

Texas Tech University Energy and Water Management Plan FY 2023 Update

State Energy Conservation Office requires Texas Tech University (TTU) to publish the Energy and Water Management Plan (formerly Energy Savings Program Update) in accordance with 34 Tex. Admin. Code §19.14. In addition, Texas Tech University reports water, electricity, and natural gas consumption using Energy Star Portfolio Manager according to Tex. Gov. Code Sections 447.009 (c) and (e).

The Energy and Water Management Plan will be posted on the Operations Division website.

A. Energy Goals

1. University Energy Use

Energy units are converted to thousands of BTUs per square foot (kbtu/ft²) to compare the various energy forms. Goals and energy use are therefore stated in kbtu/ft². Estimated savings are measured against energy consumption for the prior fiscal year.

In FY23, the campus consumed 145.34 kbtu/ft², a 6% increase of the previous year. The goal was to consume no more than 140 kbtu/ft². The following impacted Texas Tech's energy performance:

- Degree days increased by 3%, based on CUSUM analysis would increase the Energy Use Index (EUI) by 1.12 kbtu/ft².
- Total electric consumption for the University decreased by 1.3%. Realized a 0.87 kbtu/ft² reduction to the EUI.
- Cogeneration steam, provided at no cost to the university by a local utility company (LP&L), is tabulated in the balance of university energy use, but no dollar savings are reported on the cogeneration line since they would be realized as a reduction of natural gas use. Cogeneration steam impacted the EUI by 4.72 kbtu/ft² an increase of 53.7% in comparison to last year. FY23 will be the last year that LP&L will utilize the cogeneration station. Next year, Texas Tech expects to have an increase in natural gas consumption to produce additional steam.
- Campus, E&G and AUX buildings, natural gas consumption increased by 3%. Realized a 0.33 kbtu/ft² increase to the EUI.
- Central Heating and Cooling Plant # 1 (CHACP # 1) natural gas consumption increased by 11%, subsequent impact on the EUI was 6.81 kbtu/ft².

- As the cost of electricity is uncertain, The Operations Division strategically elected to utilize the steam chillers, which have a larger impact on the EUI (3.27), over the electric chillers.
- Due to a 29% increase in steam demand for the campus and the discovery of condensate and steam leaks in the steam-condensate tunnel system, which averaged 35 gpm in condensate loss for the year, impacted the EUI by 3.54 kbtu/ft².
- Chilled water losses in the tunnel system averaged 2.1 gpm for the fiscal year. This is a 63% reduction in comparison to last year. The EUI reduction is negligible but overall costs should have decreased by \$10k in comparison to last year.
- Freeze Protection Protocol: if outside air drops below 32°, Texas Tech turns on air handlers and pumps to protect coils and pipes from freezing. The cost of this practice in FY23 was \$391,566. Freeze Protection increased the EUI by 1.73 kbtu/ft².

In Table I, the campus energy use is broken down by utility type. Electricity consumption decreased for the fiscal year, but electricity rates increased by 10% in which increased cost by \$896,893. Natural gas consumption increased, reasons detailed above, but natural gas rates decreased by 15%. Texas Tech realized a savings of \$318,651. The net increase is \$578,242.

Table I: University Energy Use (kbtu/ft²):

September '22 – August '23

Utility	FY22 Actual	FY23 Actual	% Change from previous year	Year to Year Cost Comparison
Electricity	55.16	54.29	Down 1.6%	\$896,893
Natural Gas	79.21	86.34	Up 9%	-\$318,651
Cogeneration Steam	3.07	4.72	N/A	\$0
Total	137.44	145.35	Up 5.8%	\$578,242

2. Campus Electrical Use

In compliance with 34 Tex. Gov. Code §19.14, Texas Tech University set a goal to reduce total electrical consumption by 2.5% for FY23. Table II shows the kilowatt hours per square foot (kwh/ft²) for the campus.

For FY23, electrical consumption was 16.67 kwh/ft², a 0.8% decrease compared to FY22 (16.81 kwh/ft² for the year).

