

Texas Tech University Energy and Water Management Plan FY 2021 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 allow for comparisons of 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.

Due to the COVID 19 pandemic, Texas Tech closed the campus mid-March 2020. Texas Tech realized an energy avoidance of 5.23 kbtu/ft² due to energy saving measures that were implemented. Texas Tech closed out FY20 with the energy saving measures still in place.

In FY21, Texas Tech opened all university facilities. All of the energy saving measures implemented during the pandemic were removed. To provide a better service to facilities, Texas Tech increased the outside air intakes for all air handlers. Towards the end of the fiscal year, Texas Tech also installed 179 ionization units across campus.

The above COVID preventative measures cannot be directly quantified for their energy penalty. Texas Tech expected to see an increase in utility cost due to these preventative measures.

In FY21, the campus consumed 142.76 kbtu/ft², a 2.8% increase of the previous year. The goal was to consume no more than 142 kbtu/ft². Therefore, Texas Tech fell short of the goal by 0.76 kbtu/ft² for the following reasons:

- New facilities increased square footage by 164,321 ft², and decommissioned facilities decreased square footage by 6,461 ft². The net campus square footage increased by 157,860 ft². The new buildings impacted the EUI by 1.52 kbtu/ft².
- Freeze Protection Protocol: the cost of freeze protection evolutions in FY21 was \$146,761. Freeze Protection impacted EUI by 1.04 kbtu/ft². The Winter storm Uri increased our utilities cost by \$1,083,909.

- The cogeneration steam plant is operated by our electric provider, Lubbock Power & Light. During this fiscal year, LP&L connected the city grid to ERCOT, and the cogeneration steam plant needed to be inspected and corrected to the standards of ERCOT before being utilized. The cogeneration steam plant did not operate from December 2020 – July 2021. Last year, the cogeneration steam plant provided 7 million pounds of steam to the main campus. This year only 2 million pounds of steam was supplied. The reduction in steam from the cogeneration plant increased steam generation (natural gas consumption) operations in the Central Heating & Cooling Plant. The estimated loss of cogeneration steam is \$149k.
- 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 41.8 gpm in condensate loss, roughly 70% of the steam generated. This increased cost of steam generation by \$216,600.

In Table I, the campus energy use is broken down by utility type. Electricity cost increased by \$2,196,881, and natural gas cost increased by \$511,907. The net increase is \$2,789,965. Roughly 18% of the increase in utility cost is due to an increase in electricity and natural gas rates, 19% and 21% respectively.

Table I: University Energy Use (kbtu/ft²): **September '20 – August '21**

Utility	FY20 Actual	FY21 Actual	% Change from previous year	Year to Year Cost Comparison
Electricity	51.51	53.54	Up 3.9%	\$2,134,647
Natural Gas	84.30	87.53	Up 3.8%	\$655,317
Cogeneration Steam	3.02	1.69	N/A	\$0
Total	138.83	142.76	Up 2.8%	\$2,789,965

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 FY21. Table II shows the kilowatt hours per square foot (kwh/ft²) for the campus in Lubbock County.

For FY21, electrical consumption was 15.70 kwh/ft², a 1% increase compared to FY20 (15.55 kwh/ft² for the year).

The 3rd Quarter and 4th Quarter show significant increases in electrical consumption. Last year, the campus was closed due to the pandemic and HVAC equipment was

adjusted to run at a minimum where allowed. When comparing electrical consumption for the last two quarters of a year for FY21 and FY19, there is a 2.8% decrease in electrical consumption.

Table II: Campus Electricity Use (kwh/ft²): **September '20 – August '21**
(Lubbock County)

Whole Campus Electricity Use in kwh/ft²	FY20 Reference Data in kwh/ft²	2.5% Reduction Goal in kwh/ft²	FY21 Actual Consumption in kwh/ft²	Percent Increase/Decrease
1st Quarter	4.14	4.04	3.94	Down 4.9%
2nd Quarter	4.21	4.11	3.76	Down 10.8%
3rd Quarter	3.35	3.27	3.85	Up 15%
4th Quarter	3.85	3.75	4.15	Up 7.9%
Yearly Total	15.55	15.16	15.70	Up 1%

3. Fleet Fuel Management Plan (Vehicles)

Table III below compares the percent change in miles traveled for FY20 and FY21. It indicates a 53.5% increase in miles traveled which can be attributed to Texas Tech halting nonpriority travel, including research, from March to August due to COVID last fiscal year.

