
CASE STUDY

# Modernization of Control and Information Infrastructure for a Utility Plant Control System

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CampusEnergy2020
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UTILITIES & ENERGY SERVICES
TEXAS A&M UNIVERSITY

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**Session 1E**: Models Tools & Connected Plants

# OVERVIEW

TEXAS A&M UNIVERSITY

- 5,200+ acres
- 800+ buildings
  - 30+ million gross square feet
  - 26+ million GSF conditioned
- Over 6 million GSF added since 2016
- 69,000 students
- Over 10,000 faculty and staff
- $950+ million total annual research







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# UTILITIES & ENERGY SERVICES

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## Operate/maintain seven utility plants:

- CUP, SUP1, SUP2, SUP3, HSC, RELLIS, MCB

## Utility Plant Capacities:

- **50MW power generation**
  - 34 MW gas turbine
  - 16 MW steam turbines
- **66,000 tons of cooling (both electric & steam driven)**
  - 37 chillers
  - 24,000 ton-hours of thermal storage
- **440,000 PPH of steam**
  - 3 steam boilers
  - 8 steam to hot water heat exchangers
- **500 million BTU/hr of heating hot water**
  - 56 hot water boilers







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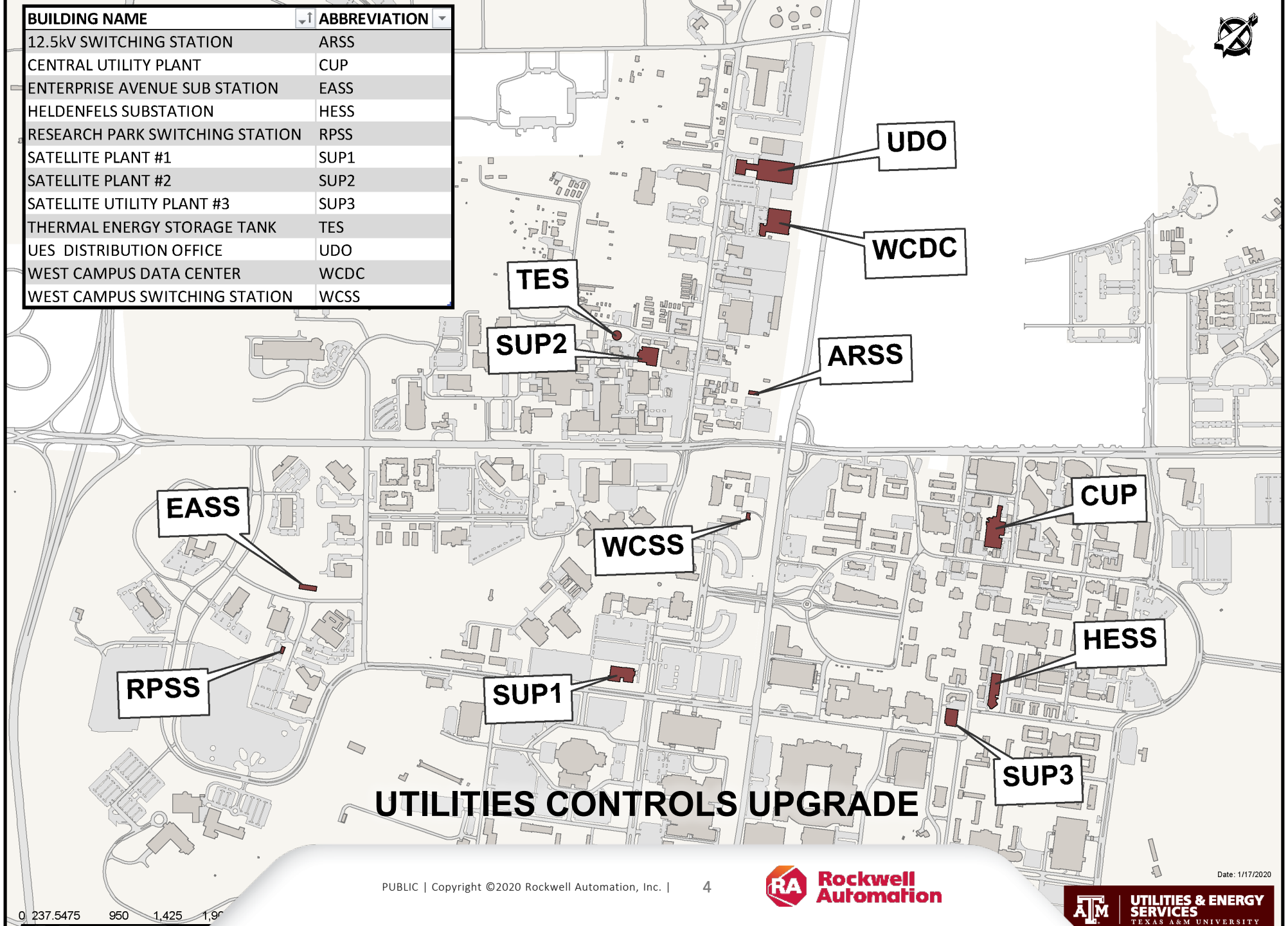