Table II: Campus Electricity Use (kwh/ft²):**September '22 – August '23**

Whole Campus Electricity Use in kwh/ft²	FY23 Reference Data in kwh/ft²	2.5% Reduction Goal in kwh/ft²	FY23 Actual Consumption in kwh/ft²	Percent Increase/Decrease
1st Quarter	4.18	4.08	4.36	Up 4.4%
2nd Quarter	3.95	3.85	3.97	Up 0.5%
3rd Quarter	4.16	4.06	4.00	Down 4%
4th Quarter	4.51	4.39	4.33	Down 3.9%
Yearly Total	16.81	16.39	16.67	Down 0.8%

3. Fleet Fuel Management Plan (Vehicles)

Table III below compares the percent change in miles traveled for FY22 and FY23. It indicates a 5.8% reduction in miles traveled. However, this is not a result of less miles traveled. All mileage reports were not accounted for to accurately show the total miles travelled this fiscal year.

Table III: Miles Traveled

	FY21	FY22	FY23
Miles Traveled	2,910,896	1,718,333	1,618,447
		-41.0%	-5.8%

Table IV below indicates that fuel efficiency increased 67.8%. From the note above, this is not a true representation of fuel efficiency.

Table IV: Fuel Efficiency

	FY21	FY22	FY23
Miles per Gallon	14.23	7.71	12.95
		-45.8%	67.8%

4. Water Conservation (Thousands of Gallons)

For FY23, combined water consumption (domestic and irrigation) was 293,339 thousand gallons. This is down 12.7% compared to FY22 (335,828 thousand gallons).

During this fiscal year, it became evident that a sizable portion of the main campus irrigation is being sourced from domestic water rather than well water. The 207% increase in rainfall largely contributed to the decrease in consumption in domestic water and well water.

**Table V: University Water Use
(Thousands of Gallons):**

September '22 – August '23

Utility	FY22 Actual	FY23 Actual	% Change from previous year	Estimated Savings
Domestic water	301,645	266,182	Down 11.8%	\$142,794
Sewer	301,645	266,182	Down 11.8%	\$79,342
Irrigation water	34,183	27,157	Down 20.6%	\$51,111
Yearly Total	335,828	293,339	Down 12.7%	\$273,247

Table VI below indicates that well water consumption was 17,015 thousand gallons for FY23, a decrease of 37.9% compared to last year.

Table VI: Campus Well Water Use (Thousands of Gallons):

Utility	FY22 Actual	FY23 Actual	% Change from previous year
Well water	27,379	17,015	Down 37.9%

Table VII below indicates that domestic water consumption for remote sites was 6,741 thousand gallons in FY23. This was down 16.4% compared to FY22 (8,063 thousand gallons).

Table VII: Remote Sites (Thousands of Gallons):

September '22 – August '23

Utility	FY22 Actual	FY23 Actual	% Change from previous year	Estimated Savings
Domestic Water	8,063	6,741	Down 16.4%	\$8,995
Sewer	7,141	4,185	Down 41.4%	\$2,846

Table VIII below indicates that well water consumption for remote sites was 57,627 thousand gallons in FY23. This is down 20.7% compared to FY22. The Rawls Golf Course meter failed in July. The reported well water consumption for July and August was zero. The meter will be repaired in FY24.

**Table VIII: Remote Well Water Use
(Thousands of Gallons):**

September '22 – August '23

Utility	FY22 Actual	FY23 Actual	% Change from previous year
Well water	72,643	57,627	Down 20.7%

Table IX below indicates that Central Heating and Cooling Plant #1 (CHACP) well water use to the cooling towers was down 20.7%.

**Table IX: CHACP #1 Well Water Use
(Thousands of Gallons):**

September '22 – August '23

Utility	FY22 Actual	FY23 Actual	% Change from previous year
Well water	160,701	152,044	Down 5.4%
Sewer	80,351	76,022	Down 5.4%

