

Texas Tech University Energy and Water Management Plan FY 2022 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 FY22, the campus consumed 137.44 kbtu/ft², a 3.7% decrease 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 decreased by 5%, resultant EUI reduction should have been 1.59 kbtu/ft².
- Energy usage per ton was identical to last year, yet Texas Tech used 700k more tons of chilled water this summer due to the increase in temperatures. The average outside air temperature for the summer months increased by an average of 7%. This increased the EUI by 0.83 kbtu/ft².
- New facilities increased square footage by 450,928 ft², and decommissioned facilities decreased square footage by 6,461 ft². The net campus square footage increased by 444,467 ft². The new buildings increased the EUI by 4.05 kbtu/ft².
- Texas Tech experienced an abnormal number of condensate and steam leaks in the steam-condensate tunnel system. This led to energy inefficiencies at the Central Heating and Cooling Plant. For the year, Texas Tech averaged 38 gpm in condensate loss. The losses increased campus cost by \$194,087 and impacted the EUI by 1.32 kbtu/ft².
- Chilled water losses in the tunnel system average 5.7 gpm for the fiscal year. The average losses should be around 2.5 gpm. The losses increased campus cost by \$9,713 and increased the EUI by 0.2 kbtu/ft².
- 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 FY22 was \$215,778. Freeze Protection increased the EUI by 1.07 kbtu/ft².

In Table I, the campus energy use is broken down by utility type. Electricity cost increased by \$3,043,328, and natural gas cost increased by \$741,004. The net increase is \$3,784,332.

Natural gas costs increased 27%. The increase in natural gas cost is due to a 35% increase in gas rates as Texas Tech realized a 9.5% decrease in consumption this year. Electricity costs increased 27% due to a 22% increase in rates and a 4.1% increase in consumption this year.

Table I: University Energy Use (kbtu/ft²): **September 21 – August ‘22**

Utility	FY21 Actual	FY22 Actual	% Change from previous year	Year to Year Cost Comparison
Electricity	53.54	55.16	Up 3%	\$3,043,328
Natural Gas	87.53	79.21	Down 9.5%	\$741,004
Cogeneration Steam	1.69	3.07	N/A	\$0
Total	142.76	137.44	Down 3.7%	\$3,784,332

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 FY22. Table II shows the kilowatt hours per square foot (kwh/ft²) for the campus.

For FY22, electrical consumption was 16.81 kwh/ft², a 7% increase compared to FY21 (15.70 kwh/ft² for the year).

Table II: Campus Electricity Use (kwh/ft²): **September ‘21 – August ‘22**

Whole Campus Electricity Use in kwh/ft²	FY21 Reference Data in kwh/ft²	2.5% Reduction Goal in kwh/ft²	FY22 Actual Consumption in kwh/ft²	Percent Increase/Decrease
1st Quarter	3.94	3.84	4.18	Up 6.1%
2nd Quarter	3.76	3.67	3.95	Up 5.2%
3rd Quarter	3.85	3.76	4.16	Up 8.1%
4th Quarter	4.15	4.05	4.51	Up 8.6%
Yearly Total	15.70	15.31	16.81	Up 7%

3. Fleet Fuel Management Plan (Vehicles)

Table III below compares the percent change in miles traveled for FY21 and FY22. It indicates a 41% 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

	FY20	FY21	FY22
Miles Traveled	1,895,858	2,910,896	1,718,333*
		53.5%	-41.0%

Table IV below indicates that fuel efficiency decreased 45.8%. From the note above, this is not a true representation of fuel efficiency.

Table IV: Fuel Efficiency

	FY20	FY21	FY22
Miles per Gallon	9.27	14.23	7.71
		53.5%	-45.8%

4. Water Conservation (Thousands of Gallons)

For FY22, combined water consumption (domestic and irrigation) was 335,828 thousand gallons. This is up 28.5% compared to FY21 (261,253 thousand gallons).

The increase in domestic water presents opportunities of further investigation into ensuring main water feeds from the City of Lubbock are protected with RPZs, identifying where irrigation is fed off the city main and converting to well water feeds, and identifying high intensity use domestic water facilities to ensure meters are installed for tracking consumption.

Lubbock County had 9.61 inches of rainfall this past year. A 72% decrease compared to the prior year.

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

September '21 – August '22

Utility	FY21 Actual	FY22 Actual	% Change from previous year	Estimated Savings
Domestic water	233,278	301,645	Up 29.3%	(\$337,603)
Sewer	233,278	301,645	Up 29.3%	(\$265,002)
Irrigation water	27,975	34,183	Up 22.2%	(\$104,064)
Yearly Total	261,253	335,828	Up 28.5%	(\$706,670)

Table VI below indicates that well water consumption was 27,379 thousand gallons for FY22, a decrease of 8.6% compared to last year.