Table III: Miles Traveled

	FY19	FY20	FY21
Miles Traveled	2,473,481	1,895,858	2,910,896
		-23.4%	53.5%

Table IV below indicates that fuel efficiency has increased by 31.9%.

Table IV: Fuel Efficiency

	FY19	FY20	FY21
Miles per Gallon	8.34	11.00	14.23
		31.9%	29.3%

4. Water Conservation (Thousands of Gallons)

For FY21, combined water consumption (domestic and irrigation) was 261,253 thousand gallons. This is down 3.2% compared to FY20 (269,802 thousand gallons).

The significant decrease in irrigation and well water can be attributed to the increase in rainfall during this fiscal year. Lubbock County had 34.79 inches of rainfall this past year. An 89% increase compared to last year.

Table V: University Water Use (Thousands of Gallons): **September '20
– August '21**

Utility	FY20 Actual	FY21 Actual	% Change from previous year	Estimated Savings
Domestic water	232,383	233,278	Up 0.4%	(\$14,652)
Sewer	232,383	233,278	Up 0.4%	(\$23,322)
Irrigation water	37,419	27,975	Down 25.2%	\$30,617
Yearly Total	269,802	261,253	Down 3.2%	(\$7,357)

Table VI below indicates that well water consumption was 29,949 thousand gallons for FY21, a decrease of 46% compared to last year.

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

Utility	FY20 Actual	FY21 Actual	% Change from previous year
Well water	55,529	29,949	Down 46.1%

Table VII below indicates that domestic water consumption for remote sites was 4,233 thousand gallons in FY21. This was down 5.4% compared to FY20 (4,474 thousand gallons). Remote Sites domestic water rates increased by 6.8% this fiscal year.

Table VII: Remote Sites (Thousands of Gallons):

Utility	FY20 Actual	FY21 Actual	% Change from previous year	Estimated Savings
Domestic Water	4,474	4,233	Down 5.4%	(\$472)
Sewer	3,748	3,563	Down 4.9%	\$701

Table VIII below indicates that well water consumption for remote sites was 78,061 thousand gallons in FY21. This is down 25.7% compared to FY20.

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

Utility	FY20 Actual	FY21 Actual	% Change from previous year
Well water	105,088	78,061	Down 25.7%

Table IX below indicates that Central Heating and Cooling Plant #1 (CHACP 1) well water use to the cooling towers was down 9.8%.

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

Utility	FY20 Actual	FY21 Actual	% Change from previous year
Well water	146,133	131,787	Down 9.8%
Sewer	73,066	65,893	Down 9.8%

B. Energy Reduction Measures

1. Educational and General Space

- a) Free Cooling Project at CHACP 1 – The Water Side Economizer provided over 2.6 million tons of free cooling (7.3% of total chilled water produced) this fiscal year, an estimated savings of \$47,917.
- b) Back Pressure Turbine at CHACP 1 supplied 17.9% of CHACP 1’s electrical use for a cost savings of \$201,731.
- c) Receive free cogeneration steam from utility provider. Saved the University \$59,561.
- d) Improved CHACP 1 chilled water efficiencies resulting in reduced tonnage during summer operations (June-Aug), saved \$140,000.
- e) Corrected programming on the chilled water system at the Civil Engineering building. Realized savings in eSight was \$17,800.
- f) Updated chilled water controls (valves and actuators) at the Chemistry South building. Savings will be verified in FY22.
- g) Worked with vendor to solve comfort issues in the Bayer Plant Science South building, which was caused by programming of chilled water controls.