B. Energy Reduction Measures

1. Educational and General Space

- a) Recognized by the Association for the Advancement of Sustainability in Higher Education as a STARS Silver Institution based on its reported accomplishments in campus sustainability.
- b) Free Cooling Project at CHACP # 1 – The Water Side Economizer provided over 3 million tons of free cooling (7.4% of total chilled water produced) this fiscal year, an estimated savings of \$58,119.
- c) Back Pressure Turbine at CHACP # 1 supplied 25.9% of CHACP’s electrical use for a cost savings of \$373,308.
- d) Received free cogeneration steam from utility provider. Saved the University \$184,022.
- e) Replaced a faulty variable frequency drive for an air handler at Rawls COBA.
- f) Installed chilled water meters at Southwest Collections and Chemistry.
- g) Installed steam meters at Jones Stadium West and United Supermarkets Arena.
- h) Installed an electric meter at Child Development Research Center.
- i) Installed condensate meters at Rec Center Aquatic and Talkington Hall.
- j) In efforts to recapture condensate from the campus, Texas Tech University installed power pressure pumps at Wiggins and National Wind Institute and condensate pumps at Southwest Collection.

- k) Identified a closed condensate valve in the tunnel causing condensate to back up at ESB II.
- l) Found a defective steam control valve at Human Sciences. The valve has been isolated and will be repaired in FY24.
- m) Retubed Boiler #2 at the CHACP # 1 for reliability of capacity. Project cost is \$4 million.
- n) Submitted a list of deficiencies in the BAS system for new construction facilities: Development Center, Ag Pavilion, and Child Development Research Center.
- o) Developed a campus setpoint standard and protocol to maintain system efficiency while allowing for minor adjustments to ensure occupant comfort.
- p) Replaced the variable frequency drive for the heating water pump at Humanities.
- q) Refurbished air handlers at the Law building using the technology provided by Aquis. A custom-engineered coating solution that addresses common problems specific to air handlers such as water leaks, corrosion, carryover and standing water.
- r) Upgraded the controls and valves for the chilled water system at Mechanical Engineering North.
- s) Secured steam to campus air handlers during Summer 2023 to eliminate simultaneous heating and cooling which would decrease efficiency.
- t) Upgraded pneumatic steam valves to electronic for better control of maintaining setpoints in the Administration building.
- u) Submitted 274 workorders for discrepant air handler operations, faulty HVAC equipment, and buildings' chilled water return temperature setpoints.
- v) Repaired chilled water leak from a buried line between Humanities and Education buildings.
- w) Upgraded HVAC controls at the Child Development Research Center, Math, Animal Food Science, Music, and Psychology. Projects will continue through FY24.
- x) Collaborated with Utilities to develop Conservation Notices to send out if ERCOT sends out a conservation notice or notice for potential brownouts.
- y) Reviewed 50% construction documents for Academic Sciences Building and West Village C to ensure HVAC systems and controls meet Texas Tech's standard for meeting energy efficiency goals.

- z) Replaced shorted motor and variable frequency drive on chilled water pump at Mechanical Engineering South due to chilled water leak.
- aa) Installed new HVAC systems and controls at Early Head Start.
- bb) Installed CenterPoint Panels at the Burkhart Center in December to address concerns of airborne biologics through the HVAC system. Through monitoring and testing, it would later be determined if there is an opportunity to decrease the prescribed or regulated use of outdoor air in the building for dilution. By reducing the OA from 130 cfm per occupant to 6 cfm per occupant, during the cooling season alone, the reduction of OA amounted to \$7,251.15.
- cc) Audited chilled water control system to identify differential setpoints higher than 15 psi. Ag Pavilion and Development Center were used as test studies for reducing differential pressure and studying the effects on providing adequate cooling to the buildings.
- dd) Perform a testing and air balance of the air handlers at CHACP # 1 using the services provided by Palmetto Air and Water Balance.
- ee) Placed an air handler that was previously running 24/7 to serve lab space on a schedule. Estimated saving is \$5,213 annually.
- ff) Replaced the chilled water and heating water pumps variable frequency drives due to internal faults at Burkhart.
- gg) Cleaned twenty-one chilled water coils at five buildings: CHACP # 1, Physical Plant, Wiggins, Electrical Eng, and Drane Hall.
- hh) In effort to reduce chilled water consumption across the campus during winter break, the chilled water return setpoint was increased to a range of 60-65°. The realized reduction was 40% in flow across fourteen E&G buildings.
- ii) Replaced a faulty variable frequency drive for an air handler at Administration.
- jj) Reduced HVAC air handler exceptions by 10,694 hours and \$22,766 at Science (AHU 3), Human Sciences (AHUs 1, 2, and 6), IMSE (AHUs 14 and 19), Civil Eng (AHU 4), and TCVPA (All AHUs).

