Optimizing Strategies Through Effective Modeling

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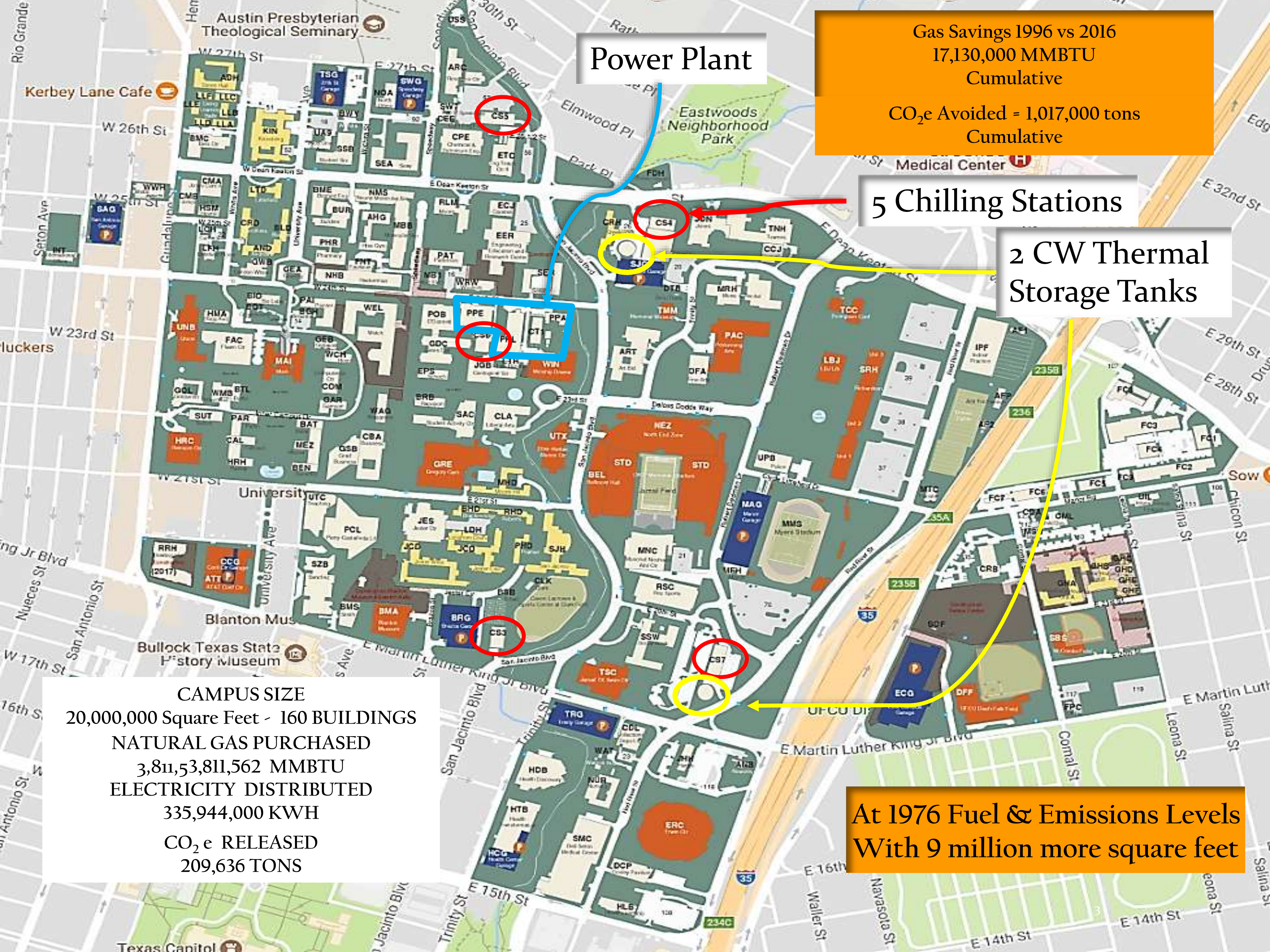
ASHRAE
EBC Energy in Buildings and Communities Programme
U.S. DEPARTMENT OF ENERGY

Background

- 100% power, heating and cooling requirements for 20 million sf and 150+ buildings
- Power Plant
  - 135MW of on-site Combined Heat and Power (65 MW Peak)
  - 1.2 million lb/hr of steam generation (300K Peak)
- Chilled Water
  - 60,000 tons capacity in 5 plants (33K Peak)
  - 9.5 Million Gallons - 2 Thermal Energy Storage Tanks
- 9 miles of distribution tunnels
- 30 Miles of electrical ductbanks
- 5 campus wide outages in 54 years
- 84% to 87% Average Annual Thermal Efficiency