- h) Completed steam/heating water and chilled water controls upgrade at College of Media & Communication, improving overall efficiency of both systems. Savings will be verified in FY22.
- i) Secured steam to campus air handlers during Summer 2021 to eliminate simultaneous heating and cooling which would decrease efficiency.
- j) Identified the chilled water return set point was not 55° F at English/Philosophy. This was corrected and chilled water usage was reduced from \$21,000 in July to \$15,000 in August.
- k) Replaced three VFDs for heating water and chilled water pumps at the CDRC/CSAR building.
- l) Updated chilled water controls (valves and actuators) at Human Science Tower building. Savings will be verified in FY22.
- m) Identified a chilled water valve leaking by at Art 3D. The chilled water valve actuator was adjusted reducing chilled water usage from 106,000 gallons/day to 23,000 gallons/day.
- n) Followed up on the commissioning of new HVAC controls at Drane and identified a pneumatic controller that was left in manual mode at Drane Hall, resulting in excessive chilled water flow. The controller was placed back in "Auto" and chilled water flow was reduced.
- o) Identified that the supply fan for air handler unit 1 at the Plaza was running continuously. Five Star installed a VFD to allow the supply fan to adjust due to demand.
- p) Utilized the eSight system to identify an increase in domestic water usage at Mechanical Engineering North and Wiggins. The excessive use at Mechanical Engineering North was identified as a preventative measure. The excessive use at Wiggins was identified as a domestic water leak in the mechanical room.
- q) Fisheries building reduced the operating hours of their HVAC systems, reducing operating expense by \$2,700 annually.
- r) West Hall, 3rd Floor West reduced the operating hours of their HVAC systems, reducing operating expense by \$240 annually.
- s) Goddard Range and Wildlife reduced the operating hours of their HVAC systems, reducing operating expense by \$950 annually.

- t) The Daily Toreador, located in College of Media & Communications, reduced the operating hours of their HVAC system, reducing operating expenses by \$2,400 annually.
- u) Installed a condensate meter at the Art 3D building.
- v) Installed a chilled water meter at United Supermarkets Arena.
- w) Integrated 6 chilled water meters, 2 natural gas meter, 12 steam/condensate meters, 9 domestic water meters, and electrical meters into the eSight Energy Accounting System and Utilivisor.
- x) Submitted 191 workorders for discrepant air handler operations, faulty HVAC equipment, and buildings' chilled water return temperature setpoints.
- y) Replaced a VFD for an air handler's supply fan at Civil Engineering building.
- z) In FY20, Texas Tech estimated the annual savings for adding controls and setpoints for the mixing valves to allow for monitoring and control of the chilled water systems at Industrial Manufacturing Systems Engineering New to be \$72k. In FY21, eSight identified the realized savings as \$53k.
- aa) Submitted a list of deficiencies in the BAS system for new construction facilities: Weeks Hall, Experimental Sciences II, and Talkington Theater Expansion.
- bb) Identified steam/heating water inefficiencies at Electrical Engineering: leaking steam valve leaking and heating water pump not running, creating excessive temperature in heating water system.
- cc) Updated controls and valves on eleven air handler units at Reese 555.
- dd) Upgraded air handler controllers at the Administration building.
- ee) Performed a test and air balance on the chilled water system at Biology.
- ff) Replaced a VFD for an air handler's supply fan at Art 3D building.
- gg) Replaced two VFDs for two air handlers' supply fans at the Chemistry 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) Created a prioritized list of energy projects and recommendations for University Student Housing.
- d) Identified inoperable actuators for the chilled water return and bypass valves at Sneed Hall. In April 2021, JCI installed and programmed new actuators into Metasys. Estimated savings was \$111/day. Realized savings in eSight to date are \$12,500.
- e) Identified that the hot deck for an air handler in Bledsoe Hall was over temping. Troubleshooting revealed a heating water valve was stuck open. The valve was replaced, eliminating simultaneous heating and cooling.
- f) Replaced a VFD for the chilled water pump at Carpenter Wells.
- g) Replaced a VFD for the heating water pump at Gordon Hall.
- h) Replaced chilled water valves and controls at the following Housing Halls: Horn Knapp, Stangel Murdough, Gordon, and Coleman. The total Housing investment was \$113k. Facilities System will validate savings in the next fiscal year.
- i) Upgraded control components for the bypass and return valve at the Student Rec Center. Facilities System will validate savings in the next fiscal year.
- j) Replaced a VFD for the chilled water pump at Carpenter Wells.
- k) Completed steam/heating water and chilled water controls upgrade at Weymouth Hall, improving overall efficiency of both systems. USH saved \$59k in energy cost this fiscal year.
- l) Completed a project to install electronic chilled water and steam control valves for Wiggins. The realized five-month savings are \$25k.
- m) Generated 46 HVAC work orders for specific equipment discrepancies for Athletics, United Spirit Arena, Innovation HUB, Student Wellness, and the Student Recreation Center.
- n) Performed an audit of the HVAC system and controls at Murray Hall. USH will use the audit to budget work in the next fiscal year.
- o) Installed HVAC system controls for the John Walker Soccer Complex.

