

# Detailed Monitoring and Engineering Oversight at Texas Tech University

Don Moore and  
Ken Scheepers

2.3  
kWh/sqft



**CampusEnergy2020**

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Green  
2.0 kWh/sqft

Current  
2.3 kWh/sqft



utiliVisor<sup>southwest</sup>



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## Agenda



- Utilities on the Texas Tech University Campus
- Accomplished by the Texas Tech Team
- The Logical Next Step
- utiliVisor Southwest
- Next Steps for Texas Tech University as a Result of the Detailed Monitoring

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## Mission

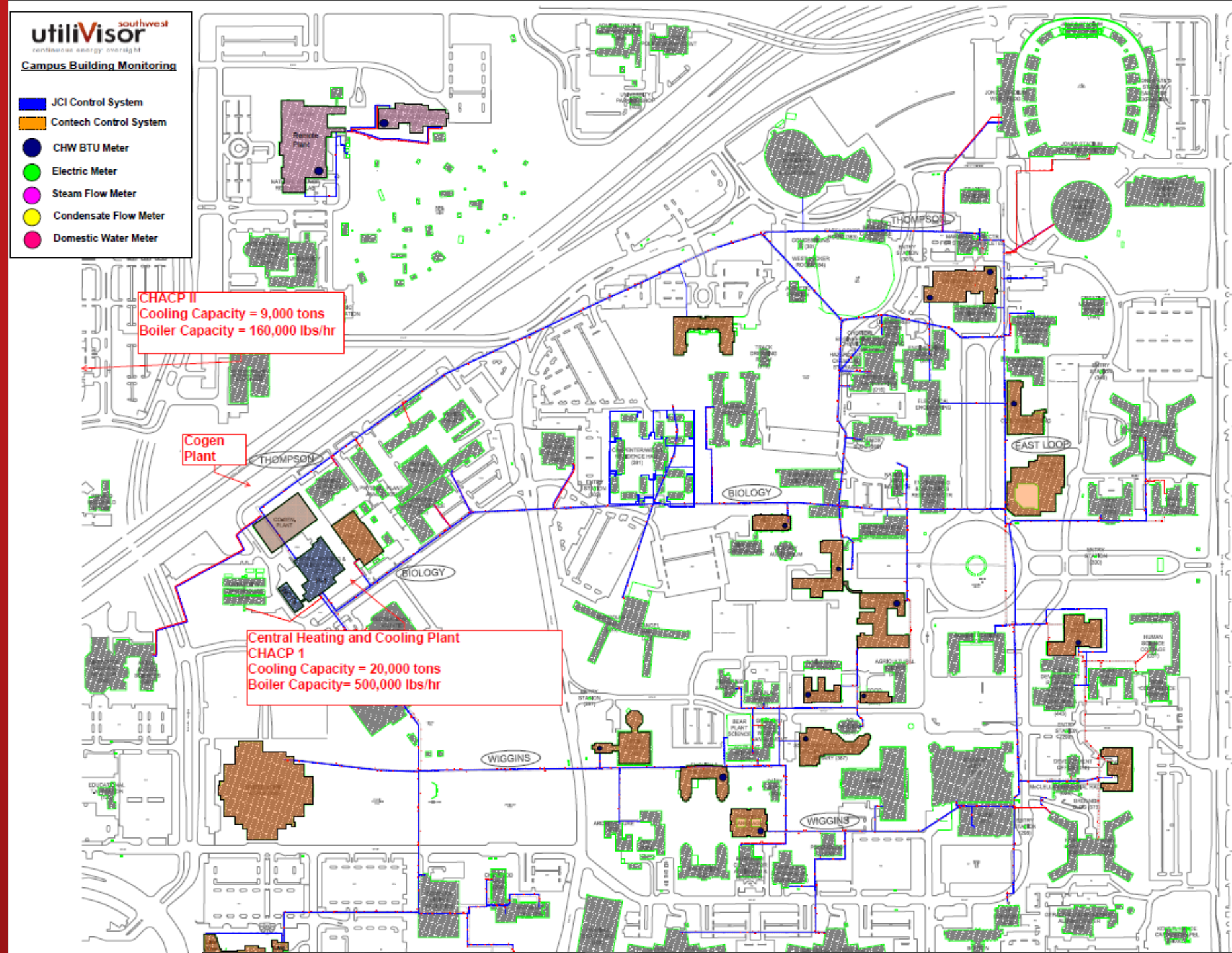
Texas Tech University Utilities provides steam, chilled water, compressed air, and treated water to:

- Texas Tech Campus
- Texas Tech Health Sciences Center
- University Medical Center
- The Texas Tech University Museum