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UTILITIES & ENERGY SERVICES
TEXAS A&M UNIVERSITY

# CAMPUS GSF VS ENERGY CONSUMPTION

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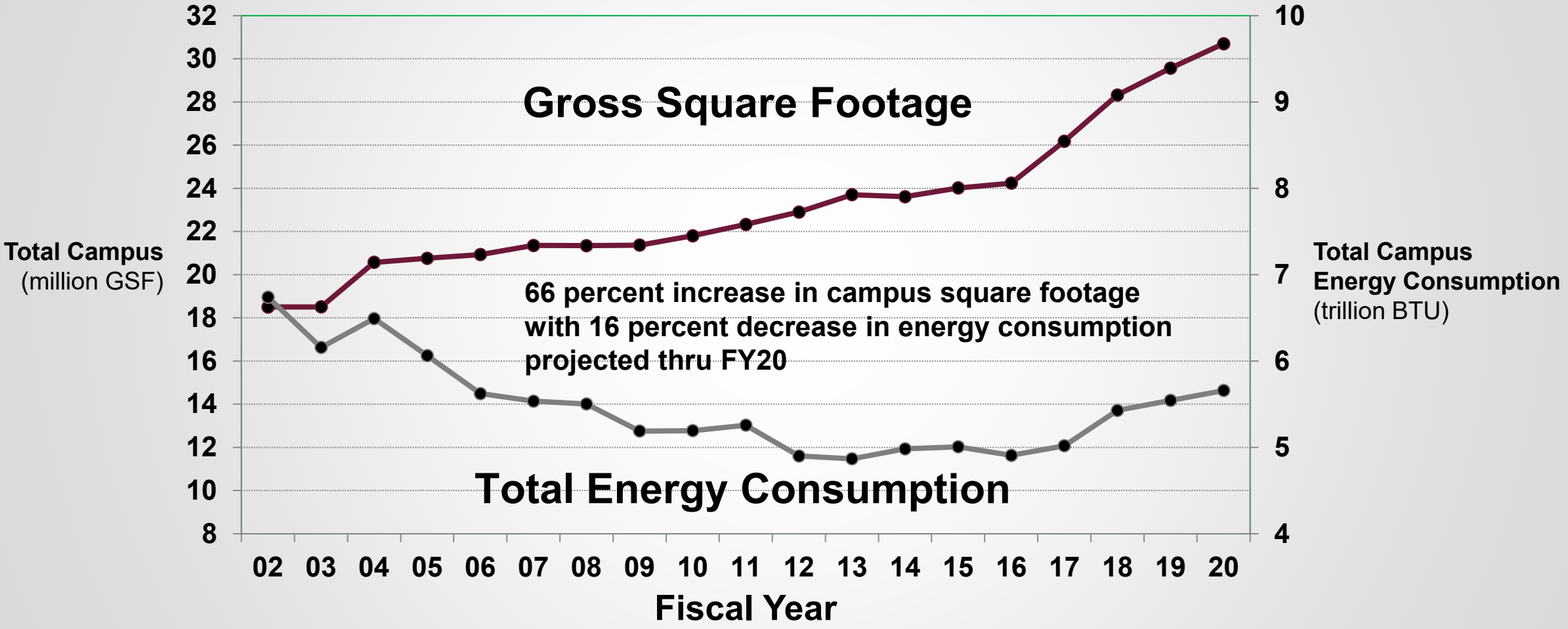




