
AABC Commissioning Group

AIA Provider Number 50111116



The Evolution of Commissioning at the University of Texas at Austin

Course Number: CXENERGY1821



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April 26, 2018

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The University of Texas at Austin
Utilities and Energy Management

Course Description

An examination of the needs of an institutional client, and the gap left by the traditional new building commissioning process. The University of Texas has been working to transform the requirements of their Commissioning Providers to more robustly support their building operations and optimization while continuing to deliver quality construction projects. Changes include more involvement in the turnover process, a stronger focus on the warranty period, and bringing additional expertise to the table.

Learning Objectives

At the end of the this course, participants will be able to:

1. Understand the needs of institutional clients and the shortfalls of the Initial Commissioning Process from the perspective of an institutional client.
2. Learn about value-added methods for increasing Commissioning Authority (CxA) involvement in the warranty process. Understand the possible CxA scope items in a warranty phase / post occupancy commissioning process.
3. Understand the alignment of LEED V4, the ongoing Monitoring Based Commissioning (MBCx) process, and the requirements of an institutional client.
4. Learn about “Measurement & Verification” results from successful post-occupancy Commissioning project at University of Texas Austin.

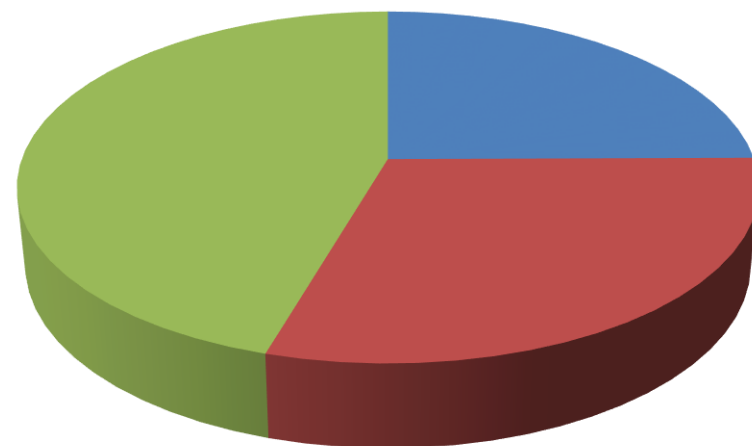
WHAT DO INSTITUTIONAL CLIENTS WANT?

From Capital Project Quality Perspective:

- ✓ Owners' O&M requirements to be clearly understood
- ✓ Clear commissioning process milestones integrated into the project delivery process
- ✓ Project delivery team accountability for performance
- ✓ Commissioned systems (not just equipment) that will be maintainable, reliable and energy efficient
- ✓ "Initial Commissioning" process from design through warranty phase to confirm the Owner's performance (and design) requirements have been met BEFORE project delivery team is released.
- ✓ An improved handover of project documentation including commissioning records
- ✓ Post Construction "Ongoing Commissioning" support as building load comes on and operators continue to learn building

COMMISSIONING GOALS

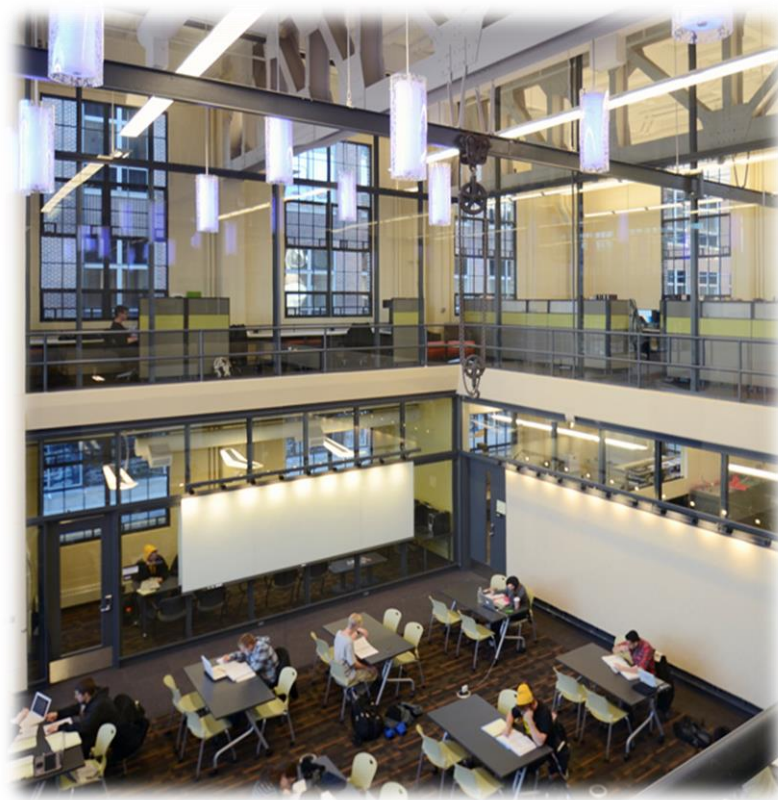
- ☐ Deliver buildings that meet Owner needs
- ☐ Improve equipment performance and mitigate/avoid accelerated deterioration & premature failures
- ☐ Improve occupant comfort and productivity
- ☐ Optimize energy performance by maximizing efficiency in system performance
- ☐ Timely turnover of commissioning documentation
- ☐ More effective building operators