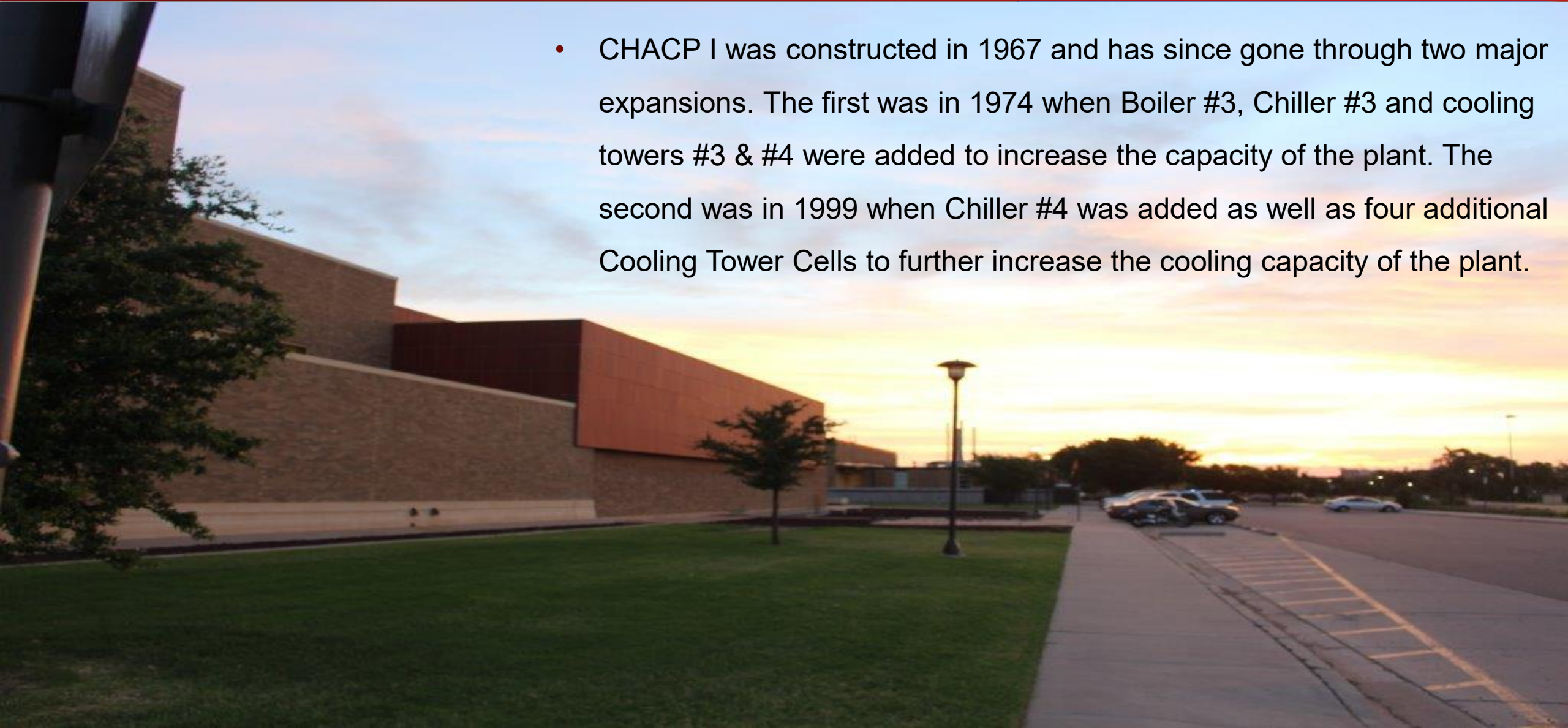


# Utilities on the Texas Tech main Campus



# Central Heating and Cooling Plant (CHACP) # 1

- CHACP I was constructed in 1967 and has since gone through two major expansions. The first was in 1974 when Boiler #3, Chiller #3 and cooling towers #3 & #4 were added to increase the capacity of the plant. The second was in 1999 when Chiller #4 was added as well as four additional Cooling Tower Cells to further increase the cooling capacity of the plant.





## Central Heating and Cooling Plant (CHACP) # 2

- CHACP II was constructed in 1974 to provide steam and chilled water for heating and cooling services to the Texas Tech University Health Sciences Center and the University Medical Center



# Brandon Station, Co-Generation Plant

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- The plant is attached to a simple cycle cogeneration plant, that when ran, supplies up to 40,000 pph of steam for free.
- The plant and campus are attached to electrical infrastructure owned by the local utility company.
- Texas Tech does not currently pay a demand charge.



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Keys to  
Continued  
Success with  
the Texas  
Tech  
University  
Campus

- Training of operations engineers. Texas Tech University has taken a ground up and long-term approach to enhancing our operations team; which has been one of the main keys to our success.
- Extensive training for instrumentation personnel was performed to allow in-house tuning and programming changes.
- Leveraging the systems in place to document and track successes has motivated the team for continued growth.