2. Auxiliary Space

- a) Cleaned duct work at Stangel Murdough and Coleman to remove debris to increase the indoor air quality and occupant comfort.

- b) Audited the University Recreational Center with an engineering consulting firm and identified the need to replace pumps, steam valves, controls, dampers, and variable frequency drives to increase the efficiency of the HVAC system and controls and improve occupant comfort. All equipment and controls were replaced throughout the fiscal year.
- c) Identified a defective pressure reducing valve at Wall Gates that prevented steam from entering the convertor for heating the building. The pressure reducing valve was replaced, and heating was restored to the building.
- d) Identified a problem with the current transformer on Stangel Murdough chilled water variable frequency drive. Replaced the current transformer and placed the pump back in auto.
- e) Replaced the variable frequency drive for an air handler at Student Wellness Center.
- f) eSight identified that the efficiency in the chilled water system at Carpenter Wells was decreasing by assessing the chilled water return temp. The chilled water bypass valve was found isolated. The chilled water system was corrected causing the flow to drop from 350 to 75 gpm. An estimated cost avoidance of approximately \$10,000/month
- g) Instituted monthly energy reviews with University Student Housing (USH) to report current trends in utility usage in all areas of USH. Reported specific equipment discrepancies.
- h) Instituted quarterly energy reviews with Athletics, Student Union, Student Rec Center, and United Supermarket Arena to report current trends in utility usage in all areas of their buildings. Reported specific equipment discrepancies.
- i) Upgraded the air handlers and both the chilled and heating water systems with new equipment and controls at Hulen Clements and Wall Gates.
- j) In effort to reduce chilled water consumption across the campus during winter break, the chilled water return setpoint was increased to a range of 60-65°. The realized reduction was 40% in flow across nine Auxiliary buildings.
- k) Corrected the differential programming on the chilled water system at Horn Knapp saving Housing \$18,580 in chilled water consumption.
- l) Identified that the heating water system at Knapp Hall was not meeting the demand of the system due to a control issue.
- m) Replaced four differential pressure sensors at Carpenter Wells to increase the efficiency of the chilled water system.

- n) Replaced heating water controls and steam valves at Gordon Hall to increase efficiency and reliability of the system.
- o) Performed a complete control upgrade for all HVAC systems and components at the Student Union Building in FY22. This fiscal year the realized savings was \$46,009 in chilled water and \$5,125 in steam.
- p) Generated 52 HVAC work orders for specific equipment discrepancies for Athletics, United Spirit Arena, Innovation HUB, Student Wellness, and the Student Recreation Center.
- q) Troubleshoot and corrected actuation of the chilled water bypass valve, saving Housing \$5k for July and August at Weymouth Dorm.
- r) eSight identified that the chilled water system was operating inefficiently based off the chilled water return temp. Energy Management worked with the building manager to monitor the changes of increasing the chilled water return setpoint to 55° in late March. From April to August, Athletics saved \$21,446 in chilled water costs at Jones Stadium.

3. Energy Audits

- a) Performed steam/condensate audit of condensate receivers on campus to identify buildings that have the condensate return water redirected to drain. Work orders were submitted for each building identified.
- b) Performed five interior lighting audits: Rawls COBA, Humanities, Human Sciences, Human Sciences Tower, and Math.
- c) Conducted an audit of the exterior lighting across the Main Campus, which subsequently prompted the initiation of a project to transition the lighting in the parking lots and pathways near Chitwood, Weymouth, and Coleman dormitories to LED. Additionally, the project encompassed the installation of six new poles to enhance lighting levels. Further potential projects are under consideration for the upcoming fiscal year.
- d) Performed 19 HVAC audits: USA, Civil Eng, Horn Knapp, Chemistry, COMC, RCOBA, Science, Administration, Music, Library, Architecture, Biology, ESB II, Human Sciences, Human Sciences Tower, Law, Humanities, Education, and Holden.
- e) In the fall, while steam was on to the campus, the steam/heating water system controls were audited to identify whether all heating water systems were following the Campus Standard lock-out program.