- Design/Construction
- Operations/Years 1 - 25
- Operations/Years 26 - 40

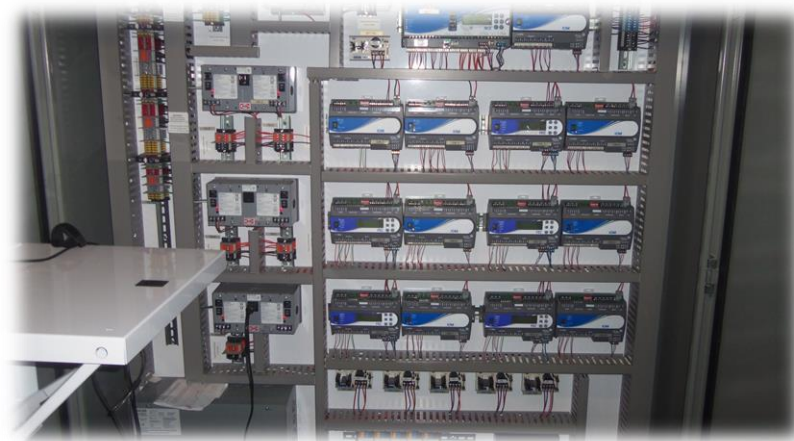
COMMISSIONING BENEFITS

- ✓ **Cost avoidance through early identification and resolution of issues**
- ✓ **Energy and life cycle operational costs savings**
- ✓ **Correct controls and building systems operation**
- ✓ **Maintainable building systems**
- ✓ **Increased performance**
- ✓ **Increased equipment life**
- ✓ **Reduced warranty call-backs**



WHY IS COMMISSIONING NEEDED?

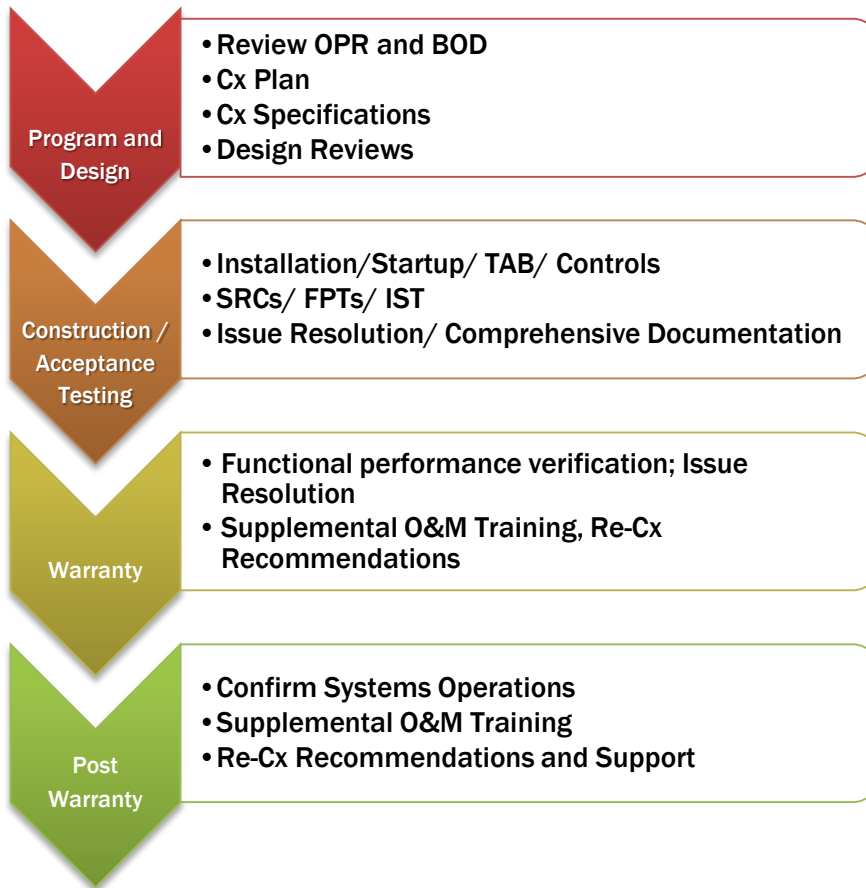
- ❑ Building Performance Matters Now More than Ever
- ❑ More Complex and Powerful Systems
- ❑ Tests Programming for Energy Efficiency
- ❑ Long Term Performance of the Facility
- ❑ Identifies Unfinished MEPF Systems
- ❑ Completes Building Turnover
- ❑ Accreditation Requirements (i.e. JCAHO, Tier 4 Data Center, LEEDV4 O&M)



COMMISSIONING PHASES/PROCESSES

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New Construction Commissioning



Existing Building Commissioning



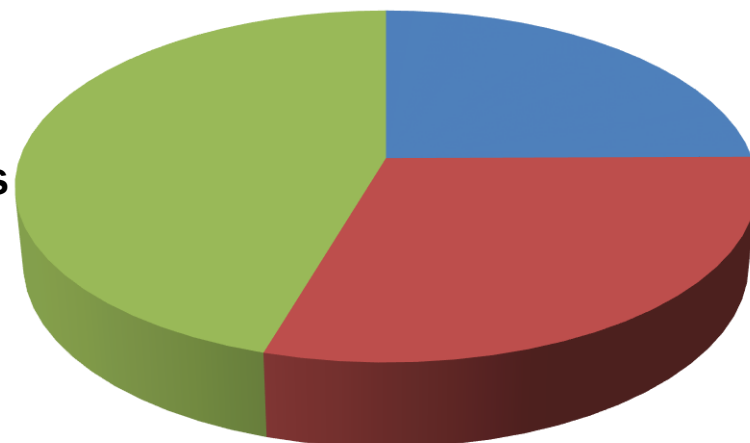
WARRANTY PHASE CX TASKS

- **Trend Analysis** (control related over extended period of time)
- **Deferred Testing** (due to calendar, seasonal or other requirements – if required)
- **Modified Procedures** (10-month meeting with Owner, operators, engineer... and incorporate as required)
- **Re-commissioning Manual** (provides a procedure for continuous or future Cx of the facility)
- **Monitoring Based Commissioning**