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## Next Steps

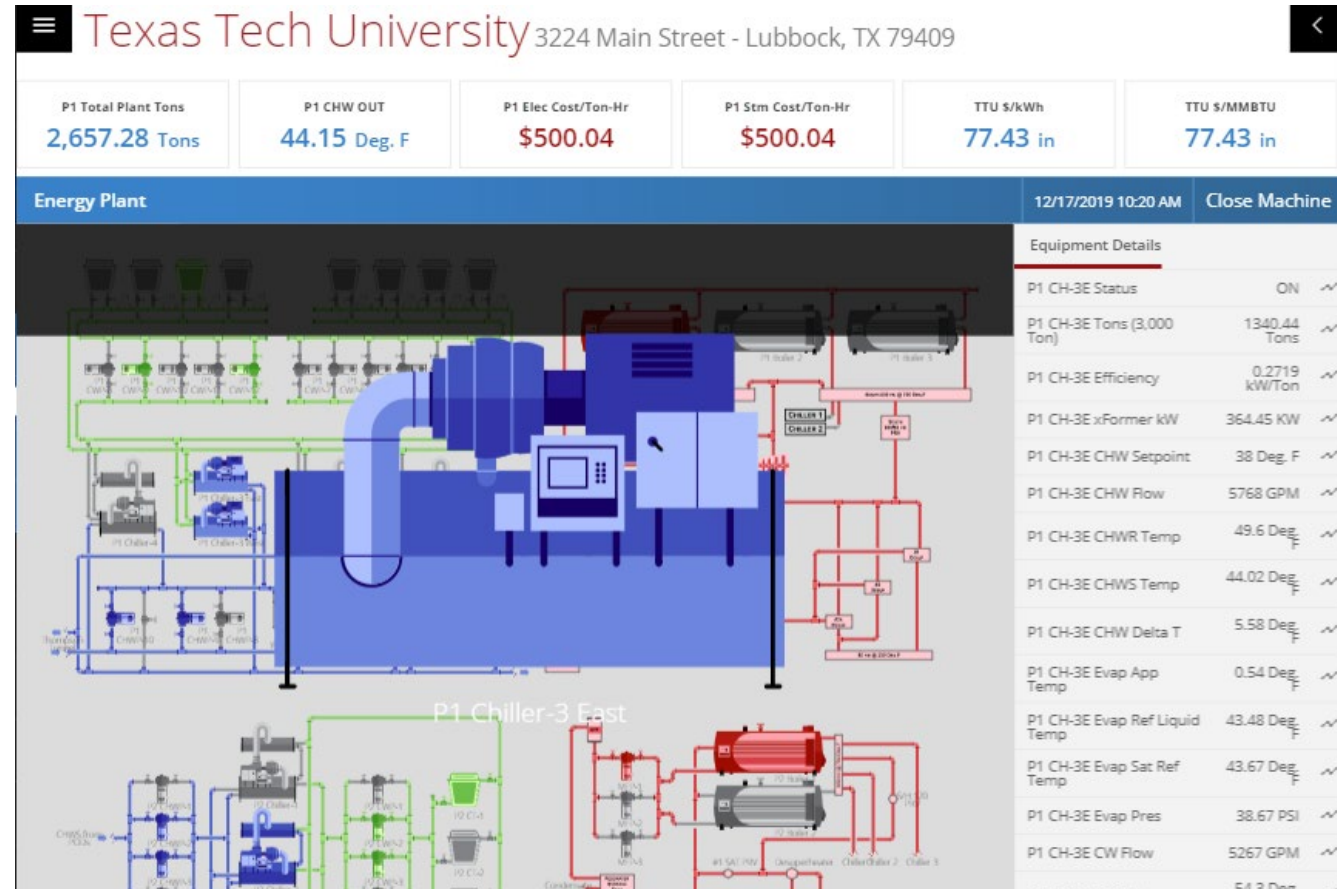
- In 2015, Texas Tech University agreed to a 3-year performance contract with TDIIndustries, a licensee of utiliVisor to provide continuous energy oversight to the plants.
  - Due to the complexity of the two systems, Texas Tech University and TDI/utiliVisor agreed on a one-year period to establish the plants actual operating baselines.
  - Within 9 months, utiliVisor established the baselines and began providing recommendations.
- TDI/utiliVisor met the performance contract requirements ahead of the required time, and to date, the energy savings has surpassed \$2.2M.
- Aligned with Texas Tech University's goals; utiliVisor continues to identify issues and increase plant reliability and efficiency.

# Accomplished by the Texas Tech University Operations Team - CHACP Efficiency

## Plant Retrofit

In Spring of 2016, two 3100 ton electric chillers replaced on inefficient steam turbine centrifugal chiller:

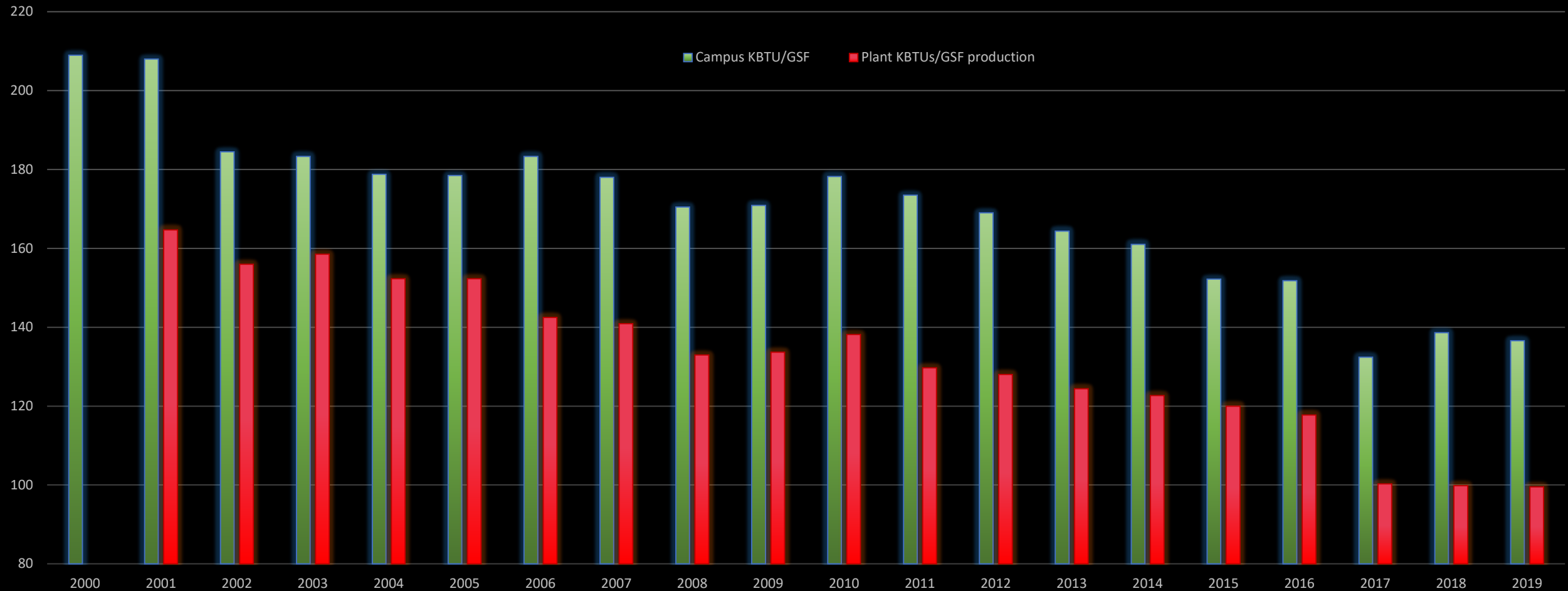
- Electric and Gas Energy Sources may be chosen based on pricing
- Smaller units allow for more efficient use of cooling capacity when lower volumes of chilled water are required.
- Lower Reduced maintenance costs
- Quick startup
- Reduction of installation cost; versus another steam chiller
- Aligned with Texas Tech University's sustainability efforts





# Trends – Campus and Plant Energy per Gross Square Foot

2000 - 2019 Texas Tech University Central Plant #1 and campus KBTUs/GSF



# The Logical Next Step – Implementation of utiliVisor Southwest



## Holistic Approach

Complete audit and analyzation of CHACP 1+ CHACP 2 and campus distribution.



## Unique Site Conditions

The unique conditions of each site are addressed including equipment constraints / challenges, people, and capital requirements.



## Patented Technology & Customized Analytics

utiliVisor's patented technology is supported with engineering expertise from our Operations Center.

## Continuous Energy Oversight from our Operations Center

Consistent monitoring of systems and data ensure performance goals are met and new savings opportunities are realized even in an ever-changing environment.

