand established the previous winter. The ratchet was created to pay for the expensive electric utility equipment that is needed to handle peak demand. Because transformers, wires, etc., must remain in place to serve the maximum load whenever it occurs, customers are asked to pay those costs.

Recommend verify staging of electric heat in HVAC units and staging of HVAC units on to help reduce peak electrical (Kw) demand.

6.0 PRIORITIZED HVAC SCHEDULE FOR REPLACEMENT

In general, priority consideration of HVAC replacement or upgrading projects include but are not limited to the following;

- High maintenance costs or issues
- High down time and frequency (reliability)
- Age equipment
- Condition equipment
- Indoor environment and comfort
- Refrigerant type and availability
- Capacity of equipment
- Function or use change
- Increased load from new electronic or other equipment, etc.
- Adequate outside air
- Unavailability of parts
- Maintenance frequency and cost

NISD Priorities for HVAC Replacement

The following are recommended priority for replacement.

Priority #	Facility
#1	Steele Accelerated H.S.
#2	Air cooled chiller (1) Northwest H.S.
#3	Boilers at Performing Arts Center
#4	Older equipment at Beck, Hatfield, Prairie View, Chisholm Trail, Medlin, New Administration

The District has been successful and has done a good job in keeping up with energy efficient HVAC equipment replacement. The above are just routine normal part of the process.

See Table: Northwest ISD HVAC Description and Replacement Projects in Section 5.0.

The priorities are based on equipment age. Other factors as listed above may be considered such as maintenance issues that develop and also extended useful life of equipment.

7.0 GUIDELINES TO ASSIST IN DEVELOPING LONG-RANGE ENERGY PLANS (PER SB 300) FOR PUBLIC ENTITIES

Background

The 2009 Texas Legislature passed SB300 that accomplished the following;

- Requires a school board approved long range plan to reduce annual electric consumption by 5%.
- Repeals requirements to reduce electric consumption by 5% each year for 6 years.
- Left reporting and posting of energy requirements intact (HB 3693 from 2007 session).

SB300 requires five percent annual electric consumption reduction beginning with 2008 state fiscal year and consume electricity in subsequent fiscal years in accordance with the district's energy plan. The act applies beginning with the 2009 – 2010 school year.

The district plan must include strategies for achieving energy efficiency that result in net savings for the district or can be achieved without financial cost to the district. For each strategy in the plan include short term capital cost and lifetime costs and savings that may result from implementation of the strategy. In determining if a strategy may result in financial cost to the district, consider the total net savings that may occur over the seven year period following implementation of the strategy.

Helpful Hints

- Read and understand SB300
- Document 2008 state fiscal year electricity and natural gas consumption
- Determine if district is complying with prior requirement left intact by SB300 (i.e. HB 3693) for reporting and posting energy consumption.
- Establish an energy tracking system and keep updated monthly
- Document maintenance, operations, and custodial strategies to reduce energy usage.
- Document energy efficiency projects already accomplished
- Document energy efficiency projects in progress
- Assign someone for responsibility of energy manager in the district.
- Perform energy audits of existing facilities
- Develop strategies for reducing energy consumption that had no first cost
- Develop list of potential capital projects with costs and benefits
- Prioritize strategies
- Document plan in accordance with SB300

Observations

Based on observations made in this work NISD is complying with the SB 300. There may be some needed documentation of the work and achievements of the district. This report documents much of the very successful long term energy efficiency work of NISD. For example, in the past 12 months NISD has saved 2,879,085 kw-hrs electricity compared to the previous 12 months. This is 13.7% savings.

8.0 ENERGY TECHNICAL SERVICE REVIEW OF POTENTIAL BOND

This section addresses ideas/suggestions for consideration if and when NISD decides to conduct a future bond for capital construction projects.

Power Factor Correction

Power factor is a measure of how efficiently electrical equipment uses the electricity supplied to it. Many devices consume electrical power that cannot be converted to useful work (lighting a bulb or tuning a motor for example). However, electric circuits must still have the capacity to carry this "unusable" power. The more facilities requires, the larger utility power, therefore, many utility companies (such as Oncor) bill larger customers for low power factor. Capacitors reduce the amount of "unusable" power that equipment consumes and increases the power factor. Contributors to low power factor are generally motors and magnetic ballasts. Retrofitting these components with high power factor models can raise a facility's overall power factor. Where retrofits are impractical or have already been completed, installing capacitors will be necessary to improve the power factor.