COMMISSIONING CLOSE-OUT ACTIVITIES

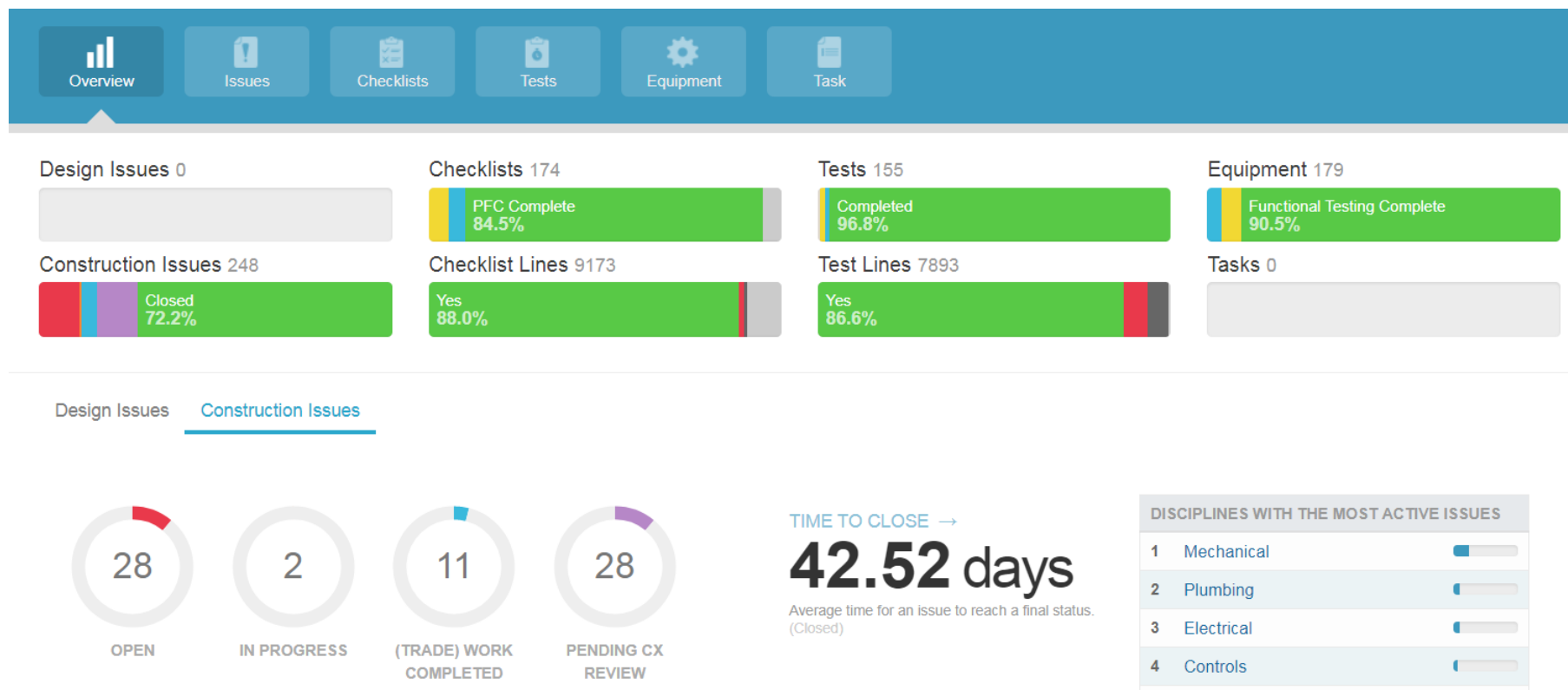
- **Project Close-Out (Transitioning from Contractor to Owner Facility Operation)**
- **Ensuring a Successful Training Program**
- **Transfer of Knowledge and Meaningful Systems Documentation**
 - **Final Commissioning Report**
 - **O&M Data/Manuals**
 - **TAB Report verification**
 - **Systems Manual**
- **Documented Baseline Operations**
- **Ensuring Accurate CMMS/BIM Data for Implementation**



- **Design/Construction**
- **Operations/Years 1 - 25**
- **Operations/Years 26 - 40**

WHERE AND WHAT ARE THE GAPS?

Incomplete functional testing results and delayed Cx Final Reports and Systems Manual



WHERE AND WHAT ARE THE GAPS?