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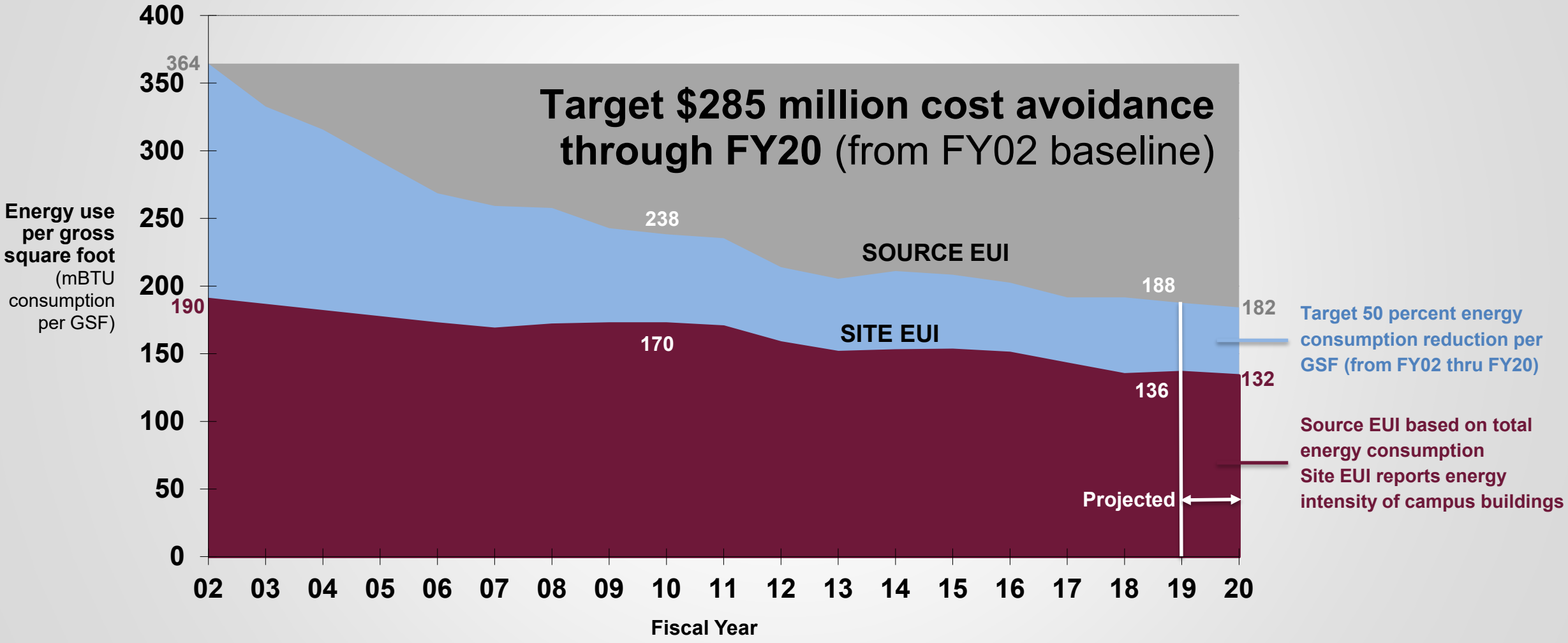
# ENERGY USE INTENSITY (EUI)
# ENERGY USE PER GSF



# UES CONTINUUM OF SERVICES

TEXAS A&M UNIVERSITY

## PROCUREMENT

Calculate and project campus energy requirements

Specify annual and monthly consumption of electricity and natural gas

Review and recommend payment of energy invoices

Serve on TAMU energy risk management committee

## TRANSMISSION

**TAMU owns:**
Domestic water transmission system

**Atmos owns:**
HP (600 psi) NG delivery system

**BTU owns:**
138kV ERCOT electrical transmission system

Coordinate closely with Atmos, ERCOT and BTU

## PRODUCTION

**Management of:**

- Seven utility plants
  - CUP & 3 SUPs
  - RELLIS Campus
  - HSC Campus
- Moore Connally Building
- Solid Waste & Recycling
- Two wastewater treatment facilities
- Domestic water systems

**Production of:**

- Electricity
- Chilled water for cooling
- Hot water for heating
- Domestic cold & hot water
- Steam

## DISTRIBUTION

**TAMU owns and operates campus delivery systems:**

- 12.5kV electrical
- Domestic water (hot & cold)
- Chilled Water
- Heating Hot Water
- Steam
- Sanitary Sewer
- Storm Drainage