For each school served by Suez Energy/Oncor Electric Delivery with power factor surcharges, billing data was obtained from Energy for Schools. Actual demand, billing demand, adjusted billing demand, wires charges, and power factor were available. The amount of correction, in kilovars (kvar), needed to bring the power factor to a minimum of 0.95 was then calculated in order to size power factor correction capacitors. An estimate of probable cost was also determined.

In Northwest ISD, the following locations were found to have been assessed surcharges for power factor less than 0.95 in the previous 12 months (June 2009 – May 2010):

Chisholm Trail Middle School (ESID 7668720)
Haslet Elementary (ESID 6703520)
Justin Elementary (ESID 6442080)
Lakeview Elementary (ESID 2804325)
Nance Elementary (ESID 7635534)
Prairie View Elementary (ESID 7719125)
Roanoke Elementary (ESID 6683851)
Sendera Ranch Elementary (ESID 8659460)
Seven Hills Elementary (ESID 1016088)

Actual demand (kw) is the peak kw registered by the meter during the current month. Billing demand is the higher of the actual kW for the current billing month or 80% of the highest monthly kW established in the 11 months preceding the current billing month (the "ratchet"). Adjusted billing demand is the power factor adjusted billing demand, calculated by the following formula:

ABD = BD x 0.95 / power factor

Oncor provides for imposing a power factor surcharge for any month where the power factor is below 0.95 at the time of the monthly peak.

A capacitor installation consists of the capacitors plus controls to measure the actual power factor and adjust the amount of correction as required to avoid overcorrection. Since the capacitors will be used to improve the entire facility's power factor, the units should be installed near the main electrical service entrance. This location would ideally be in the main electrical room if space is available. If any equipment (chillers, pumps, etc.) in the school has variable speed drives, special engineering studies may be necessary to determine the proper method of installation.

The billing data obtained reflects current conditions. Additions or changes in major equipment or school usage could change power factor correction requirements.

If facilities have low power factor and the utility charges a penalty, then power factor correction will save on the utility costs. Payback will depend on the power factor number, the utility assessment and cost of correction.

Billing information was obtained for all three utility companies providing electricity to Northwest ISD – Suez Energy, Tri-County Electric Coop., and Co. Serv Electric. From this information it does not appear that Tri-County Electric Coop or Co. Serv Electric are applying power factor surcharges.

POWER FACTOR CORRECTION SUMMARY (Units sized for month requiring maximum correction)								
Facility	ESID	Month	P.F.	Annual Penalty (Est.)	Capacitor Unit Size , kvar (Est.)*	Cost (Est.)**	Payback, years (Est.)	Comments
Chisholm Trail MS	7667820	Aug-09	0.847	$1,033	125	$12,500	12.1	
Haslet ES	6703520	Jul-09	0.913	$105	-	-	-	Correction is not recommended.
Justin ES	6442080	Aug-09	0.904	$241	50	$5,000	20.7	
Lakeview ES	2804325	Feb-10	0.865	$295	125	$12,500	42.4	
Nance ES	7635534	Aug-09	0.727	$1,075	175	$17,500	16.3	Power factor has shown significant improvement in recent months with no penalty. Recommend monitoring for the time being.
Prairie View ES	7719125	Jul-09	0.854	$735	100	$10,000	13.6	
Roanoke ES	6683851	Aug-09	0.943	$65	-	-	-	Correction is not recommended.
Sendera Ranch ES	8659460	Aug-09	0.804	$1,137	125	$12,500	11.0	
Seven Hills ES	1016088	Jul-09	0.932	$54	-	-	-	Correction is not recommended.

* Next standard size larger than calculated required capacitance

** Cost includes capacitor unit and standard installation only. Special circumstances at a location may increase cost.

Remote Computer Management Software

Electricity to power desktop computers can represent a considerable expense for school districts. A typical PC running continuously throughout the school year costs about $60 annually to operate. For a district with, for example, 4,000 computers, this would total some $240,000. Turning the same computers off after hours, weekends, and holidays would result in an approximate 60% savings. The actual costs are likely less, since at any given time some computers may be off or in standby mode etc., but they would still be significant.