Phased substantial completions that affect Systems level commissioning completion

Substantial Completion		
Substantial Completion	Area	Substantial Completion Date
1	Passenger Elevators 1-4	8/10/2017
	Various Corridors and Rooms Throughout Building (See attached Map)	
2	Café	8/17/2017
	Café Exterior Seating	
	ECJ Level 1	
3	Exterior Skin	8/29/2017
	East Terrace	
	Skylight	
	Roof	
	Various Corridors and Rooms Throughout Building (See attached Map)	
4	Service Elevator 1	9/7/2017
	Various Corridors and Rooms Throughout Building (See attached Map)	
5	Various Corridors, Rooms, and Site Locations Throughout the Project (See attached Map)	9/14/2017
6	Various Corridors, Rooms, and Site Locations Throughout the Project (See attached Map)	9/28/2017

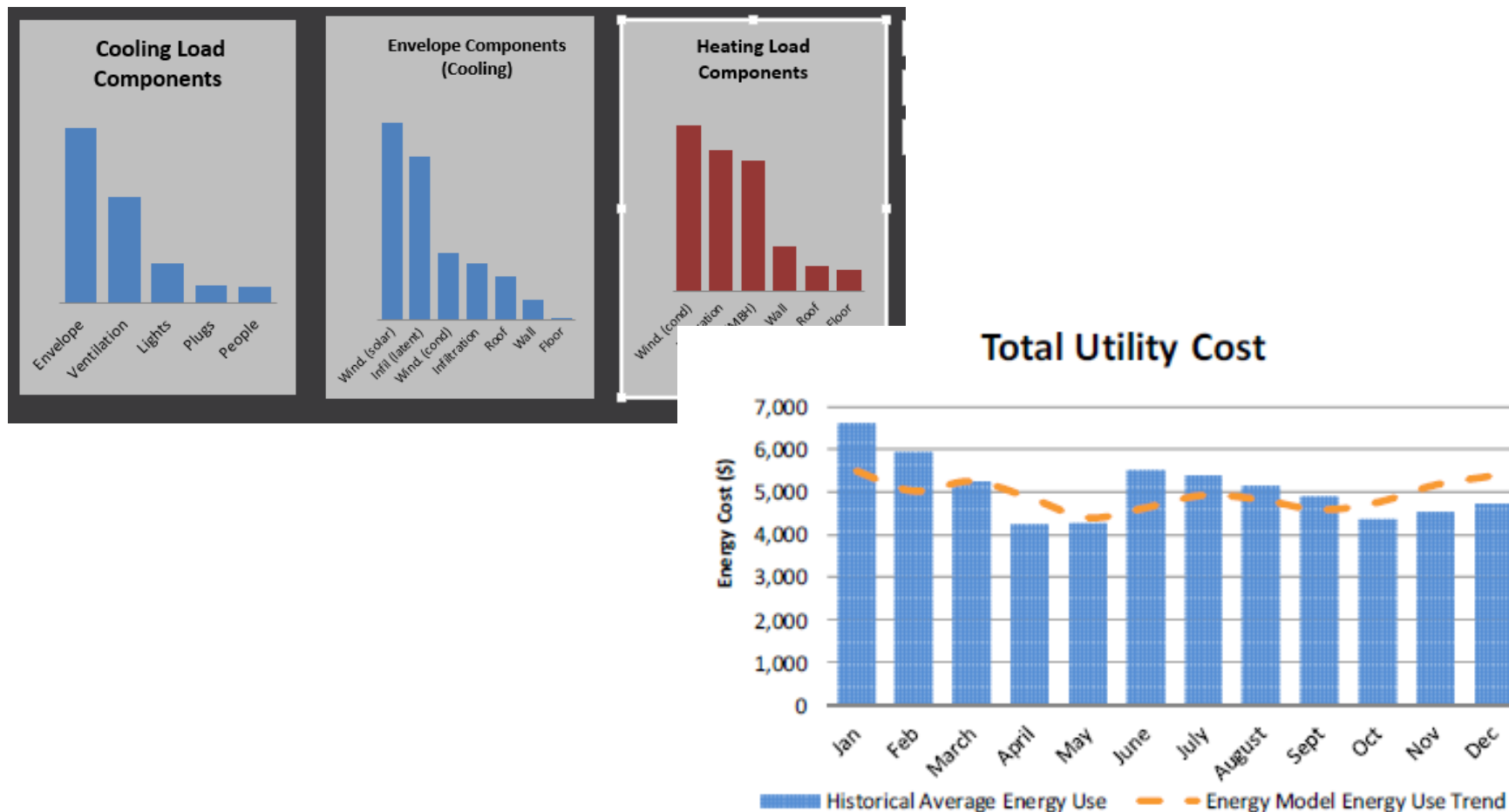
WHERE AND WHAT ARE THE GAPS?

In complete training (not all completed and not all systems ready for training use)

OWNER TRAINING					
Spec Section	Sub Section	Title	Subcontractor/ Supplier	Training Scheduled	Training Held
22 1123	2.01.A	PLUMBING EQUIPMENT - Semi-Instantaneous Hot Water Generator - Owner Training	PORTER		9/6/17 - AM
26 0573	3.03	FAULT & COORDINATION STUDY & ARC FLASH HAZARD ANALYSIS - Vendor provided Arc Flash Training	WALKER		Complete
10 4410	3.5.B.1	SMOKE CURTAINS - Owner Training	US SMOKE & FIRE		
14 2123	1.13.B	ELECTRIC PASSENGER ELEVATORS - Owner Training	EMR		
144200	3.4.A	WHEELCHAIR LIFTS - Owner Training	EMR		
23 0801	1.3.1.9	COMMISSIONING OF DIRECT DIGITAL CONTROL SYSTEM - Owner Staff Training	SIEMENS		
23 0923.A	2.26.	AIR QUALITY MONITORING - Training (Each Year for 4 Years) At Manufacturer's Factory - Owner Request training to occur on site at EERC.	SIEMENS		
23 0923.A	2.26.	SMOKE PURGE - Training	SIEMENS		
23 0923.A	1.09.A	DIRECT DIGITAL CONTROL SYSTEMS - Owner Training	SIEMENS		
		DIGITAL WAYFINDING SIGNAGE - Owner Training	WALKER		
27 4116	3.7.A	DIGITAL ROOM SCHEDULER - Owner Training	WALKER		
28 3111	3.11.A	DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEMS - Owner Training	WALKER		
27 0800	1.4.1	COMMISSIONING OF COMMUNICATIONS SYSTEMS - Owner Training	WALKER		
27 4116	3.7.A	AUDIOVISUAL SYSTEMS - Owner Training	WALKER		

WHERE AND WHAT ARE THE GAPS?