$60 million Annual Budget



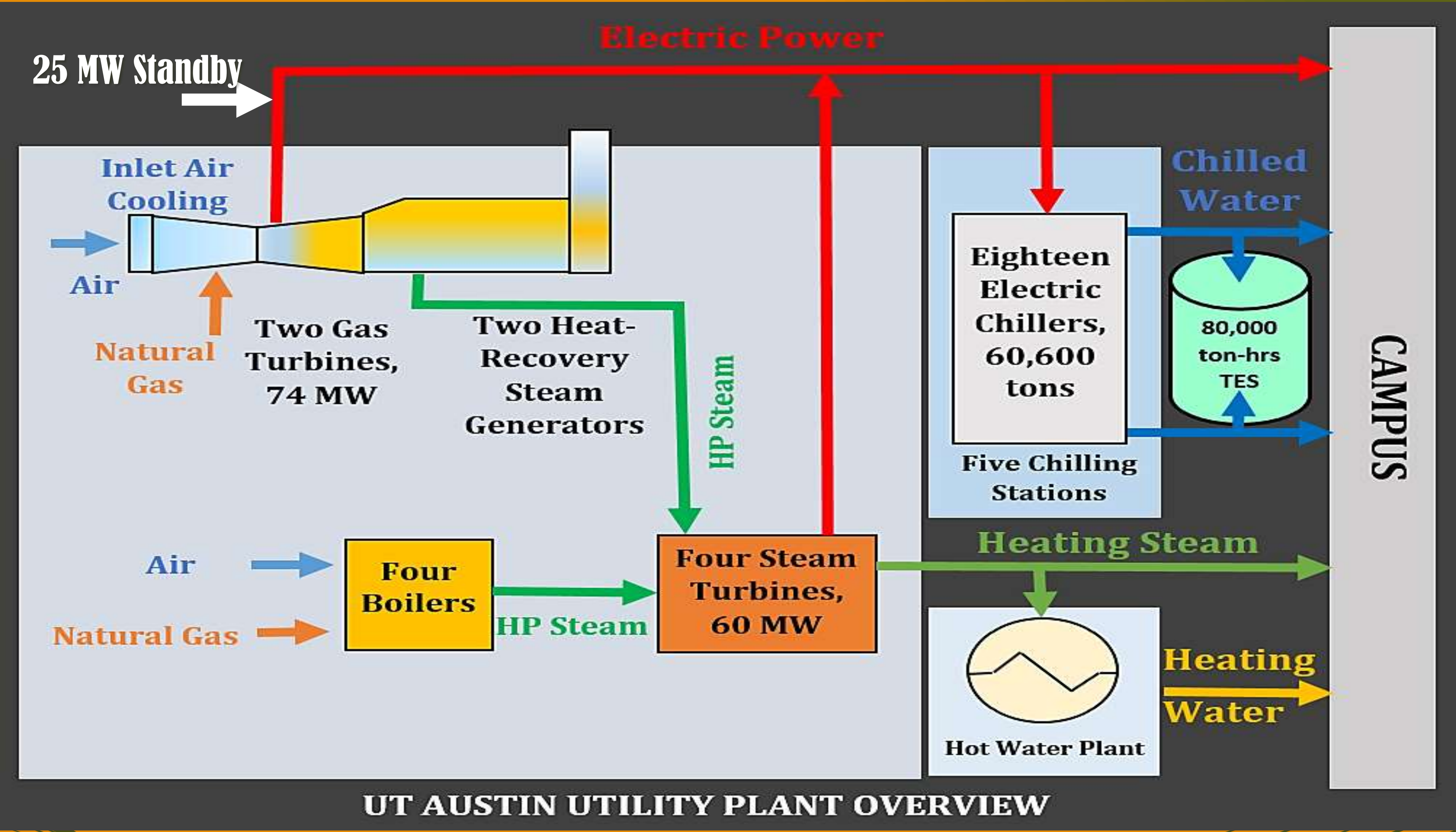
Power Plant
Gas Savings 1996 vs 2016
17,130,000 MMBTU
Cumulative
CO_2e Avoided = 1,017,000 tons
Cumulative
5 Chilling Stations
2 CW Thermal Storage Tanks
CS1
CS3
CS4
CS5
CS7
CAMPUS SIZE
20,000,000 Square Feet - 160 BUILDINGS
NATURAL GAS PURCHASED
3,811,53,811,562 MMBTU
ELECTRICITY DISTRIBUTED
335,944,000 KWH
CO_2 e RELEASED
209,636 TONS
At 1976 Fuel & Emissions Levels
With 9 million more square feet
Austin Presbyterian Theological Seminary
Kerbey Lane Cafe
Eastwoods Neighborhood Park
Medical Center
Blanton Mus
Bullock Texas State History Museum
Texas Capitol