C. Energy Reduction Plans and Feasibility Studies

Texas Tech University is currently planning energy efficiency measures including:

- a) Utilize an Energy Brokerage Firm to help facilitate a new natural gas procurement contract.
- b) Perform 5-yr maintenance on the back pressure steam turbine generator to ensure continuity of cost savings.
- c) Utilize the Water Side Economizers at CHACP # 1 to achieve electric and natural gas savings when outside air temperature allows.
- d) Partnership between CHACP # 1 & Energy Management to monitor Human Science bldg. performance and determine how building and plant efficiencies correlate.
- e) Install two 1500-ton electric chillers at CHACP 2 to increase capacity, efficiency, and diversification in the production of chilled water. Project cost is \$4.5 million.
- f) Continue to repair steam and condensate leaks to regain efficiencies in the production of steam for heating the campus.
- g) Complete the audit of exterior pathway lights and calculate the estimated cost for the LED upgrade, along with the potential energy savings.
- h) Create a five-year plan for upgrading HVAC systems, lighting, and controls.
- i) Institute monthly reviews of the Equipment Down Report and Software Override Report with goals to prioritize equipment repairs that are energy intensive.
- j) Complete the recommissioning project for Murray air handlers. Replace chilled water and heating water valves and actuators.
- k) Develop a Sustainability Master Plan to administer and provide guidelines for future sustainability efforts.
- l) Utilize dashboards and alarms created in eSight to assist with persistent commissioning and monitoring of building utilities.
- m) Perform energy assessments (building models and audits) for all priority facilities.
- n) Identify HVAC exceptions that can be better served by supplemental units.

- o) Continue upgrading metering systems for electricity, steam, natural gas, chilled water, irrigation, and domestic water, and integrating into eSight Energy Accounting System to improve energy monitoring and identification of excursions. Select meter data will be connected to Utilivisor for the purpose of balancing loads at CHACP # 1.
- p) Work with Facilities Planning and Construction (FP&C) to ensure meters are installed and integrated into eSight and Utilivisor during the construction process.
- q) Perform twenty-four building audits to identify energy efficiency measures and update Building Energy Management Profiles.
- r) Perform thirty-two steam audits to identify defective steam valve and actuators.
- s) Systematically recommission chilled water mixing valves to increase chilled water delta T to $>16^{\circ}$.
- t) Audit steam distribution system.
- u) Identify and utilize an energy modeling software to create energy models for campus buildings.
- v) Prepare monthly or quarterly energy reports for all Auxiliary units.
- w) Identify and document sequences of operation for all HVAC systems. Once identified, put a schedule in place for the Control Center to regularly monitor and review for discrepancies. If discrepancies are noted, appropriate actions will be reviewed and followed through.
- x) Audit the building automation system alarms with intention to create alarm parameters and priorities.
- y) Continue HVAC and controls assessment with third party vendor at Human Sciences and Human Sciences Tower. Goal is to identify 35% reduction in energy. Savings will be reported in FY24 report.
- z) Plan the controls upgrade for the following buildings on the legacy control systems: Library, Engineering Center, and Reese 250.
- aa) Identify energy efficiency measures that sum is equal to or greater than \$750k in cost avoidances.

D. Fuel Consumption Reduction Plan

Numerous departments on campus are now utilizing electric utility vehicles; Fleet Services Office continues to advise other departments regarding the feasibility of doing the same.

The Fleet Services Office will network with vehicle custodians to exchange information on vehicle efficiency and solicit additional best practices and other preferred initiatives for the university vehicle fleet.

The Fleet Services Office started installing GPS monitors on multiple vehicles to assist with route mapping to increase gasoline efficiency and to analyze fleet utilization for Texas Tech University and recommend best practices for future purchases. GPS monitors are still being added to vehicles around campus.

E. Water Management Plan

Operations Division will develop historical analysis of water consumption and efficiency and devise long-term water conservation strategy to include both domestic water and irrigation water. New irrigation meters and existing domestic water meters will be integrated into the eSight Energy Accounting System and Utilivisor, as required. Where possible, xero scape and desert scape landscape materials will be used in an effort to reduce maintenance and water needs.