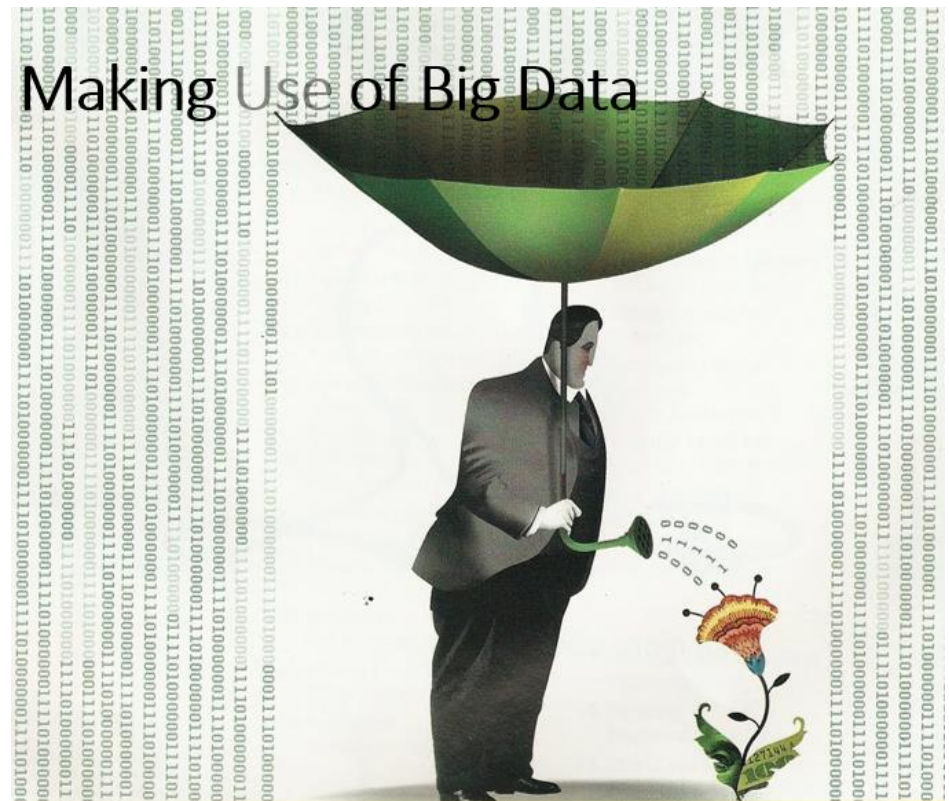
Building Loading is typically gradual



WHERE AND WHAT ARE THE GAPS?

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Building Operators suffering from “Fire Hose” effect



LEEDV4 FUNDAMENTAL & ENHANCED CX

V4 LEED Fundamental - CxA

Independent from Design & Construction

Report directly to Owner – **engaged before DD**

Reviews OPR & BOD - **OPR to cover building envelope envelope**

Commissioning Plan

Commissioning in Contract Documents

Verify Installation and Performance

Review results of testing

Final commissioning report

Minimum One Design Review prior to mid-design

Review exterior enclosure design – by A/E SME

Prepare a CFR and O&M Plan

Minimum Systems

Commissioned

- ✓ HVAC&R & Controls
- ✓ Lighting & Daylighting Controls
- ✓ Domestic Hot Water Systems
- ✓ Renewable Energy Systems

✓ Electrical Service and Distribution

V4 LEED Enhanced Path 1 - 3 points

Design Review

Review Submittals Concurrent

Confirm Systems Manual Req in CDs

Develop Systems Manual

Verify Training & Reqs in CDs

10th Month Warranty

Develop an on-going commissioning plan plan

LEEDV4 ENHANCED CX OPTIONS

V4 LEED Enhanced: Path 2 Option 1

Achieve Path 1 Enhance Commissioning 3 pts

AND

Develop monitoring-based procedures and include in the commissioning plan 1 pt

- Measurement requirements
- Points to be tracked
- Limits of acceptable values
- Action plan for identifying and correcting correcting errors and deficiencies
- Training to prevent errors
- Planning for repairs needed to maintain performance
- Frequency of analyses in the 1st year or operation (at least quarterly)
- Update Systems Manual with any mods