Performance Features

- Largest Microgrid in the United States
- Ability to 100% Island all Power at will
- Net Zero Power to ERCOT Grid plus
  - Real-Time Load Balancing for Steam and Chilled Water
- 25 MW Stand-By power from Grid
- N+2 Redundancy for Power via Substation and Stand-By
- 2 Independent High Pressure Gas Mains to Plants
- Instantaneous Load-Shed built in for
  - Excess Steam
  - Excess Power
  - Chilled Water Thermal Storage (for back-up and load shifting)

Performance Features

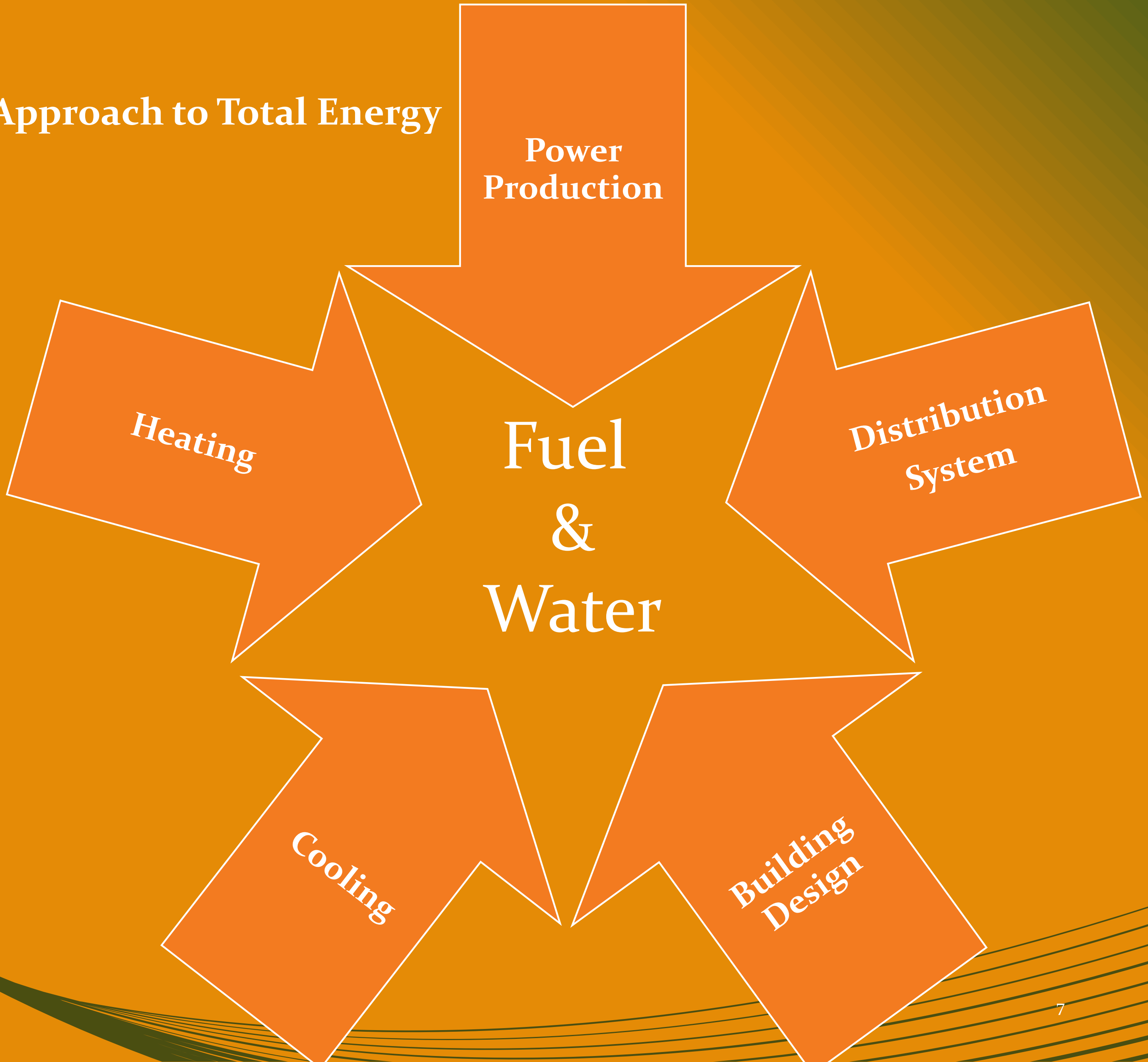
- Real Time Energy Modeling
  - Chilled Water Distribution
  - Overall Energy Balance
- Optimization
  - Chilled Water System (Average .65 kW/Ton Annual Average)
  - Heat Rate (9,140 Btu/kW Annual Average)
- Real Time Plant Condition Monitoring (BNF Plant Health Index)
- All Buildings - Dual Connections for Electricity, Steam & Chilled Water
- Meter 95% of all Campus Facilities (900 meters – electricity, steam, chilled water and domestic water)