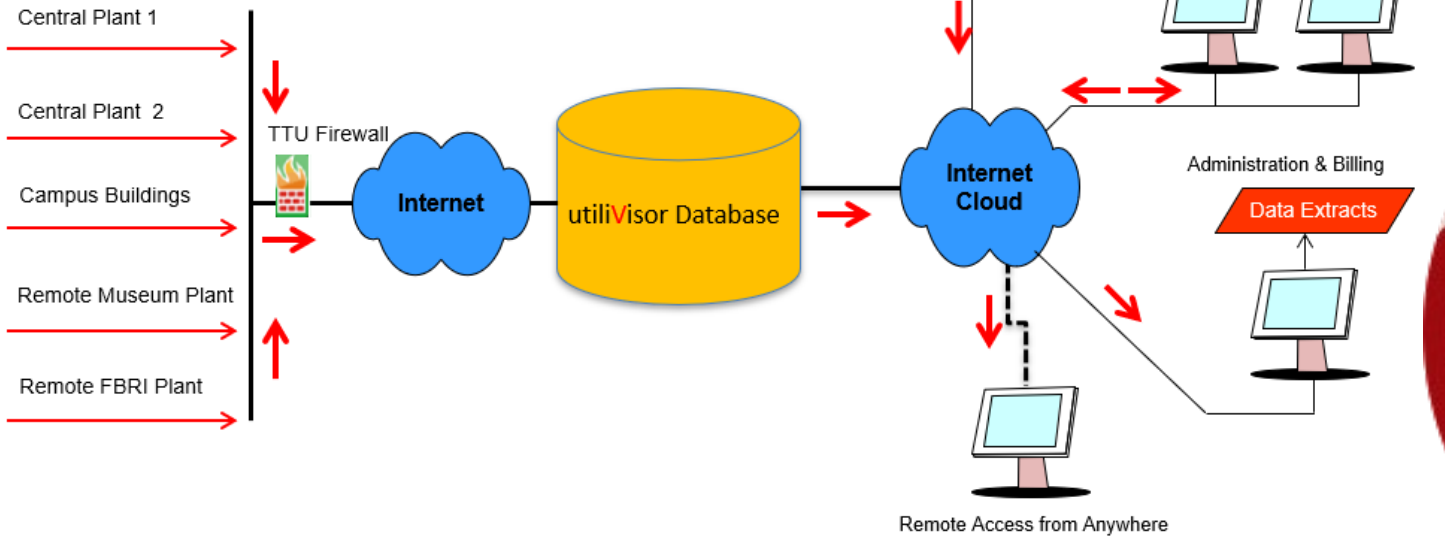




# Our Process

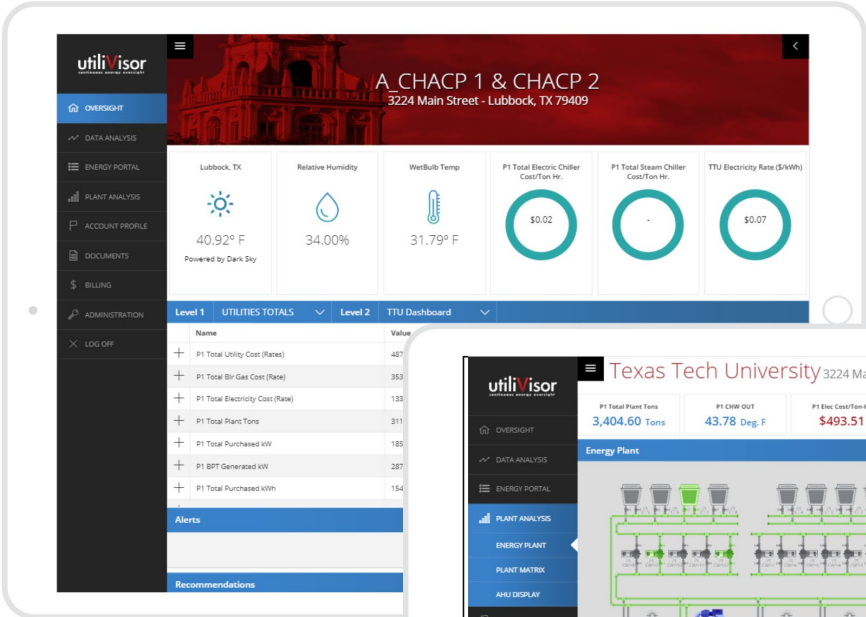
## Data Flow

Texas Tech University Equipments & Controls Systems export one-way data

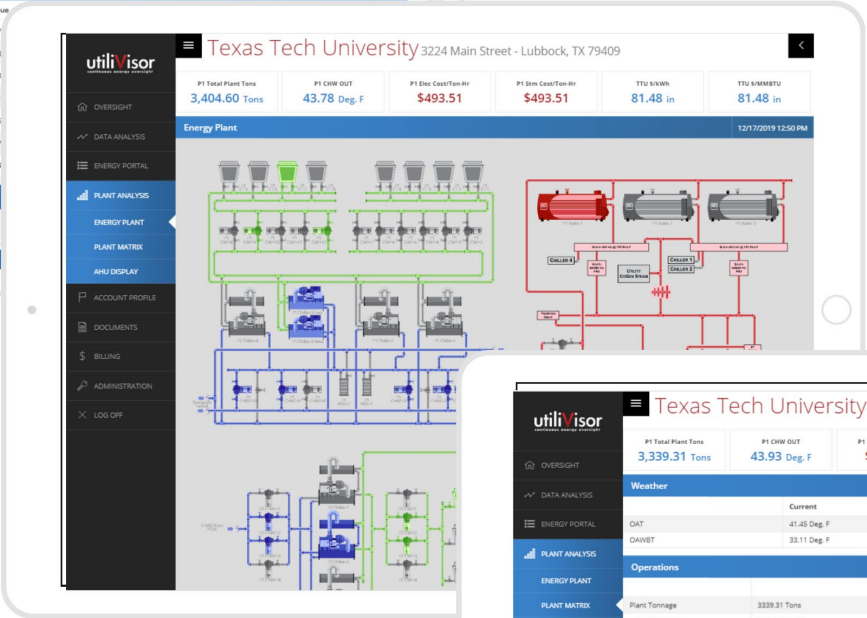


0.72  
kw/ton

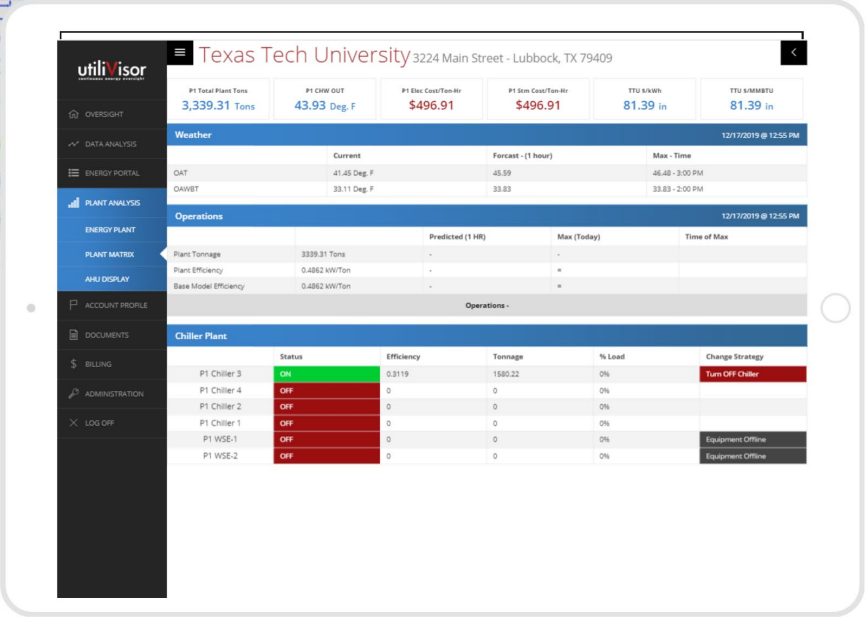
Deliverables



Oversight



Plant Analysis



Energy Plant Matrix



# Energy Conservation Measures and Savings

Carrier Minimum Speed Savings

From: Chris Angerame

Subject: Carrier Minimum Speed Savings

Date: 12/16/2019 1:17 PM CST

Attachment: TTU\_CH-3 Min Speed.PNG

Don,

Monitoring Chiller 3E/W ops since 11:15 AM today, I wanted to highlight the attained savings the team has made from from reducing the minimum speed setpoint again to 65% from August 2018. This is also in combination with the oil lineup issue you and your team discovered and corrected, that was noted in utiliVisor by high approach temperatures.

Chiller 3E = 456,566 kWh (overall efficiency improved from 0.44 to 0.4 kW/ton)