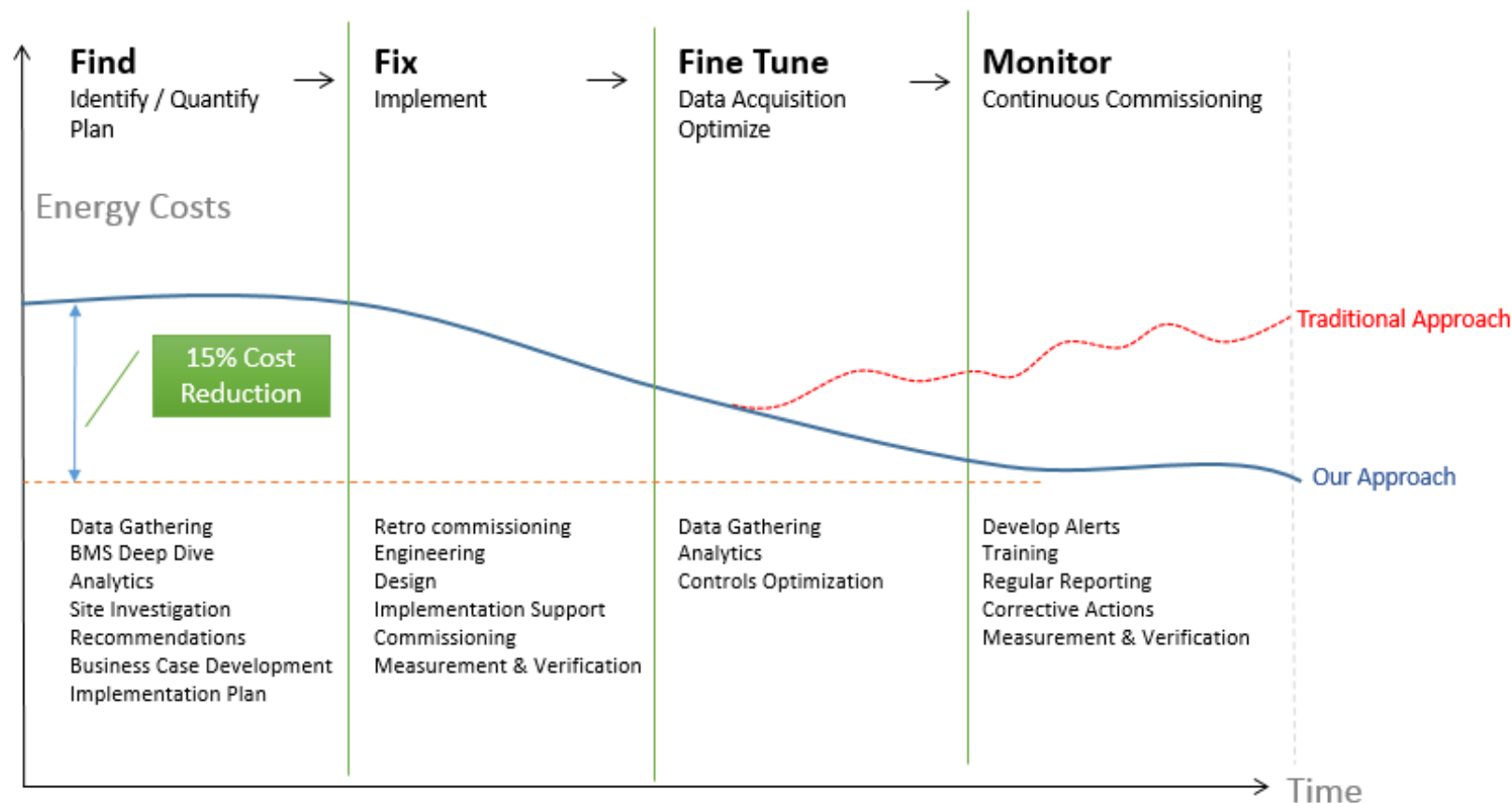
V4 LEED Enhanced: Path 2 Option 2

Envelope Commissioning 2 pts

Complete the Cx process activities per ASHRAE ASHRAE Guideline 0-2005 and NIBS Guideline 3 Guideline 3 - 2012

- Review contractor submittals
- Confirm system manual reqs in CDs
- Verify training reqs in CDs
- Verify Systems Manual updates and delivery delivery
- Verify operator and occupant training
- Verify Seasonal testing
- 10th Month Warranty
- Develop an on-going commissioning plan plan

MBCX AND FAULT DETECTION DIAGNOSIS



UT AUSTIN CAMPUS AND POWER PLANT OVERVIEW

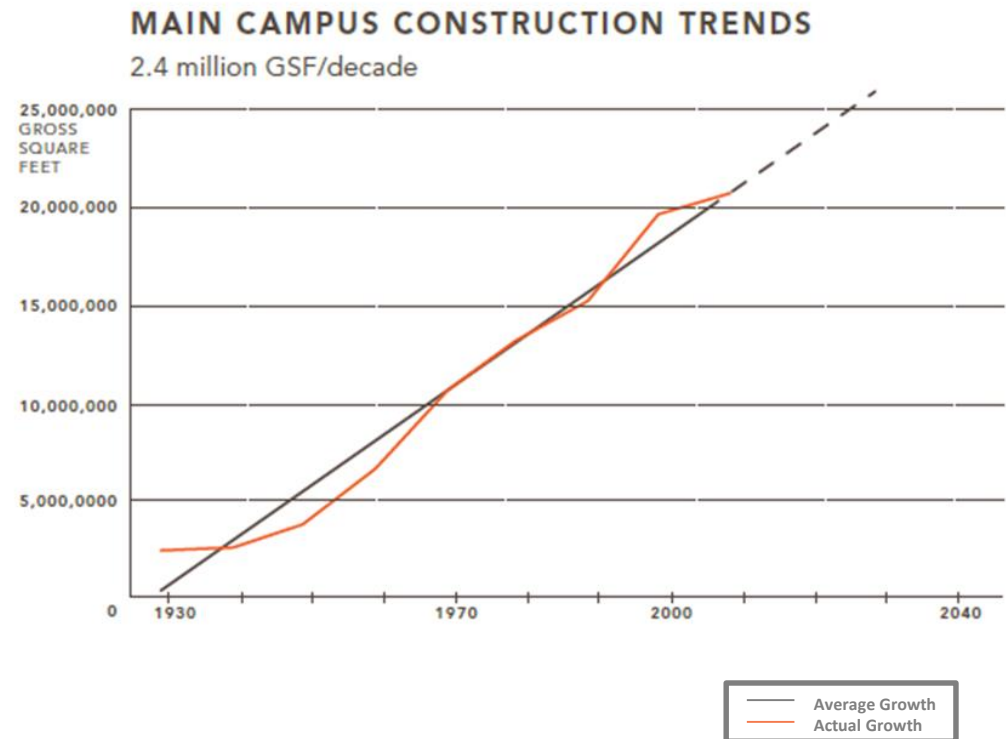
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- 20+ million square feet of building space
- Variety of building uses
- Age range from 100 years old to brand new
- Combined heat & power plant and chilling stations providing
 - Chilled Water
 - Steam
 - Electricity