Electric Power
25 MW Standby
Inlet Air Cooling
Air
Natural Gas
Two Gas Turbines, 74 MW
Two Heat-Recovery Steam Generators
HP Steam
Eighteen Electric Chillers, 60,600 tons
80,000 ton-hrs TES
Five Chilling Stations
Chilled Water
CAMPUS
Air
Natural Gas
Four Boilers
HP Steam
Four Steam Turbines, 60 MW
Heating Steam
Hot Water Plant
Heating Water
UT AUSTIN UTILITY PLANT OVERVIEW

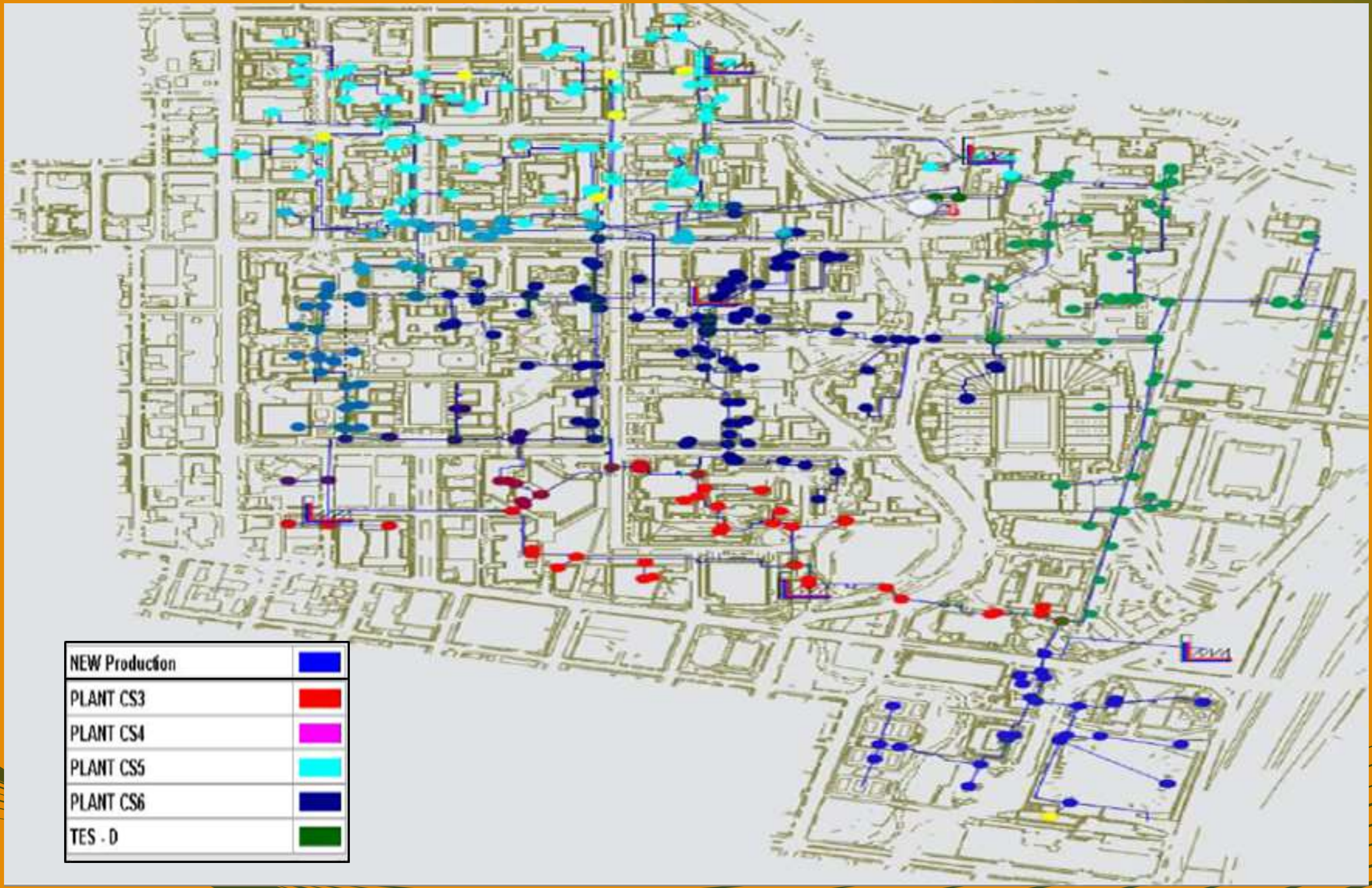
Modeling/Optimization

- Termis
  - "Real Time" Chilled Water Model
  - Static Steam Model
- Optimum Energy
  - OptiCx – "Real Time" Chilled Water production and distribution optimization
- Energy Portal
  - "Real Time" and historic metering for 95% of space for electricity, chilled water, heating and domestic water
  - Track Energy Utilization Indices, CO_2e and Annual Cost for 160 buildings
- Hanara
  - Prism Historian
  - Plant Health Index – "Real Time" Asset Condition Monitoring
- Other Models
  - Domestic & fire water distribution
  - Sewer, storm water hydraulic