Chiller 3W = 411,991 kWh (overall efficiency improved from 0.43 to 0.388 kW/ton)

Total Savings from 8/2018 = 868,557 kWh\*

\*Note: I normalized for tonnage and entering condenser water temperature for each 5 min interval or order to show specific savings for this ECM only.

At \$0.07/kWh this represents \$60,799 saved

Great job again! I have attached a data analysis graph for the month of December indicating the increased operating hours @ 65% speed.

Regards,

Chris Angerame

TTU\_CH-3 Min Speed.PNG

Click here to reply.

A\_CHACP 1 & CHACP 2

3224 Main Street - Lubbock, TX 79409

Data Analysis

CA-Carrier VFD Speed

12/1/2019 12:00 AM to 12/16/2019 11:59 PM

Stats

Average

P1 CH-3E VFD Speed 66.21 %

P1 CH-3W VFD Speed 65.54 %

Maximum

P1 CH-3E VFD Speed 99.03 %

P1 CH-3W VFD Speed 98.72 %

Minimum

P1 CH-3E VFD Speed 0.10 %

P1 CH-3W VFD Speed 0.10 %

Sum

P1 CH-3E VFD Speed 270,396.54 %

P1 CH-3W VFD Speed 267,650.82 %

Extended Stats

Graph must be saved before loading extended stats.