**HSC Campus (Bryan)**

**RELLIS Campus**

**Atmos owns:**

- LP & IP natural gas delivery system

## METER & BILLING

Over 2,500 revenue-quality meters in over 500 buildings

Manage utility rate model and rate setting

Cost recovery for all utilities and energy

Energy efficiency improvement initiatives

## ENERGY MANAGEMENT

Customer comfort and service

Environmental control

Building automation and HVAC operation

Energy stewardship

Energy Performance Improvement

Project design review

Capital improvement coordination



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# TYPICAL FACTORS REQUIRING MODERNIZATION OF CONTROLS

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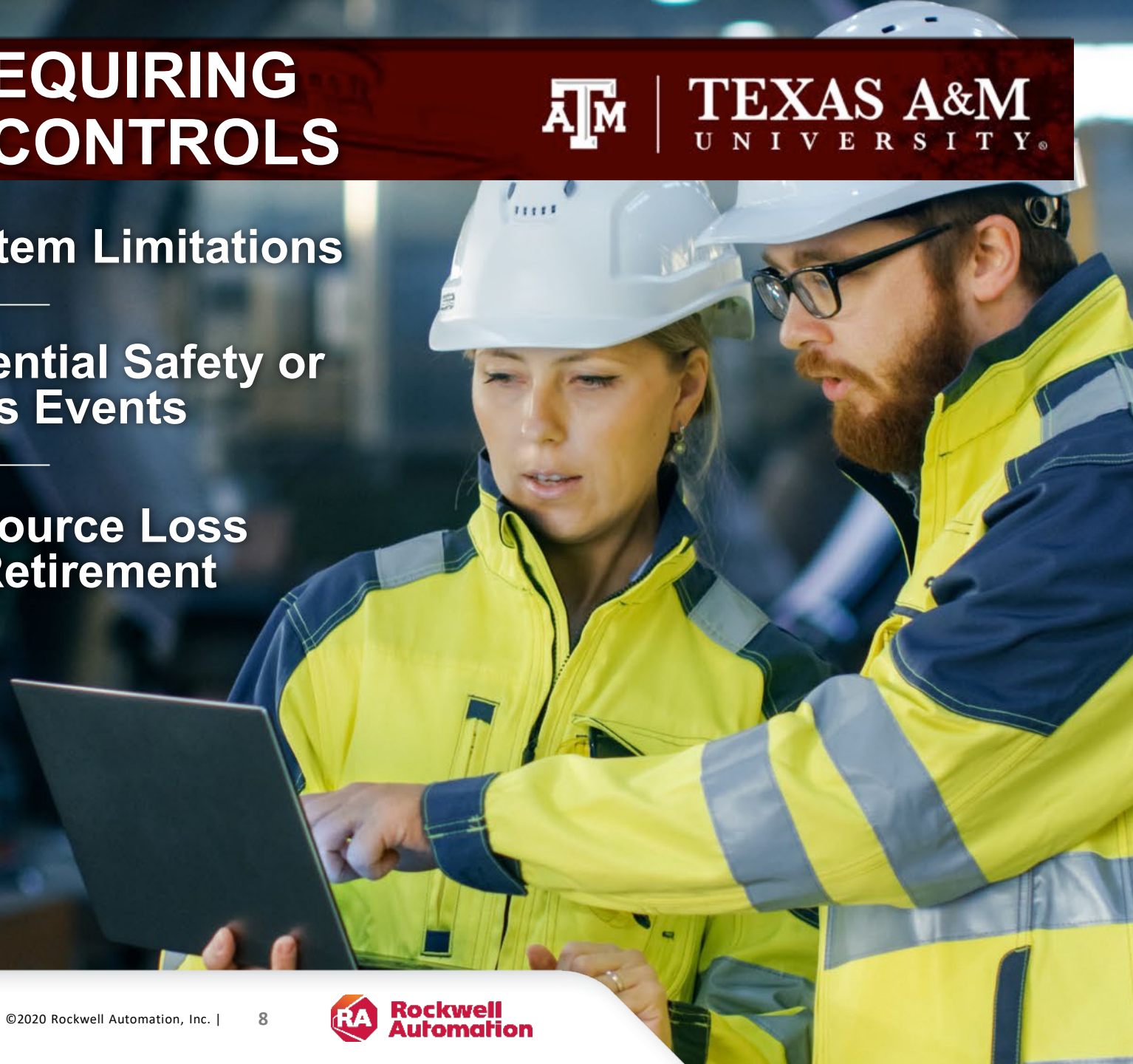
- Data Visualization & Analysis
- System Failures
- Cybersecurity
- Poor Documentation
- New Standards Regulations, and Technology
- Support Cost Issues
- System Limitations
- Potential Safety or Loss Events
- Resource Loss or Retirement





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# CONTROLS SYSTEM AND PROJECT DEVELOPMENT

TEXAS A&M UNIVERSITY

| UPGRADE TIMETABLE | DATE |
|---|---|
| Emerson WDPF DCS - Installed | **1990** |
| Upgrade WDPF – Upgrade to Ovation | **2006** |
| Ovation expansion and upgrade | **2011** |
| Modernization requirement identified | **2016** |
| Developed preliminary project scope | **2017** |
| Evaluated control vendor proposals | **2018** |
| Finalized project delivery and bid evaluation | **2019** |
| Project construction award and kickoff | **2020** |

## COMPELLING CONSIDERATIONS/JUSTIFICATION

Hardware & Software Obsolescence

Data Acquisition & Analysis

System Integration Requirements

Cybersecurity



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# UES PROJECT OVERVIEW

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## Central Utility Plant (CUP)

- 48 MW of power generation capacity
- 27,500 tons of chilled water production
- 17,830 BHP of steam boiler capacity
- Ancillary equipment

## 3 Satellite Utility Plants (SUPs)

- 29,400 tons chilled water production
- 159,869 MBH hot water boiler production
- Ancillary equipment

## 138KV Substation

- SEL Server

## Wastewater Treatment Plant

- Permitted for 4 MGD

## Controls Upgrade

- Legacy Emerson Ovation DCS
- AB, CLX, SLCs & CMXs

## TAMU IT Policy

- Control System IT Infrastructure Modification



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# TECHNICAL EVALUATION AND IMPLEMENTATION TEAM

TEXAS A&M UNIVERSITY

## KEY STAKEHOLDERS

- Executive Director, Utilities & Energy Services
- Director, Utilities & Energy Services
- Associate Director, Utility Production Services
- Manager, Technical Services
- Manager, Utility Production Services
- Controls Engineer, Technical Services
- Supervisor, Instrumentation and Controls
- Supervisor, Water & Wastewater
- Technical Staff, Instrumentation and Controls
- UES IT Services
- TAMU Procurement Services/Contract Admin
- Office of General Counsel