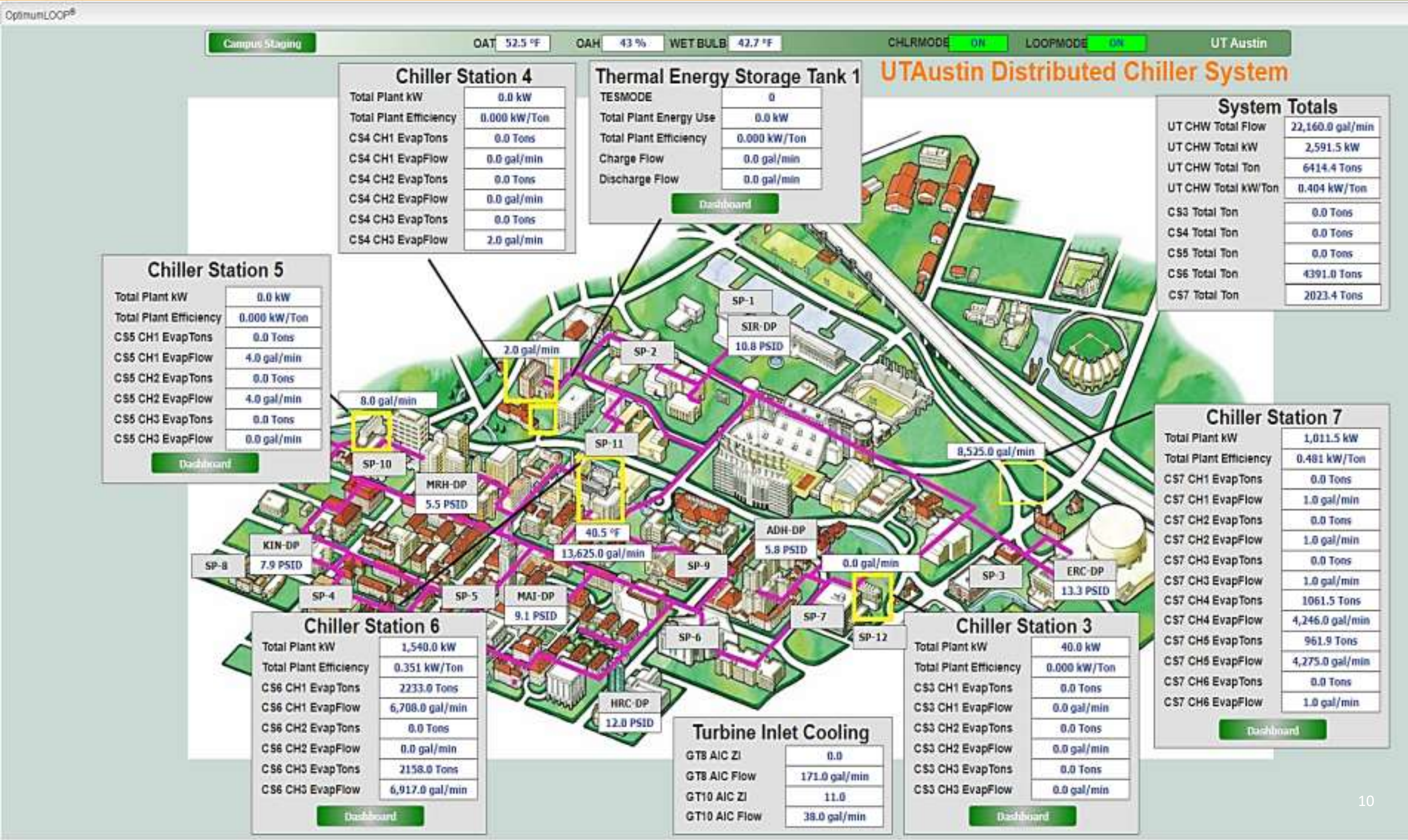
Holistic Approach to Total Energy