Mon December 16, 2019 12:40 pm

P1 CH-3E VFD Speed: 65.50 %

P1 CH-3W VFD Speed: 66.10 %

100

90

80

70

60

50

40

30

20

10

0

Dec 4

Dec 6

Dec 8

Dec 10

Dec 12

Dec 14

Dec 16

P1 CH-3E VFD Speed

P1 CH-3W VFD Speed

# Energy Conservation Measures and Saving

## P2 CWS Temp/CT kW vs. Turbine Speed

From: Chris Angerame

Subject: P2 CWS Temp/CT kW vs. Turbine Speed

Date: 12/17/2019 1:42 PM CST

Attachment: TTU\_P2 Tonnage vs. Turbine Speed.pdf

Afternoon All,

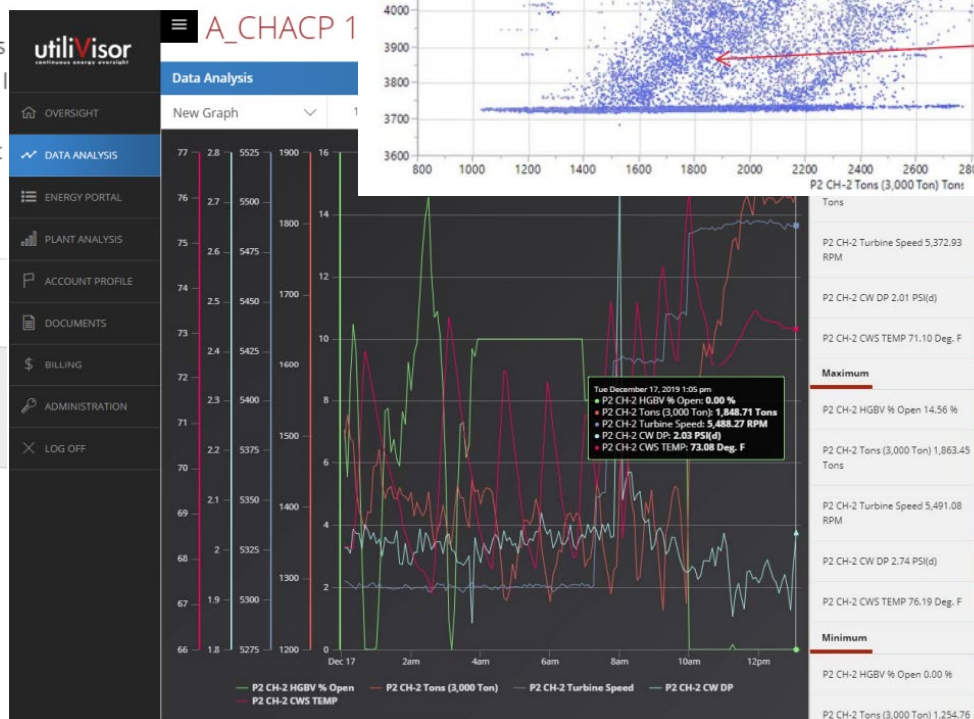
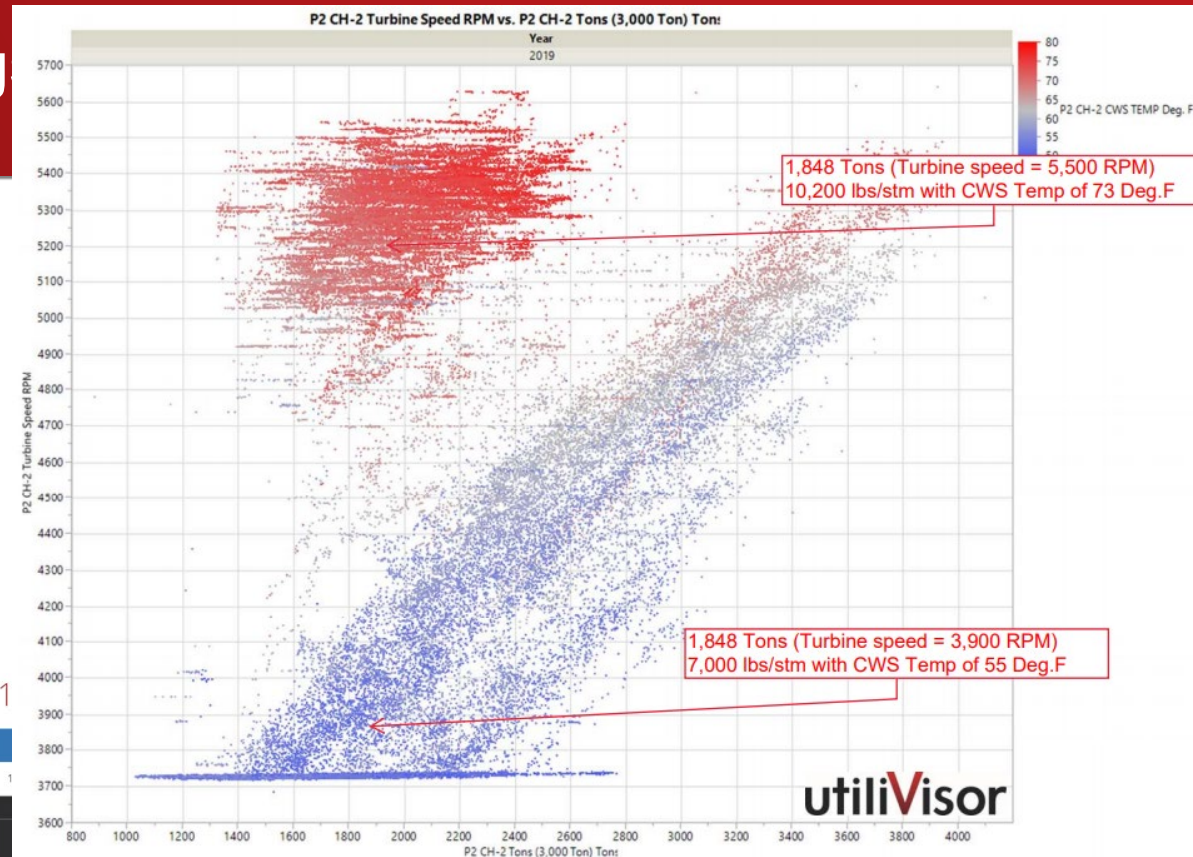
I will be sending an agenda for tomorrow's meeting shortly but wanted to discuss the elevated condenser water supply temperatures in P2.

1. Are all three cells receiving CW Flow or just CT-1?
2. Even though we are showing CT Fan speed, all kW's have been recording 0 kWh. We are determining fan status by kW and not speed (can you confirm if this is correct).
3. At the current tonnage (coupled w/ the increased CWS temperatures) you will notice the turbine speed is maintaining much higher RPMs compared to previous ops.
4. The Hot Gas Bypass appeared to have opened at ~50% Load (even though the speed was has the minimum speed (3,700 RPM) been adjusted for safety reasons? At this particular I expect the RPM around 3,900 RPM (please refer to the attachment).
5. At similar OAWBTs we would only expect the CT kWh to increase by ~50 kWh (breakpoint

Regards,  
Chris Angerame

[TTU\\_P2 Tonnage vs. Turbine Speed.pdf](#)

[Click here to reply.](#)