Empirical evidence indicates that voluntary compliance with requests to shut down computers not in

use is not very high. Operating systems, such as Windows, come with available power management settings to put computers into standby or “sleep” mode after a period of inactivity; however, these settings must be enabled by the user. They can be changed or even disabled, which makes them virtually ineffective.

Remote management software can reduce electric consumption and costs. A shut down signal is sent from a central server via the network to remote machines at a predetermined time. Many remote management programs give any users that are working a warning that their workstation is to be shut down shortly. Users can override the shut down or save their work and allow the shut down. Some software programs automatically save any open files the user may have inadvertently left open before shut down so that no work is lost. For districts with a large number of networked desktop computers, the payback period on the software may only be a period of months.

Information technology (IT) departments and energy managers sometimes disagree regarding turning off computers at the end of the day. PCs that are off use virtually no electricity, which maximizes savings for the energy manager. IT department personnel often want to push software updates during nights and weekends, and, therefore, want machines left on. Remote management software can wake up computers, push software updates, then turn the computers off again. Also, some available software can provide audit reports prior to activation to assist in determining actual energy savings. In other words, before sending out the shut down signal, the number of computers left on is determined.

When deciding whether or not to invest in remote management software to enhance energy savings, districts should take a look at their long range IT plans. The software provides the greatest potential for energy savings, and the shortest payback period, when controlling desktop computers, since they use the most energy. Networked laptop computers can also be controlled; however, the reduction in electric use will not be as great. Also, in some schools laptops are charged overnight and used only from battery power during the day. We understand that the future of computing in schools may head toward the use of dumb terminals, which are basically a monitor and a keyboard, without any processing capabilities. Energy consumption by these units would be quite low, so the purchase of remote management software may not be a good long term investment if the use of dumb terminals is planned. The software is often purchased with a license that expires after a given period of time, such as one year or five years. Therefore, the length of the license purchased should be considered in terms of how long it will benefit the district. The selection and implementation of computer management software should be a joint effort between the IT department and energy manager.

NISD energy manager and the IT department have been coordinating and working together to manage after hour on time of computers. Some of the local campus IT personnel are working with energy management.

Two other large school district in the DFW area have purchased software to centrally manage the afterhours on/off time of computers. One spent $134,000 for 12,000 computers and includes five year license for the software. They are expecting paybacks of about one year.

For 4000 computers (NISD), estimated budget would be about $50,000.

Natural Gas to Total Electric Schools

Nance Elementary 701 Tierra Vista Way Ft. Worth, Texas 76131	Hughes Elementary 13824 Lost Spurs Road Roanoke, Texas 76262

Nance and Hughes Elementary Schools were constructed in 2005. At that time natural gas was not available for these locations. Natural gas was a significant distance and not anywhere near the areas.

Mr. Bobby Oney (214-549-7144) of Atmos reported that even after the Nance Elementary was constructed all the subdivisions nearby were total electric. He reported today that from the north natural gas is still 11,500 ft. away and from the south 11,000 ft. away. Mr. Oney estimated about $200,000 to bring natural gas to the site. This cost does not include on-site piping to HVAC units, water heater (kitchen) and new HVAC units.

Another Atmos representative reported similar comments about Hughes history and status concerning natural gas availability. He reported that natural gas still is one to two miles away from Hughes.

Comparison Total Electric Vs. Electric/Natural Gas

	Facility	Sq.Ft.	Sys	Kw-hrs	$ Elect	MCF	$ MCF
Suez Oncor 17¢/kw-hr	Nance E.S.	79,040	DX; Elect. Htg.	912,777	155,623	0	0
Tricounty 10.2¢/kw-hr	Hughes E.S.	79,040	DX; Elect. Htg.	876,096	89,018	0	0
10.2¢/kw-hr	Granger E.S.	80,736	DX; Elect. Htg.	842,880	86,242	735	8468
Suez Oncor 13.5/kw-hr	Sendera Ranch E.S.	81,191	DX; Elect. Htg.	769,140	103,796	1,139	10,431

Comparing the above similar campuses (Nance, Hughes total electric with Granger & Sendera Ranch electric and natural gas) shows the following if Nance and Granger were converted to electric and natural gas.

For Nance E.S.