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

Utility	FY21 Actual	FY22 Actual	% Change from previous year
Well water	29,949	27,379	Down 8.6%

Table VII below indicates that domestic water consumption for remote sites was 8,063 thousand gallons in FY22. This was up 90.5% compared to FY21 (4,233 thousand gallons). The School of Veterinary Medicine in Amarillo came online towards the end of FY21. This is the first full year of reporting consumption. 72% of the increase is attributed to the Vet School.

Table VII: Remote Sites (Thousands of Gallons):

Utility	FY21 Actual	FY22 Actual	% Change from previous year	Estimated Savings
Domestic Water	4,233	8,063	Up 90.5%	(\$2403)
Sewer	3,563	7,141	Up 100%	(\$3,846)

Table VIII below indicates that well water consumption for remote sites was 72,643 thousand gallons in FY22. This is down 6.9% compared to FY21.

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

Utility	FY21 Actual	FY22 Actual	% Change from previous year
Well water	78,061	72,643	Down 6.9%

Table IX below indicates that Central Heating and Cooling Plant #1 (CHACP 1) well water use to the cooling towers was up 21.9%.

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

Utility	FY21 Actual	FY22 Actual	% Change from previous year
Well water	131,787	160,701	Up 21.9%
Sewer	65,893	80,351	Up 21.9%

B. Energy Reduction Measures

1. Educational and General Space

- a) Free Cooling Project at CHACP 1 – The Water Side Economizer provided over 3 million tons of free cooling (7% of total chilled water produced) this fiscal year, an estimated savings of \$59,052.
- b) Back Pressure Turbine at CHACP 1 supplied 20.6% of CHACP 1’s electrical use for a cost savings of \$384,791.
- c) Received free cogeneration steam from utility provider. Saved the University \$123,184.
- d) Retubed Boiler #2 at the CHACP for reliability of capacity. Project cost is \$4 million.
- e) Created a Campus Sustainability Advisory Committee to develop a Sustainability Master Plan provide recommended guidelines for future sustainability efforts.
- f) Repaired a loose pneumatic line on the chill water valve at Music to reduce chilled water consumption bypassing through the building.
- g) Installed and programmed chilled water meter at Human Science Tower.
- h) Replaced faulty VFDs on two air handlers at the Education building.
- i) Submitted a list of deficiencies in the BAS system for new construction facilities: Weeks Hall, Experimental Sciences II, and Talkington Theater Expansion, and Black Culture Center.
- j) eSight identified an increase in domestic water usage at Mechanical Engineering North. The excessive use at Mechanical Engineering North was identified as a preventative measure to protect sump pumps.

- k) eSight identified excessive use at Wiggins which turned out to be a domestic water leak in the mechanical room.
- l) In FY21, updated chilled water controls (valves and actuators) at Human Science Tower building. Savings was tracked in eSight. Consumption was reduced by 22% (\$23,120 savings).
- m) Secured steam to campus air handlers during Summer 2022 to eliminate simultaneous heating and cooling which would decrease efficiency.
- n) Installed a condensate meter at the Art 3D building.
- o) Installed a chilled water meter at United Supermarkets Arena.
- p) Integrated 5 chilled water meters and 1 steam/condensate meters into the eSight Energy Accounting System and Utilivisor.
- q) Submitted 238 workorders for discrepant air handler operations, faulty HVAC equipment, and buildings' chilled water return temperature setpoints.
- r) Reprogrammed VAVs on the 4th and 5th floor of the Texas Tech Plaza to better serve the occupants.
- s) Replaced faulty variable frequency drive for one air handler at Art 3D.
- t) Installed a new chilled water valve on air handler #1 at the Science building.
- u) In efforts to recapture condensate from the campus, Texas Tech University installed condensate tanks heads at Human Science and Human Science Tower and steam power pressure pumps at Mechanical Engineering North, Mechanical Engineering South, Science, and Psychology.
- v) Repaired steam/condensate leak from a buried line.
- w) Upgraded HVAC controls at the Computer Center.
- x) Completed the install of power pressure pumps at ME North, ME South, Psychology, and Science.
- y) Collaborated with Utilities to develop a Demand Response Protocol.
- z) Replaced faulty variable frequency drives on two air handlers at the Education Building.
- aa) Installed Genesis Air PCP Compound in two air handlers at the Burkhart Autism Center to reduce airborne biologics and VOCs.

- bb) Reviewed construction documents for National Ranching Heritage Center, Academic Sciences Building, Talkington College of Visual Performing Arts, and the Museum to ensure HVAC systems and controls meet Texas Tech's standard for meeting energy efficiency goals.
- cc) eSight identified that the chilled water return temperature was 51°. Investigated and repaired a loose pneumatic line on the chill water bypass valve at the Classical Modern Languages and Literatures building.
- dd) eSight identified that the chilled water return temperature at Mechanical Engineering North was below the campus standard. Investigated and replaced faulty supply and return temperature sensors on the building side and the tunnel side of the chilled water system.
- ee) Replaced faulty variable frequency drive for one air handler at the Human Science Building.
- ff) Replaced faulty variable frequency drive for one air handler at Holden Hall.
- gg) Audited chilled water control system to identify differential setpoints higher than 15 psi. Science and Agriculture Education were used as test studies for reducing differential pressure and studying the effects on providing adequate cooling to the buildings.
- hh) Identified that College of Media & Communications chilled water pump was running continuously. Corrected the controls program and realized a 26% savings seen in one week
- ii) Cleaned 49 chilled water and heating water coils at four buildings: Human Science, Animal Food Science, Chemistry, and Experimental Science Building.