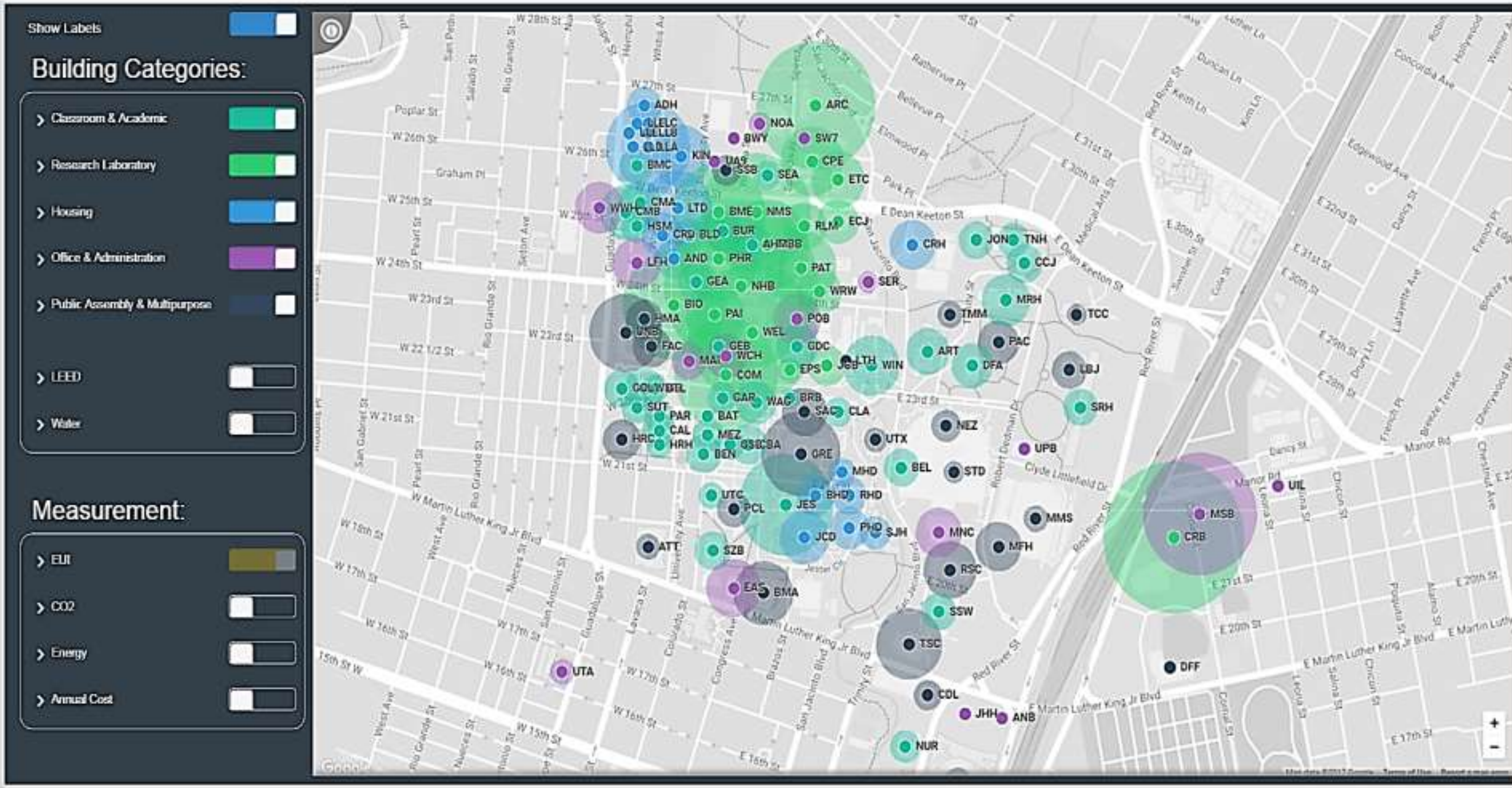
Chilled Water Model at Peak Conditions Indicating Pressure Zones