## TEAM RESPONSIBILITIES

- Specification Development with 3rd parties
- Vender Qualifications
- RFP Questions & Addendums
- Vendor Management
- Project Approvals
- Proposal evaluation and ranking by UES
- Vendor presentations
- Automation Partner selection
- Best and Final Offer/Bid Award
- Contract Negotiations
- Terms & Conditions
- Issue NTP for construction

# PROJECT CONSIDERATIONS

TEXAS A&M UNIVERSITY

## Contracting

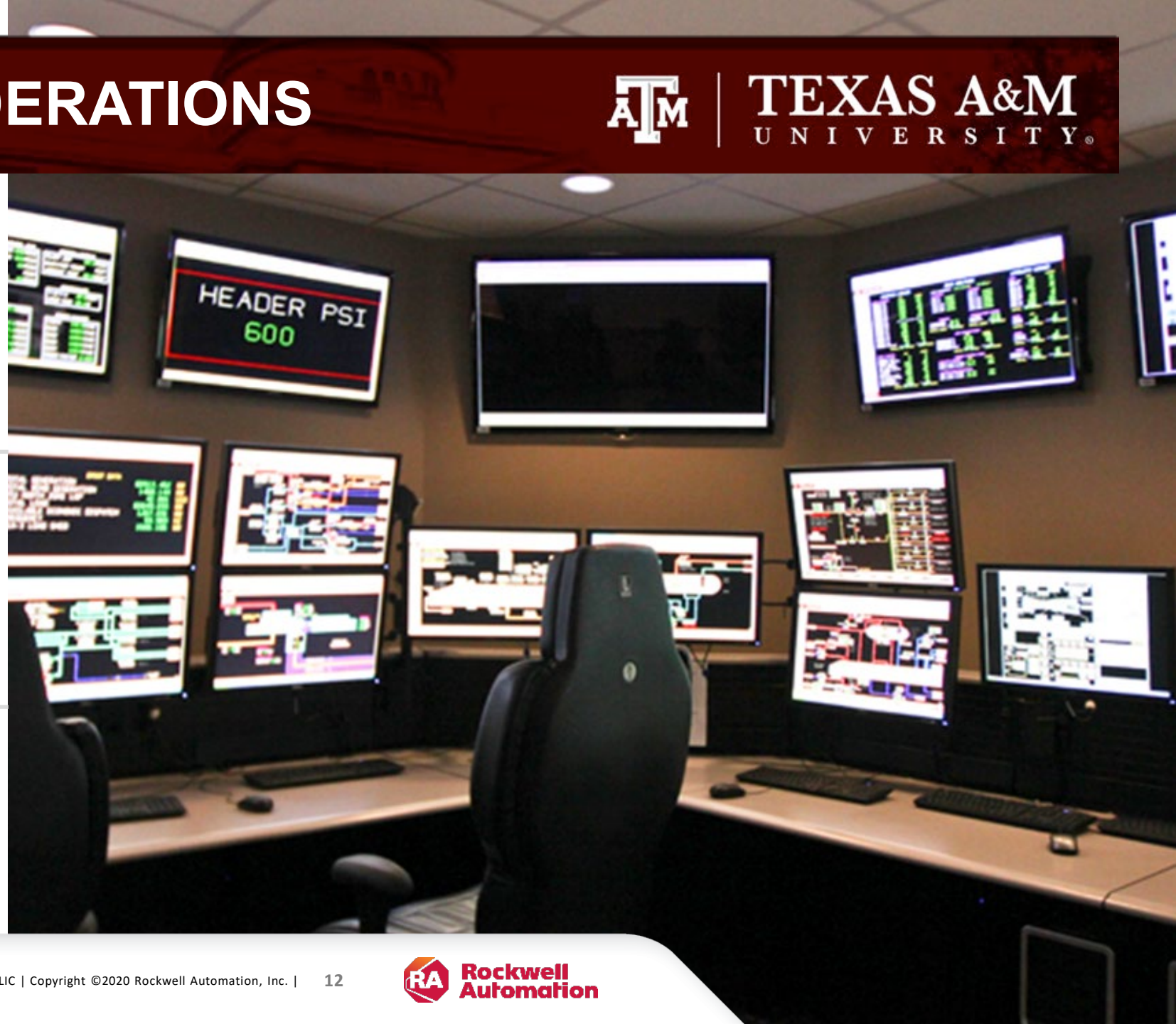
- Design-Build/EPC
- Competitive Sealed Proposal
- Contractors/Subcontractors
- State and University Terms

## Technology/Platform

- Existing Controls
- Existing Third Party Components (SEL, PI, Cisco, etc.)
- DCS, PLC, Hybrid, Modern DCS

## Delivery and Integration

- Vendor Led
- System Integrator
- EPC/Design Build Firm



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# UES PROJECT SCOPE OF WORK

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## CONTROL SYSTEM MODERNIZATION

**Upgrade or replace existing Emerson Ovation distributed control system**

Hardware and software
Maintain redundancy
Improve data access and sharing
Maintain and improve upon third-party connectivity