2. Auxiliary Space

- a) 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.
- b) 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.
- c) In FY21, replaced chilled water valves and controls at the following Housing Halls: Horn Knapp, Stangel Murdough, Gordon, and Coleman. The total Housing investment was \$113k. Savings was tracked in eSight. Housing chilled water costs reduction was \$37,335, on track for a three-year payback.

- d) eSight identified an increase in chilled water flow at the Wiggins facility. Identified that overrides were placed in the control system. 54% savings realized when overrides were removed.
- e) Upgraded 6 air handler controls at Murray Hall for energy performance and optimization.
- f) Upgraded chilled water valve controls for one air handler at Clement Hall.
- g) Upgraded chilled water and heating water system controls at Coleman.
- h) Installed HVAC controls at John Walker Soccer Complex.
- i) Upgraded chilled water system controls at Horn Knapp Hall and Stangel Murdough Hall.
- j) Replaced steam control valves at Gordon, Carpenter Wells, and Horn Knapp to provide a better service to customers for operation of heating the facility during the winter.
- k) Performed a complete control upgrade for all HVAC systems and components at the Student Union Building. Savings will be verified in FY23.
- l) Submitted a list of deficiencies in the BAS system for Student Union Building.
- m) Created a prioritized list of energy projects and recommendations for University Student Housing.
- n) Corrected the steam valve operation and setpoints at Leisure Pool reducing the usage by 16.5% (\$23,369 savings).
- o) Generated 54 HVAC work orders for specific equipment discrepancies for Athletics, United Spirit Arena, Innovation HUB, Student Wellness, and the Student Recreation Center.

3. Energy Audits

- a) Performed steam/condensate audit of condensate receivers on campus to identify buildings that are to drain. Work orders were submitted for each building identified.
- b) Performed six interior lighting audits: Academic Science Building (from construction plans), Bledsoe Gordon, Stangel Murdough, West Village, and Talkington Hall.

- c) Performed 16 exterior lighting audit: Math, National Wind Institute, Experimental Science Business, Animal Food Science, S-1 satellite, Equestrian Center, Child Development, Human Science, Black Cultural Center, Student Wellness, Honors Hall, West Village, Stangel Murdough, Bledsoe Gordon, Talkington Hall, Boston Commons.
- d) Performed 7 HVAC audits: Reese 555, Texas Tech Plaza, Hulen Clements, ESB II, USA, Coleman, and Horn Knapp.
- 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) Create a five-year plan for energy efficiency projects.
- b) Institute monthly reviews of the Equipment Down Report and Software Override Report with goals to prioritize equipment repairs that are energy intensive.
- c) Complete the recommissioning project for Murray air handlers. Replace chilled water and heating water valves and actuators.
- d) Develop a Sustainability Master Plan to administer and provide guidelines for future sustainability efforts.
- e) Utilize an Energy Brokerage Firm to help facilitate the migration from Lubbock Power & Light to ERCOT. The Firm will also assist Texas Tech System with developing a comprehensive energy master plan.
- f) Utilize the Water Side Economizer at the CHACP to achieve electric and natural gas savings when campus load allows.
- g) 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.
- h) Incorporate dashboards and alarms in eSight to assist with persistent commissioning and monitoring of building utilities.
- i) Repair steam and condensate leaks to regain efficiencies in the production of steam for heating the campus.

- j) Perform energy assessments (building models and audits) for all E&G and AUX facilities greater than 100k square footage in accordance with the Article IV Rider Section 17.11 Energy Efficiency Savings for State Facilities.
- k) Ongoing HVAC recommissioning and controls upgrades.
- l) Identify HVAC exceptions that can be better served by supplemental units.
- m) 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 CHACP1.
- n) Work with Facilities Planning and Construction (FP&C) to ensure meters are installed and integrated into eSight and Utilivisor during the construction process.
- o) Perform building audits to identify energy efficiency measures and update Building Energy Management Profiles.
- p) Systematically recommission chilled water mixing valves to increase chilled water delta T to $>16^{\circ}$.
- q) Audit steam distribution system.
- r) Identify and utilize an energy modeling software to create energy models for campus buildings.
- s) Prepare monthly or quarterly energy reports for all Auxiliary units.
- t) Identify and document sequences of operation for all HVAC systems.
- u) Implement global control commands for Demand Response, Heat Load Protocol, Freeze Protection, Occupied/Unoccupied setpoints, and Campus On/OFF.
- v) Upgrade the HVAC controls and equipment at Music, Child Development, Math, Psychology, and Animal Food Science.

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 installed 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.