+ $10,000/yr. natural gas cost
- $41,038/yr. electric cost
- $31,038/yr. net cost (energy)

For Hughes E.S.

+ $10,000/yr. natural gas cost
- $24,622/yr. electric cost
- $14,622/yr. net cost (energy)

Each campus would save about 241,400 kw-hr per year and add about 1,000 MCF per year. Note that Nance and Hughes are on different utility suppliers for electricity. Also Nance is used on weekends for church.

Preliminary estimates are that about $1,000,000 cost per school to bring natural gas to the site, replace total electric rooftop HVAC with electric and natural gas, provide on-site natural gas piping, and new natural gas kitchen water heater. The payback would be more than 25 years.

Recommendation: Because the campuses and equipment are only five years old, monitor real estate development projects that might result in natural gas being brought even closer to the schools. In the meantime, if any major additions to the campus are needed and constructed, re-evaluate cost/benefit of extending natural gas to the campuses for the addition and larger areas (e.g. Gym, Cafeteria, etc.).

Install Occupancy Sensors

Occupancy sensors turn lights off in spaces after a preset time when no people are detected. They may be utilized in most spaces, classrooms, offices, halls, meeting rooms, gyms, lockers, etc. A variety of studies indicate that lighting energy savings of 20 percent or more may be realized from using occupancy sensors. The district has retrofitted several campuses.

Replace T12 Fluorescent Lighting With T8 Fluorescent Systems

Retrofit any remaining T-12 fluorescent lighting and electromagnetic ballasts with T-8 lamps and electronic ballasts. Existing systems with 34-watt T-12 lamps and energy saving ballasts consume 72 Watts per two-lamp fixture. Electronic ballasts with 32-watt lamps consume about 59 watts, or less depending on ballasts selected. The district has made significant retrofits.

Where large numbers of T-12 light fixtures remain, the district may want to include replacement in a bond package. In-house maintenance crews can retrofit small areas of lamps and ballasts.

T5 Lighting for Gymnasiums (Replace Metal Halide)

Provide for remaining gyms in district.

HVAC Projects

See Section 5.0

9.0 RENEWABLE ENERGY SOURCES

Solar Power/Photovoltaics

Photovoltaics (PV), is the direct conversion of sunlight into electricity. Sunlight striking the solar cells activates them to produce electric current.

A PV system consists of hundreds or even thousands of solar cells. An outer glass cover protects each cell. Individual cells vary in size from about ½" to 4" across. Cells are arranged in rows into modules. An assembly of modules is called an array. The quantity of arrays needed is dependent on the power requirements of the application. In general, on the order of 100 square feet of area is needed per kilowatt (kw) of capacity. For reference, an installation large enough to provide all the power needed for a typical elementary school at peak would be about the size of a football field.

In addition to arrays of cell modules, an installation includes other components such as inverters (to convert the dc power generated by the cells to ac power), controls, wiring, etc.

Photovoltaic systems may be stand-alone or hybrid. In the stand-alone mode, the PV system provides all the electrical needs of the facility it serves. A hybrid system is combined with another power source, usually the electric utility. The utility provides power beyond what the PV system is able to supply. The electric utility will require that the PV system meet certain standards before allowing it to connect to their system. In some cases, the electric utility may purchase excess power produced by the PV system when the school does not need it (e.g. nights and weekends).

High initial costs and large physical size of installations generally make photovoltaics unsuitable for supplying all power needs to schools. However, the technology could be useful for providing some fraction of energy needs or to small remote users such as entrance signs, etc. A smaller demonstration project for students to see this technology in action might also be practical.

Applications in Northwest ISD

Nance Elementary is an all-electric school, with no natural gas available to the site. Water for the kitchen is provided by a 400 gallon boiler with 72 kw electric input. PV might be used to offset some of the electric demand of the boiler.

In other cases, a smaller installation for demonstration purposes may be feasible.

The following table shows the potential power that may be generated from a PV arrays in Northwest ISD, as well as estimated costs. The following are given as possible options at the various campuses. No evaluations have been done to determine the structural worthiness of the buildings to support an installation.