**Provide package design, drawings, installation, startup and commissioning**

**Utilize either pre-qualified vendor Emerson Ovation DCS or replacement with Rockwell**



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# TECHNOLOGY PLATFORM – EXISTING DCS HARDWARE

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| Campus | Building | Location | Drop No | Brand | Type | Comments | Hardwired IO | OEM Interface |
|---|---|---|---|---|---|---|---|---|
| Main | CUP | Rack Rm | 01/51 | OVATION | Controller | New Backplane | 171 | 115 |
| Main | CUP | Rack Rm | 02/52 | Qline | Controller | Replace | 251 | 152 |
| Main | CUP | CHW Rm | 03/53 | Qline | Controller | Replace | 243 | |
| Main | CUP | CHW Elect Rm | 3-RIO | OVATION | RIO | New Backplane | 217 | 473 |
| Main | CUP | CHW Rm | 04/54 | Qline | Extended | Replace | 469 | 226 |
| West | SUP-1 | Rack Rm | 05/55 | OVATION | Controller | New Backplane | 503 | 153 |
| West | SUP-1 | Rack Rm | 05-RIO | Qline | Extended | New Backplane | | |
| All | 138 KV SUB | 138KV Sub-station | 06/56 | Qline | Controller | Replace | 215 | 8,326 |
| West | SUP-2 | Rack Rm | 07/57 | Qline | Controller | Replace | 398 | 234 |
| Main | SUP-3 | Rack Rm | 08/58 | OVATION | Controller | New Backplane | 597 | 328 |
| Main | CUP | Rack Rm | 09/59 | OVATION | Controller | New Backplane | 250 | 733 |
| West | SUP-1 | Rack Rm | 10/60 | Qline | Controller | Replace | 367 | 183 |
| Main | SUP-1 | Rack Rm | 10-Exp | OVATION | Extended | New Backplane | | |
| Main | CUP | Bus-4 Rm | 11/61 | OVATION | Controller | New Backplane | 290 | 1,237 |
| West | SUP-1 | Rack Rm | 11-RIO | OVATION | RIO | New Backplane | 61 | |
| Main | CUP | Bus-4 Rm | 11-RIO | OVATION | RIO | New Backplane | 44 | |
| Main | CUP | Rack Rm | 12/62 | OVATION | Controller | New Backplane | 239 | 207 |
| West | SUP-2 | Mezz Elect Rm | 12-RIO | OVATION | RIO | New Backplane | 240 | |
| West | SUP-2 | Rack Rm | 13/63 | OVATION | Controller | New Backplane | 175 | 620 |
| West | SUP-3 | Rack Rm | 14/64 | OVATION | Controller | New Backplane | 114 | 160 |
| All | WWTP | WWTP | 16/66 | OVATION | Controller | New Backplane | 464 | |
| All | WWTP | B4051 | 16-1 | Qline | RIO | Replace | 97 | |
| All | WWTP | White Building | 16-2 | Qline | RIO | Replace | 55 | |
| All | WWTP | B4052 | 16-3 | OVATION & Qline | RIO | Replace | 77 | |
| All | WWTP | White Building | 16-4 | OVATION & Qline | RIO | Replace | 23 | |
| Main | CUP | | RO | AB | SLC | Migration | 72 | |
| Main | CUP | | STG-02 | AB | CMX/ Flex | Retrofit | 72 | |
| Main | CUP | | BL-001-BMS | AB | CLX-RED | Keep | 160 | |
| Main | CUP | | BL-012-BMS | AB | SLC | Migration | 80 | |
| Main | CUP | Rack Rm | BL-012-CCS | AB | CLX | Retrofit | 104 | |
| ***TOTAL*** | | | | | | | ***6,048*** | ***13,147*** |