Chilled Water Production/Distribution Optimization



Energy Portal



Historian Objectives

Avoid This

1 Challenge

Deficient Data Agility Hindering Efficient Operation

Historian engines not only collect and deliver real-time data generated from sensors embedded in each piece of equipment, but historians also store all of the collected data in servers. Despite the highly advanced hardware at the Hal C. Weaver Power Plant, the traditional historian software often took minutes to load recorded data or execute analytics. When abnormal equipment behavior or accidents occur during plant operation, operators, engineers, and managers often load months or years of historical data for detailed analysis. With limited capabilities, the existing historian took too much time to load, search, and analyze the data.

2 Challenge

Missing Critical Operational Data Leading to Misguided Decisions

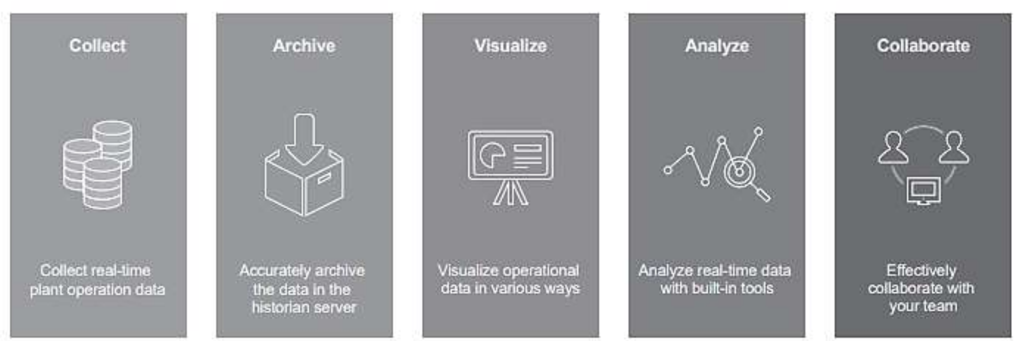
Every second of a power plant's operation is critical. Assets across the plant floor transmit vast amounts of data. Historians continuously collect and store this abundant data. Plant operators monitor and analyze the process data to draw intelligence. Therefore, every piece of data must be collected without loss. The accuracy and completeness of data directly impacts the stability of the power plant. Existing historian software occasionally displayed incomplete and fragmented data records. Incomplete data sets may have critical ramifications for gaining accurate intelligence.

3 Challenge

Limited Scalability, Limited Intelligence

Process plants utilize various tools to improve their operational process and efficiency. A plant needs a variety of third-party applications to monitor and analyze data collected from the historian. Therefore, a historian must deliver the process data to external systems to help the plant gain additional intelligence. The existing historian software provided a limited bridge to external systems. With limited scalability, the UT Austin energy complex had limited access to intelligence and operational efficiency.

Get This



HanAra Software

"Real Time" Asset Management

HanPHI, a powerful predictive analytics software, identifies impending equipment failure days, weeks, or months in advance. This intelligent software learns, models, and analyzes data to provide actionable early warnings to plant operators, engineers, and managers before a catastrophic failure occurs. With HanPHI, plant personnel implement predictive maintenance, keeping their valuable assets in optimal condition.

Plants are constantly exposed to the risk of unscheduled downtime. Failure to identify the point of equipment failure in advance requires extra time and resources to locate the cause. Other technologies provide warnings only seconds or minutes before imminent failure. With limited warning time, the plant may not have enough time to successfully react to critical failures.

With HanPHI's actionable information about the time and point of potential and hidden failures given well before an incident, HanPHI users can thoroughly prepare for impending failures.

HanPHI allows you to monitor the condition of all your equipment at a glance. HanPHI continuously monitors and identifies anomalies across assets and provides early warnings of impending equipment failures.