3. Energy Audits

- a) Performed 13 interior lighting audits: Ag Science Greenhouse, Human Science, Law School, Lanier Professional Development Center, Biology, Science, Chemistry, Administration, Music, Experimental Science, Physical Plant, Livestock Arena, and Industrial Manufacturing & Systems Engineering.
- b) Performed 11 exterior lighting audit: Stangel Murdough, Science Quad, Mathematics, National Wind Institute, Experimental Science, Student Wellness, Carpenter Wells, Honors Hall, Coleman, Chitwood, and Weymouth.
- c) Performed 19 HVAC audits: Media Communications, Rawls COBA, Law, Science, Administration, Museum, Human Sciences, Biology, Experimental Science, English/Philosophy, Education, Chemistry, Architecture, Library, Music, Murray, Chitwood, Holden Hall, and Fiber Biopolymer Research Institute.
- d) 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. The following discrepancies were identified: 4 buildings with lockouts greater than 65°, 8 buildings with lockouts less than 65°, 10 buildings that do not have a lockout setpoint, and 23 buildings that have unreliable temperature sensors. Also identified issues within some buildings' control program.
- e) In the summer, the steam/heating water mechanical systems for the following buildings were audited while steam was secured for the Summer: Rawls COBA, Electrical Engineering, Electrical Engineering Annex, Agriculture Education, Agriculture Science, Art 3D, Chitwood, Coleman, Animal Science, Housing Services, Kinesiology, Jones Stadium, Law, Law Lanier, Learning Center, Physical Plant, Student Rec Center, United Supermarkets Arena, Weymouth, and Wiggins.
- f) Review construction documents for School of Veterinarian Medicine, Mariposa Station, and Talkington College of Visual and Performing Arts Phase II.

C. Energy Reduction Plans and Feasibility Studies

Texas Tech University is currently planning energy efficiency measures including:

- a) Expand the Office of Sustainability through the creation of a Campus Sustainability Advisory Committee and develop a Sustainability Master Plan to administer and provide guidelines for future sustainability efforts.

- b) 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.
- c) Utilize the Water Side Economizer at the CHACP to achieve electric and natural gas savings when campus load allows.
- d) Retube Boiler #2 at the CHACP for reliability of capacity. Project cost is \$4 million.
- 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) Incorporate dashboards and alarms in eSight to assist with persistent commissioning and monitoring of building utilities.
- g) Repair steam and condensate leaks to regain efficiencies in the production of steam for heating the campus.
- h) 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.
- i) Ongoing HVAC recommissioning and controls upgrades.
- j) Identify HVAC exceptions that can be better served by supplemental units.
- k) 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.
- l) Work with Facilities Planning and Construction (FP&C) to ensure meters are installed and integrated into eSight and Utilivisor during the construction process.
- m) Perform building audits to identify energy efficiency measures and update Building Energy Management Profiles.
- n) Systematically recommission chilled water mixing valves to increase chilled water delta T to $>16^{\circ}$.

- o) Audit steam distribution system.
- p) Identify and utilize an energy modeling software to create energy models for campus buildings.
- q) Prepare monthly or quarterly energy reports for all Auxiliary units.
- r) Identify and document sequences of operation for all HVAC systems.
- s) Implement Heat Load Protocol to optimize air handler runtime during extreme temperatures in the summer.
- t) Monitor energy usage at Chemistry South, Media Communications, Human Science Tower, Student Rec Center Track, Horn Knapp Hall, Stangel Murdough Hall, Gordon Hall, and Coleman Hall to verify estimated savings for each project.
- u) Upgrade the HVAC controllers at the Student Union Building.

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.