## 15 CONTROLLERS

- 9 Ovation
- 6 Q-Line

## 6 RIO

- 4 Ovation
- 2 Q-Line
- 2 Combined

## 3 EXTENDED IO

- 1 Ovation
- 2 Q-Line

## 5 ALLEN BRADLEY

- 2 ControlLogix
- 1 CompactLogix
- 2 SLCs



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# TECHNOLOGY PLATFORM – EXISTING THIRD-PARTY HARDWARE

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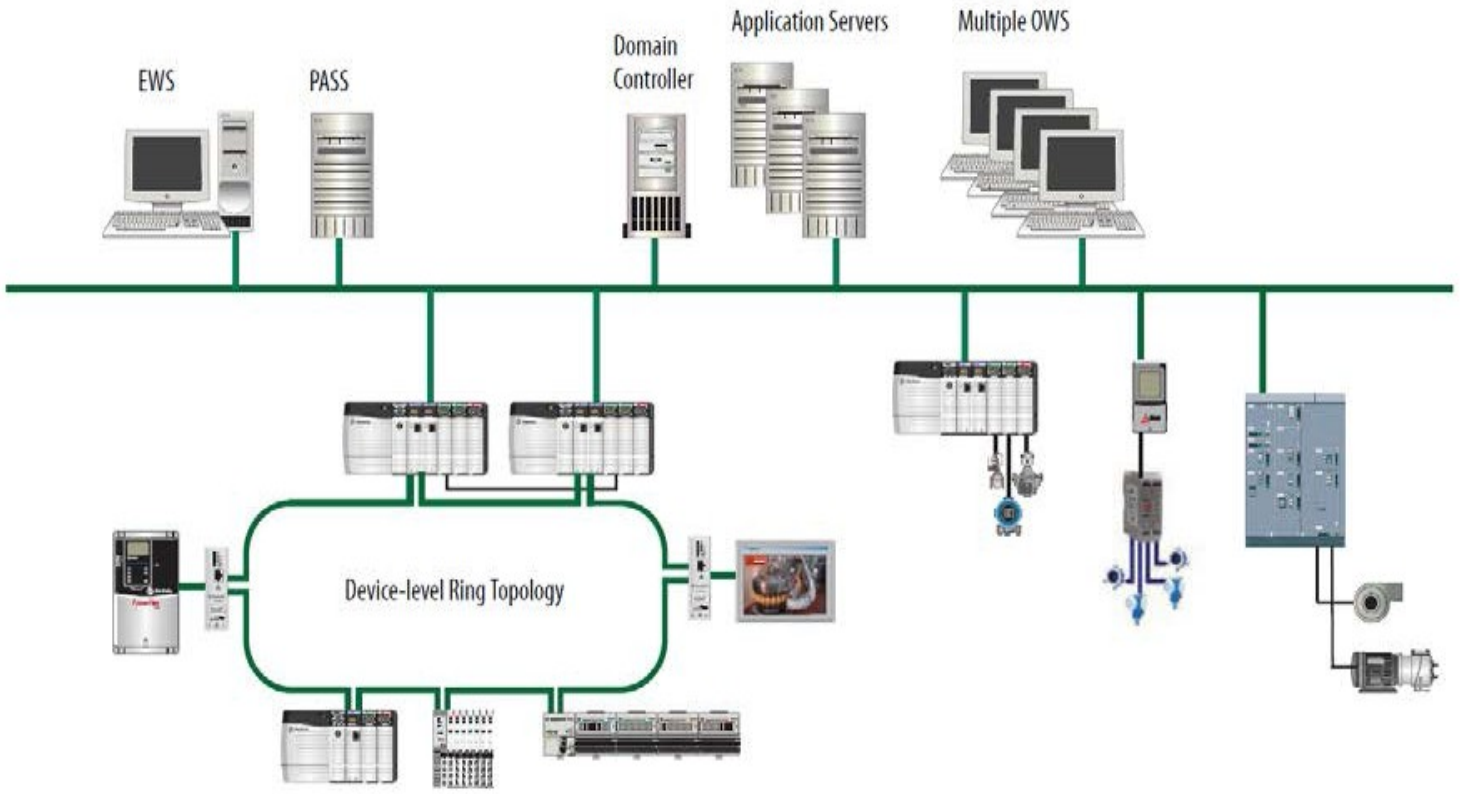
## Over 13,000 IO from OEM controllers networked via communication gateways




| EQUIPMENT DESCRIPTION | COMMUNICATION PROTOCOL |
|---|---|
| Boiler 1 BMS | Allen Bradley Ethernet |
| Boiler 1 CEMS | Allen Bradley Ethernet |
| Boiler 12 | Allen Bradley Ethernet |
| Boiler 12 CEMS | Allen Bradley Ethernet |
| 27 Chillers and 34 Boilers | Modbus 485/232 |
| CHWP 101 and 102 | Modbus TCP/IP |
| (3) HART Wireless Gateways | Modbus TCP/IP |
| Siemens Demand Flow System | Modbus TCP/IP |
| (2) Carrier Steam Turbine Driven Chillers | Modbus TCP/IP |
| GE Gas Turbine | Modbus TCP/IP |
| Veeder Root Fuel Oil Storage | Modbus TCP/IP |
| Eaton 480v Gateway (Sub 15,16,17) (NEW) | Modbus TCP/IP (NEW) |
| SEL Interface –DNP3 | DNP3 |

| Drop | MODBUS-R TCP/IP | MODBUS MASTER TCP/IP | MODBUS | NOT CONFIGURED | ALLEN BRADLEY PLC ETHER. | DNP3 | TOTAL |
|---|---|---|---|---|---|---|---|
| 1 | 115 | | | | | | 115 |
| 2 | | 8 | 144 | | | | 152 |
| 3 | 98 | | 375 | | | | 473 |
| 4 | 48 | | 178 | | | | 226 |
| 5 | | | 153 | | | | 153 |
| 6 | | | | | | | 0 |
| 7 | | | 234 | | | | 234 |
| 8 | | | 328 | | | | 328 |
| 9 | 689 | | 44 | | | | 733 |
| 10 | 18 | | 165 | | | | 183 |
| 11 | | | 240 | | 997 | | 1237 |
| 12 | | | 104 | | 103 | | 207 |
| 13 | | | 620 | | | | 620 |
| 14 | | | 160 | | | | 160 |
| 190 | | | | | | 8326 | 8326 |
| ***TOTAL*** | ***968*** | ***8*** | ***2745*** | ***0*** | ***1100*** | ***8326*** | ***13147*** |