# Energy Conservation Measures and Savings

☰ A\_CHACP 1 & CHACP 2 3224 Main Street - Lubbock, TX 79409

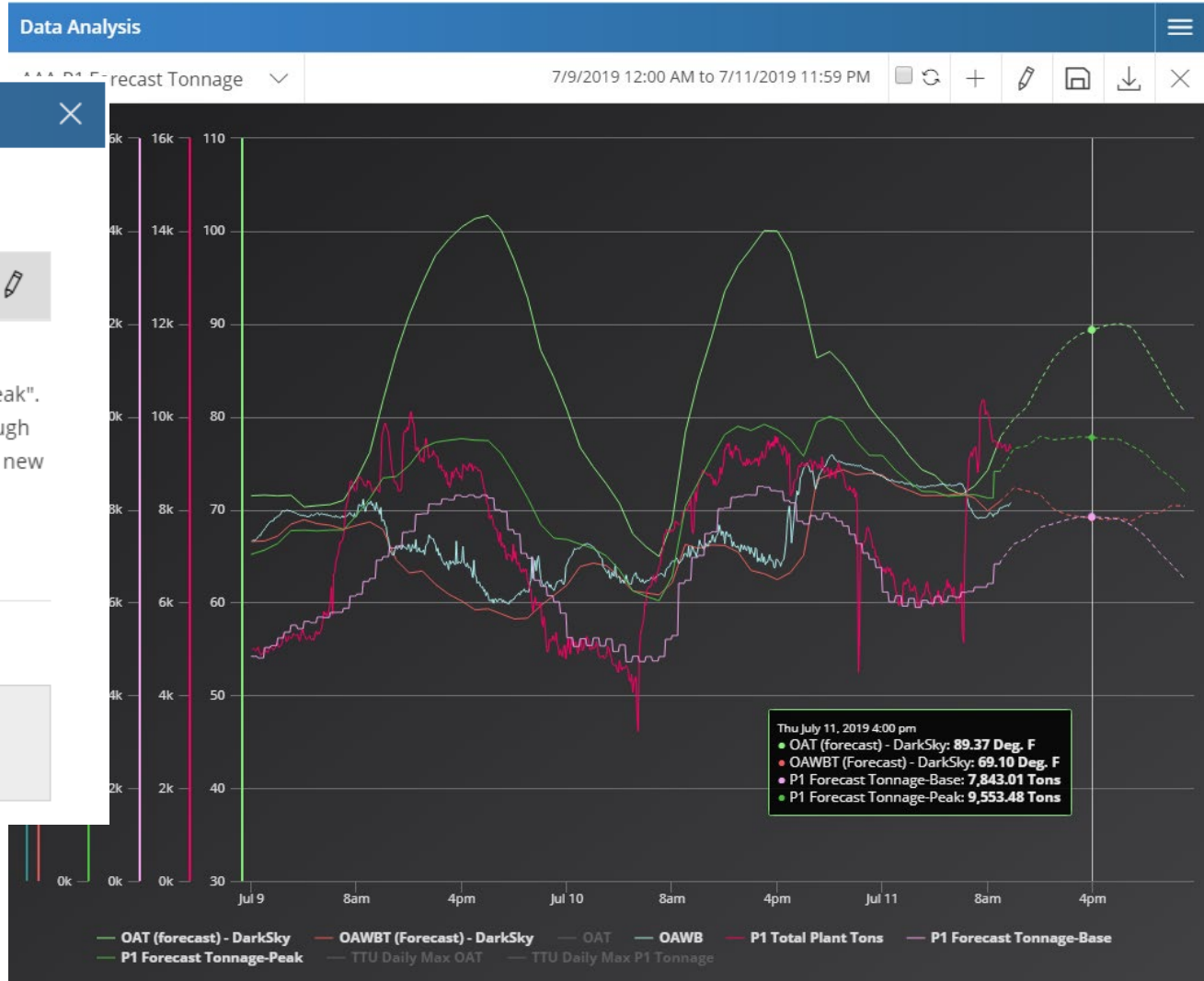
## Updated P1 Forecast Peak

**From:** Chris Angerame  
**Subject:** Updated P1 Forecast Peak  
**Date:** 7/11/2019 10:16 AM CDT  
**Attachment:** TTU\_Forecast Peak.PNG

Afternoon All,  
For your review, I have added an additional P1 Forecast Tonnage point named "P1 Forecast Tonnage-Peak". Per our last conversation, I am trying to account for the additional tonnage when water is running through an offline chiller. I will monitor for a few days and provide feedback (the morning alert now reflects this new tonnage)  
Regards,  
Chris Angerame

📎 [TTU\\_Forecast Peak.PNG](#)

[Click here to reply.](#)



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## Next Steps

- University leadership recognized that real optimization would require detailed monitoring and engineering oversight
- Texas Tech University wanted to leverage the experienced and detailed engineering staff; while simultaneously growing the knowledge of their team with the collaboration of a third party.
- Leverage the Investment in the existing equipment and systems
- Implement a predictive element
- Accurately cost justify and show real metered paybacks on plant projects
- Centralize meter collection process
- Provide greater transparency and visualization of energy consumption



# Thank You

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