Photovoltaic's Renewable Energy

School	Kw	Area (ft^2)	Est. annual energy production (kwh)	Est. system cost	Est. annual energy value	Simple payback (years)	Remarks
Nance Elementary	1	125	1,300	$8,000	$220	36	Demonstration
	10	1,250	13,000	$70,000	$2,200	32	Demonstration
	50	6,250	66,000	$300,000	$11,200	27	Offset partial demand of 72kw kitchen water heating
	72	9,000	93,000	$420,000	$15,800	27	Offset demand of 72kw kitchen water heating
Pike M.S.	1	125	1,300	$8,000	$140	57	Demonstration
	10	1,250	13,000	$70,000	$1400	50	Demonstration
Northwest H.S.	1	125	1,300	$8,000	$140	57	Demonstration
	10	1,250	13,000	$70,000	$1,400	50	Demonstration

Wind Power

Wind power turns the wind's energy into electrical energy that can be put to practical use. This is done thorough wind turbines, which closely resemble the windmills of yesteryear. Wind turbines can be used to supply power in a wide range of applications, from small users in rural areas to large-scale utility company wind farms.

A wind turbine typically consists of a rotor with blades that turn a generator at the top of a tower. The tower is typically some 80 to 120 feet tall, depending on the size of the generator and prevailing wind conditions. Towers are tall to take advantage of the fact that wind speed generally increases with height. Also, a tall tower decreases interference that might be created by obstacles such as hills, buildings, and trees nearby.

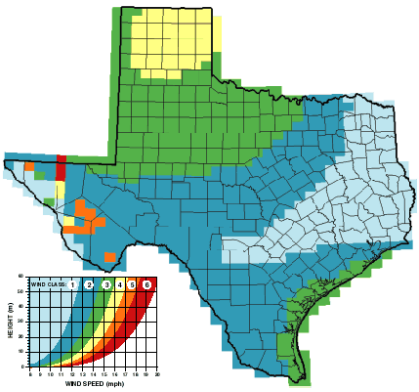
When the wind exceeds the minimum required speed for rotation, the rotor begins to turn. The rotor is connected to an electric generator through a shaft and gearbox. As long as the generator is kept turning, it creates electricity.

To be effective, wind turbines must be used in locations with adequate average wind speeds. Areas of west Texas, the Panhandle, and High Plains are considered good, while central and east Texas are generally marginal to poor. Although wind power can be utilized anywhere, lower wind speeds reduces the potential energy production.

Installations may be stand-alone or connected to the utility grid. The electric utility will require that the system meet certain standards before allowing it to connect to their system. In some cases, the electric utility may purchase excess power produced by the system when the school does not need it (e.g. nights and weekends).

Wind power systems cost approximately $3,000 to $5,000 per kw. They do require some annual maintenance.

The map below illustrates wind power potential for the state of Texas. Areas that are classified as class 3 or better (green yellow, red, or orange) are considered to have good potential for widespread use of wind turbines. NWISD ISD falls in the class 2 (**dark blue**) area; therefore, the extensive use of wind power is not recommended. However, smaller installations for demonstration purposes may be appropriate.



The following comments apply to the campuses included in this report:

Pike Middle School

The site is already rather full and space is limited. There is some space near the athletic fields, but a wind turbine installation would not be recommended here. Therefore, wind power is not recommended at this school.

Northwest High School

Due to site constraints, wind power is not recommended at this school.

The proposed future Outdoor Learning Center may be a good application for a demonstration wind power project.

Solar Water Heating

Flat plate solar collectors are active systems that collect the sun's energy and transfer that energy to water circulating from the building to the collectors. A more common use of this solar energy approach is heating domestic hot water.

A typical flat plat collector consists of transparent front cover or plate, an insulating zone bounded by the covers (rear and side covers not transparent), and a special coated absorbing plate with tubing attached. Water circulating through the tubing attached to the internal absorber plate is heated from the sun's energy collected. The transparent front cover may be glass or other appropriate transparent materials.

In a solar domestic water system the heated water is circulated (pumped) to a water storage tank. For school application there needs to be back-up heating (e.g. electric or natural gas) in the event of extended cloudy times.

This type solar energy system will consist of multiple solar panels mounted in a location to face toward the south at a designed angle (about 32°). For effectiveness trees, other buildings, etc should not create

a shade or block direct sun to the collections surface. The kitchen roof is already very crowded with HVAC equipment, fans, etc. The gym roof would be more suitable.