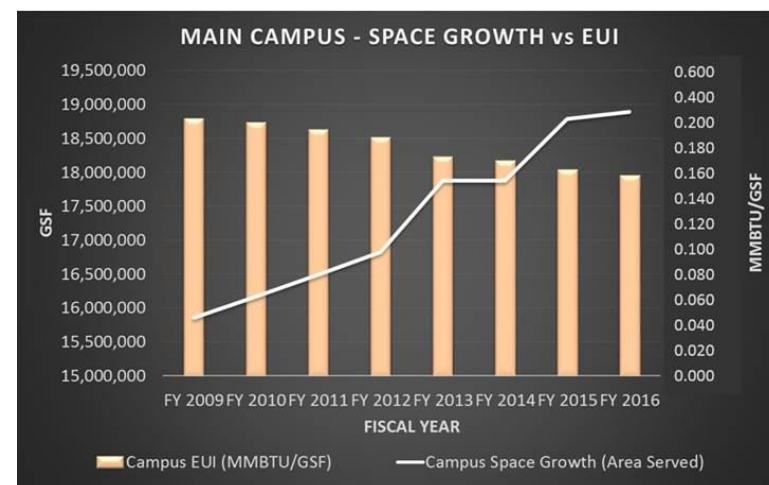
DEMAND-SIDE ENERGY MANAGEMENT & OPTIMIZATION

- Mission and Goal
 - Utilize innovative demand side energy management strategies
 - Offset projected campus energy growth
 - Reduce the average EUI on main campus by at least 2% annually
 - Prevent expansion of plant caused by peak demands



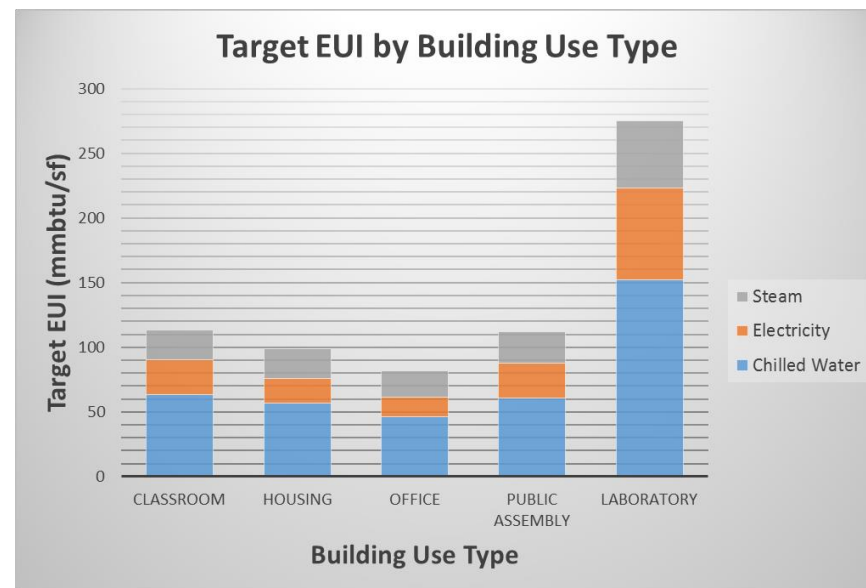
HOW?

- **Existing Buildings**
 - Existing Building Commissioning (EBCx)
 - Optimize sequences of operation
 - Scheduling
 - Reduce ventilation to meet ASHRAE requirements
 - Replace failed or inefficient equipment
 - Identify maintenance needs with an energy impact
 - Continuous energy use monitoring
 - Component replacement (e.g. lighting, valves, t-stats)
- **Behavior Programs**
 - Longhorn Lights Out
 - Horns Up Sash Down
- **New Construction**
 - New construction and renovation standards updates
 - Design review for new buildings and large renovations
 - Target EUIs