Our intelligent predictive-modeling and health-indexing technologies make HanPHI a powerful solution that has significant benefits for plant operations. Early warnings identify areas for predictive maintenance, reducing maintenance costs, unscheduled downtime, and equipment failures. With HanPHI, you can eliminate potential operational risks, extend equipment lifecycles, and increase asset reliability, efficiency, and safety within your limited budget.

Predictive Monitoring Solution

Plant

DCS/PLC/SCADA

Process Variable

Predictive Data Modeling

Expected Values

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Residuals

Equipment Health Index

SuccessTree

Plant Heath Index

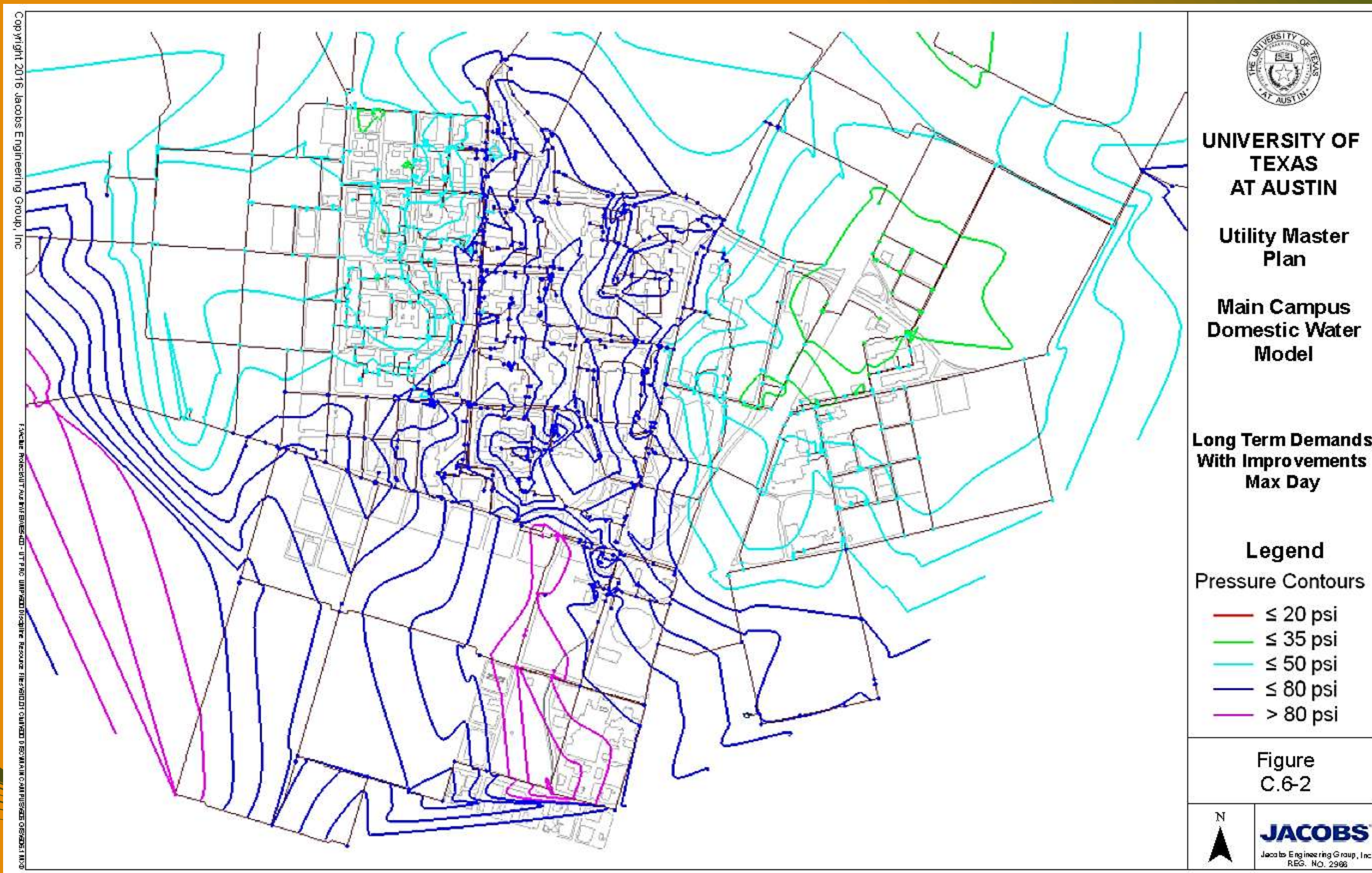
Early Warning

Tracing a Cause of Anomalies

Entire Plant Monitoring

YOU

Domestic Water Model



Waste Water Model