Nance Elementary

Solar domestic water heating for the kitchen electric boilers would require approximately 320 sq. ft. of flat plate collectors mounted on the roof. Structural suitability, screening ordinances, and codes are not evaluated and should be before further consideration of this location. Ten 4ft x 8ft collectors would save about $2,110 year of water heating for the electric boiler water supplied to the dishwasher. The preliminary estimated cost is $32,000. Hughes Elementary also is a total electric campus and results will be similar to the Nance evaluation. Nance Elementary is served by a different electric utility company and the rates are higher than Hughes.

Flat plate solar collector installation

Pike Middle School

Natural gas is available at these existing campuses. Solar collectors for domestic hot water will have much longer paybacks and less economic benefits than collectors at an all electric campus.

Summary

The following is a summary of renewable energy potential, costs, and benefits:

- Renewable energy installations could be used to promote community awareness and student learning. The most feasible applications appear to be at Nance Elementary.
- Renewable energy can offset some purchased energy (electricity and natural gas) requirement.
- Economic paybacks can be long, and in some cases exceed the expected life of the equipment.
- The District should contact local utility companies for any rebates and incentives that may be available and be on the lookout for any stimulus program grants that may be offered.
- Demonstration renewable is suitable for awareness and student learning.
- Benefits will be maximized if grants and rebate is obtained.

10.0 LED LIGHTING

LED Lighting

LEDs are semiconductors that convert electricity into light. At one time they were used only as indicator lights on electronic devices. LEDs are now being developed for use in downlights, troffers, and outdoor area lighting. One day they may replace most or all of the conventional light sources we currently use.

LEDs require a special power source commonly called a driver, which is similar to a fluorescent ballast. They can be produced in a variety of color temperatures, from warm to cool, just like other lamp types.

The Department of Energy's (DOE) long-term goals call for luminous efficacies of 160 lumens per watt (lpw) for LEDs. Efficacies of more than 100 lpw have been achieved under laboratory conditions. In the latest round of testing by the DOE, market available LED products exhibited a wide range of efficacies from 17 to 79 lpw, with an average of 46 lpw. For comparison, compact fluorescent and T-8 fluorescent fixture efficacies are about 65 and 90 lpw, respectively.

Costs of fixtures utilizing LED lamps are considerably higher than similar fixtures with fluorescent or HID lamps, and their light output is considerably lower. Therefore, more LED fixtures would be required to attain the same light levels.

Given the status of LED products, we do not recommend the widespread use of fixtures utilizing LED lamps. Research and development is occurring at a fast pace. Therefore, in the near future, products will likely be offered that rival currently available fluorescent and HID models. As demand for LED based fixtures increases, prices will fall, making the items more attractive.

In the meantime, the district may want to consider purchasing or obtaining a limited number of sample LED fixtures to install and monitor on a test basis.

Evaluation of LED Lighting at Northwest ISD

Nance Elementary

Wallpacks – Wallpacks, used to illuminate building exteriors, often use metal halide lamps ranging in size from 70-watt to 400-watt. Exterior wall fixtures utilizing LED lamps are available; however, these fixtures currently are equivalent to only a couple of compact fluorescent lamps.

Downlights – Screw-in LED replacement lamps are available for recessed downlights, such as over the counter in the library. An example is a 6-inch unit by Cree Lighting that uses about 10 watts and produces about 700 initial lumens. The product costs about $80 or more. In comparison, a 13-watt compact fluorescent lamp produces about the same light output and costs approximately $5.

Parking lots and canopies – LED light fixtures are available that are intended to replace parking lot and canopy lights. Typically, most parking lot light fixtures incorporate 400-watt metal halide lamps. These produce about 36,000 initial lumens. Currently, the largest LED fixtures available use about 175 watts and produce approximately 6000 initial lumens (about the same as a 70-watt metal halide lamp). The LED fixtures cost at least twice as much as the metal halide fixtures.

Update

While LED technology is advancing rapidly, they are not yet as efficacious as fluorescent or metal halide lamps in actual installations. That is, they do not produce as much light for the same amount of energy used. Fluorescent and metal halide lamps often produce 60 to 90 lumens per watt. In the most

recent round of testing by the Department of Energy, LED fixtures produced, on average, about 45 lumens per watt.

