THE EVOLUTION OF THE UT AUSTIN UTILITY PLANTS

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Presentation Objectives

• UT Austin’s Philosophy for Cooling
• UT’s Actual Historical Performance
• Impact to Power Generation
• VFD vs Constant Speed
• Next Steps
Holistic Approach to Total Energy
Evolution of Optimization

2007
45K Tons - Eliminate Steam Turbine Chillers, Add 15K Electric Chillers w/VFD’s but no Optimization

Annual Average kW/ton = 0.84
15 million GSF
MW = 59, Tons = 29.3k, Steam = 200k

2008
45k Tons - Start Optimizing 15K ton plant

Annual Average kW/ton = 0.80
15.9 million GSF
MW = 60, Tons = 33.1k, Steam = 190k

2009
Evaluate Distribution DP control and VFD Pumps at CS3

Annual Average kW/ton = 0.77
15.9 million GSF
MW = 62, Tons = 34k, Steam = 191k

2013
Optimize Multiple Plant Dispatch, Reduce DP to 10 to 4 psi (summer vs rest of year) (4 plants)

Annual Average kW/ton = 0.66
17.9 million GSF
MW = 61, Tons = 33.4k, Steam = 188k

2014 – 2017
Start Using 4 MG TES

4-year Average kW/ton = 0.66
18.3 million GSF
MW = 61k, Tons = 33.6k, Steam = 203k

2018 - 60k Tons
Add 15k All VFD Plant, Add VFD to 5k ton OM Chiller, Start Using 6 MG TES

Annual Average kW/ton = 0.615
19.6 million GSF
MW = 65, Tons = 38.3k, Steam = 240k

Total Cumulative Saved:
509.6K MWh
$21.3 Million
Peak MW Adjusted for Space Growth

- 2007: 59
- 2008: 60
- 2009: 62
- 2010: 64
- 2011: 65
- 2012: 66
- 2013: 70
- 2014: 70
- 2015: 70
- 2016: 70
- 2017: 77
- 2018: 77
- 2019: 59

Actual Peak MW

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Utilities and Energy Management
Performance To Date vs Last Year

- Using Both TES for First Time (80,000 ton-hrs)
- Started TES & Chilling Station Optimization
  - Working through transitions:
    - Charging to Discharging & Vice Versa
    - Multiple Chilling Station Dispatch
  - Optimize Power Generation vs Chilled Water Production
    - Shift load to Nighttime – Increase Electrical Generation Efficiency (~3% Better)
- Peak Electrical Load and Cooling Load is August to September
  - Peak Power = 59 MW vs last year at 65 MW
  - Peak Cooling Demand = 34,118 vs last year at 38,300 (includes TES Dispatch)
  - 30,000 tons are Spare (CS3, CS4 & 5-2500 ton Chillers at CS7)

Goal is to Absorb Campus Growth With No New Plants
2017 vs 2019
First full use of both TES

3 Month Average

<table>
<thead>
<tr>
<th>kW/ton</th>
<th>2017</th>
<th>2018</th>
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<tbody>
<tr>
<td>kW</td>
<td>0.614</td>
<td>0.533</td>
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<tr>
<td>for Cooling</td>
<td>8,874</td>
<td>8,340</td>
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<tr>
<td>Tons</td>
<td>12,905</td>
<td>13,599</td>
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- 2017 kW_Ton (kW/Ton)
- 2019 kW_Ton (kW/Ton)
Total MW
2016 Limited TES vs 2018 Two TES

Peak Load Reduction (4 MW Average Reduction)
Generation Flatter (Day vs Night)

+2 million GSF in 2018
Thermal Energy Storage (Total UT CHW Plant Electric kW)
Perform two regressions:

**Campus Base MW Use**
- More time of day and day of week driven
- Less weather driven

**Chiller Plant MW Use**
- Majority weather driven
- Less time of day and day of week driven

Sum together to get a total predicted MW value
OAWB versus Base Campus MW (No Chiller Plant Load)

Some weather related increase in MW, but not much.
BASE MW LOAD – TIME AND DAY DEPENDENT

Saturday and Sunday
Chiller plant MW Use is highly weather dependent
UT Campus MW Actual versus Predicted

January – December
1. Accuweather offers 36 hrs of predicted Wet Bulb temperatures
2. We can forecast campus MW, Tons, number of chillers running, chiller add/shed events, TES discharge rates, TES charge rates, etc
3. From the data we can provide operators with a 36 hour look ahead for TES charging and discharging and chiller dispatch
Questions?

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