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# TECHNOLOGY PLATFORM – MODERNIZATION BENEFITS

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- Unified platform that delivers the functionality required
- Single technology environment with a smaller toolset
- Enhanced asset visibility
- Limit foreign device interfaces between disparate systems
- More effective resource skillset
- High Availability Graphics to optimize the operation experiences



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# DOCUMENTATION DELIVERABLES

- System Architecture Diagram
- Hardware Design Document
- Functional Specification
- System Design Specification
- FAT Test Procedure
- Startup Test and Acceptance Checklist
- O&M Manual
- Training Manuals for:
  Operators, Engineers, Administrators

# EXPECTED OUTCOME

TEXAS A&M UNIVERSITY

1. Rapid system deployment
2. Simplified Commissioning
3. Faster time to operation
4. Simpler installation coordination
5. Future ready
6. Secure and resilient
7. Informative reporting
8. Lower Total Cost of Ownership (TCO)



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# ALIGNMENT WITH AUTOMATION PARTNER

TEXAS A&M UNIVERSITY

## Rockwell Automation has extensive experience and a large installed base in the Campus Energy Ecosystem

- Leading automation player in Campus Utilities
- Ability to mitigate risk on the project schedule

## Products and services are helping Universities today

- Provide Scalable architecture
- Enhanced Platform/technology capabilities
- Heightened Cyber Security

## Life Cycle support

- Low Total Cost of Ownership
- Scalable and Long-term support capability



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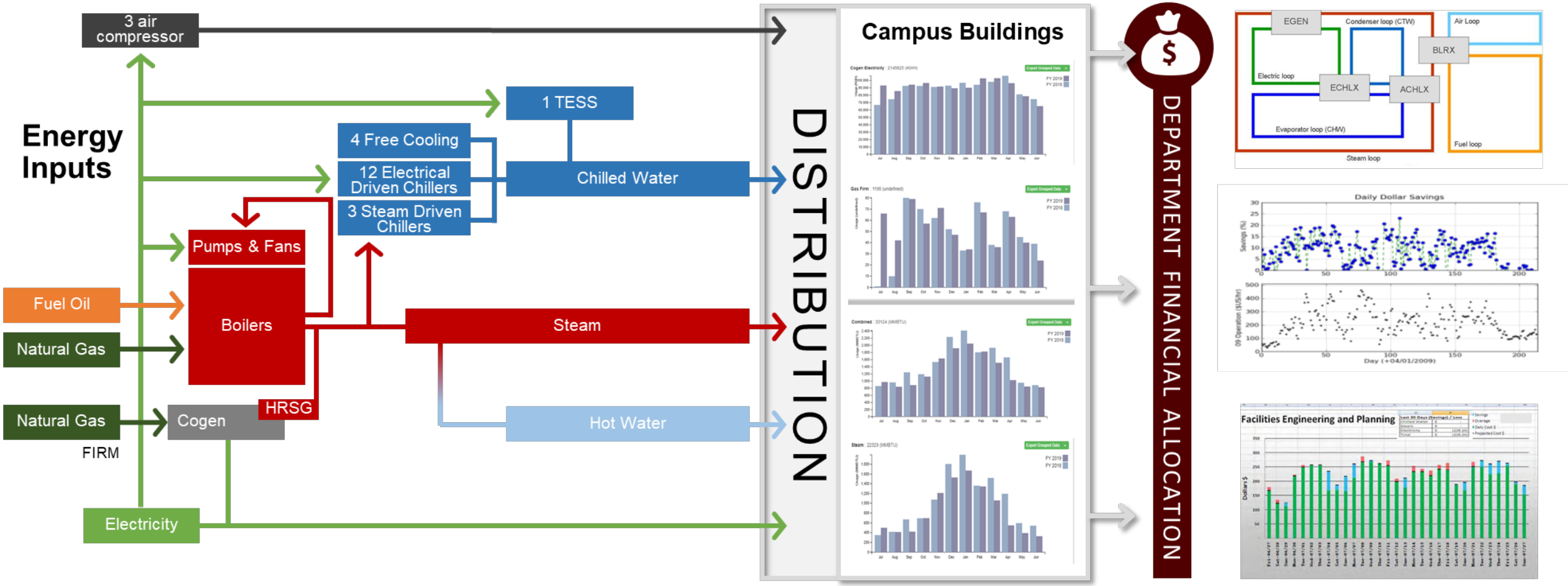
# TYPICAL FUTURE STATE

TEXAS A&M UNIVERSITY




**Energy Supply** | **Energy Production & Optimization Model** | **Energy demand**



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# Thank you

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