We recommend that Northwest ISD monitor developments in LED technology. At some point in the near future, fixtures with LED lamps are likely to perform as well as those with fluorescent and metal halide lamps. In the meantime, the District may want to obtain a few LED fixtures to install for evaluation and test purposes.

EMA employees attended the International Light Fair in May 2010 and a manufacturer's LED Lighting class in June 2010. Standards are being developed for uniform rating and testing of LED lamps and fixtures by various organizations including the Department of Energy. There apparently is much variation between lamps, fixtures, and suppliers/manufacturers. A key recommendation is to look at the fixture and request standard uniform test reports on light source and photometrics. Also work with established manufacturers with a good reputation. Try selected fixtures for testing/evaluation. Monitor the changing technology.

11.0 FUNDING OPTIONS

School Districts 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 is available. Consult with district financial consultant and attorney. 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. 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 requirements and must be analyzed in an Energy Assessment Report by a Professional Engineer who meets criteria. Upon final loan execution, the District proceeds to implement funded projects through the traditional bid/spec process. For more information contact Juline Ferris at 512/936-9283 for more information.

Capital Acquisition Program or Municipal Financing Program

This program also offers loans to purchase and install energy-saving equipment. The minimal loan amount is $100,000 and interest rates are competitive. Rates depend on current financial market conditions, the length of the loan, and the District's bond rating. Loan terms are set at three year, four year, seven year, or ten year periods and are not related to project payback. The application procedure is simple: completion of a one-page form and submission of the most recent budget and audit. For more information call 512/467-3695 or contact Texas Association School Boards.

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 District at the beginning of the lease, and the lessor retains a security interest in the purchase until the loan is paid off. A typical lease covers the total cost of the equipment and may include installation costs. At the end of the contract period a nominal amount, usually a dollar, is paid by the lessee for title to the equipment.

Rebates

Many electrical transmission and distribution companies offer rebates for energy projects that reduce the peak electrical demand (kw). Contact the provider in your area for detail. For example Oncor offers energy efficiency rebates for various projects such as upgraded new energy efficient air-conditioning, lighting, and others. The availability of rebates, the amounts, and eligibility requirements vary. Contact the provider before beginning a project as most times they require prior approval and documentation of existing conditions or items to be upgraded.

Grants

There are numerous sources of grants and their requirements, availability, and eligibility vary at times. Examples of some opportunities to monitor included the following:

- State Energy Conservation Office (SECO) monitor SECO's website and the Electronic State Business Daily
- Oncor school matching grant (www.takealoadofftexas.com)
- Oncor Solar PV Program (www.txreincentives.com/opv/)

- Discretionary and other grants offered by the federal government may be searched at www.grants.gov
- Foundations
- Public Independent School District Energy Efficiency Grants. Monitor SECO (www.seco.cpa.state.tx.us) and the Electronic State Business Daily
- Renewable energy technology grants (SECO).
- Alternative fuel and hybrid vehicle grant program (SECO).

Stimulus
The American Recovery and Reinvestment Act (ARRH), provides stimulus funding in various methods and for different energy projects. The Texas Comptroller of Public Accounts provides convenient Stimulus Tracking Reports (www.tx.comptroller@service.govdelivery.com) For energy project announcements refer to SECO website.

Qualified School Construction Bonds (QSCB's) and Build America Bonds (BAB)
QSCB and BAB bonds are debt financing tools that came out of the federal AARA stimulus. Recent legislation revised the process of QSCB's and BAB. The Hiring Incentives to Restore Employment (HIRE) Act is supposed to simplify the process and result in reduced interest cost to the district. The bonds are taxable to the purchaser and they receive the interest (currently about 5.76 percent).

The federal government pays the district the "lesser of" the taxable issuance rate or the current tax credit rate as of sale date. The district under current conditions pays near zero interest. Depending on use of the QSCB, districts can potentially use with maintenance tax note.

For BAB this is a 30 year taxable bond and the district receives a federal subsidy.

The conditions and suitability of the above bonds are subject to change. Consult with the district's financial consultant with these and all other financial methods, instruments, and options.

Bonds
Traditional school bonds are approved by the voters. These bonds are tax-exempt. Typically these bonds are used for new construction, major renovations, and infrastructure upgrades. Consult district financial planner.

Department of Energy Resource
Refer to DOE's Guide to Financing Energy Smart Schools. See www.eere.energy.gov