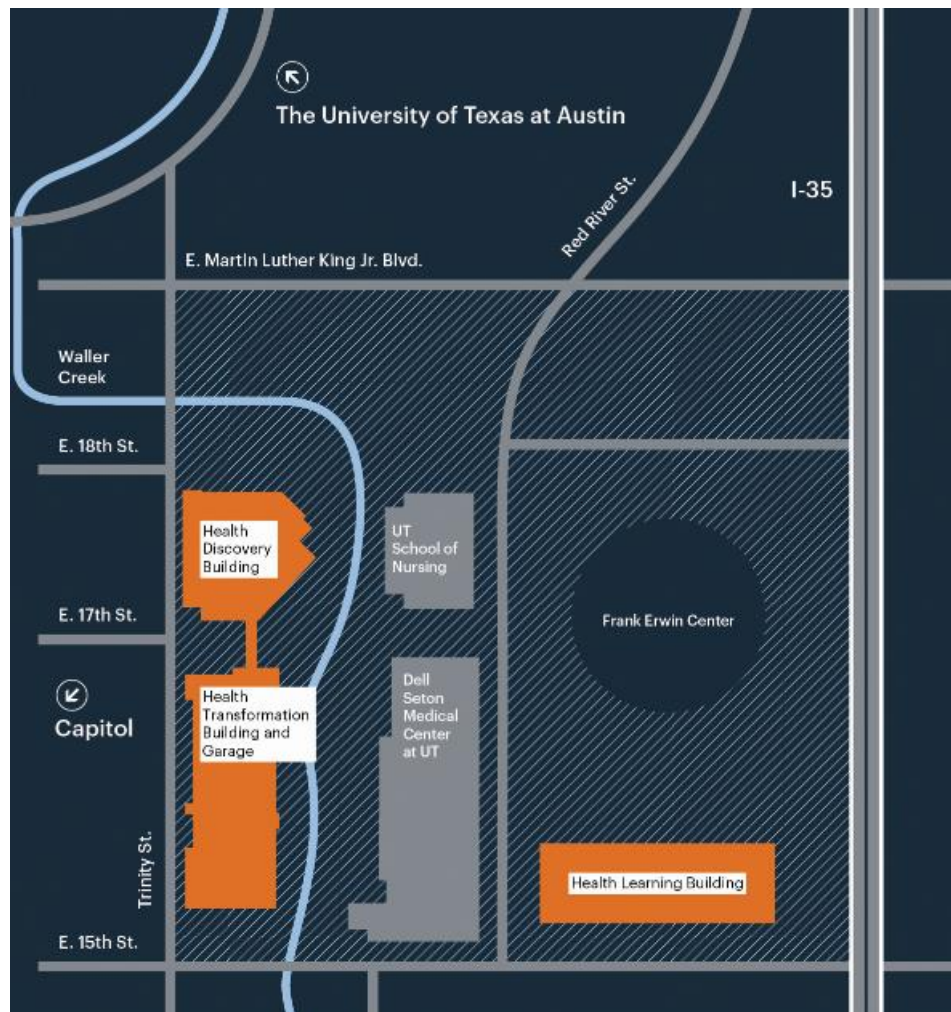


TARGET EUIs FOR NEW CONSTRUCTION

- Realistic yet aggressive
 - Energy model prior to 100% CD Phase
 - 10 months after substantial completion
- Based on campus buildings built between the years of 1990-2014
- Benchmarked against
 - Existing energy models for campus buildings
 - Analysis of performance of LEED Silver buildings
 - Labs 21 benchmarking
 - CBECS 2012 averages
 - (Look higher than CBECS because using district energy)



MAP OF AUSTIN'S HEALTH DISTRICT



-  Health District
-  Dell Medical School Buildings
-  Health District Buildings

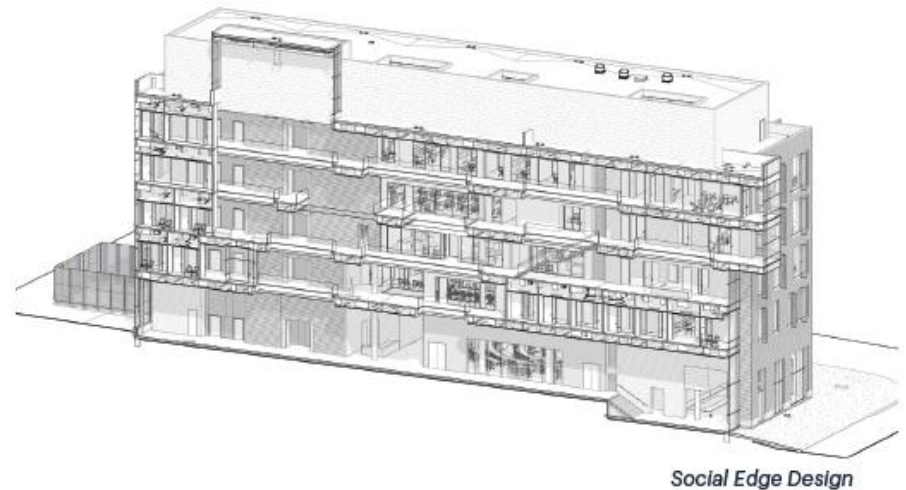


Health Learning Building

HEALTH LEARNING BUILDING CASE STUDY

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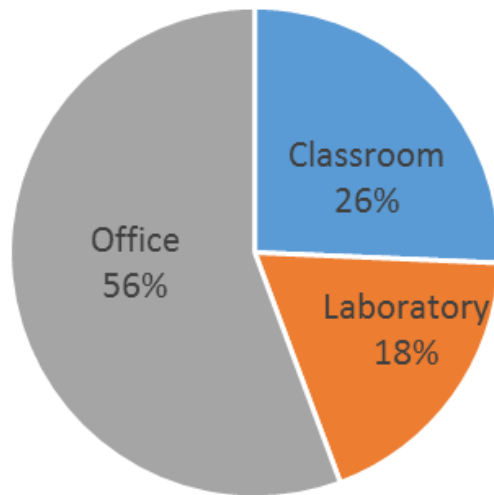
- ❑ Collaboration focus
- ❑ State of the Art Technology
- ❑ Team based learning classrooms
- ❑ Café and Courtyard
- ❑ Student Lounges and Conference Rooms
- ❑ Simulation Labs
- ❑ Anatomy Lab
- ❑ Executive and Administration Offices



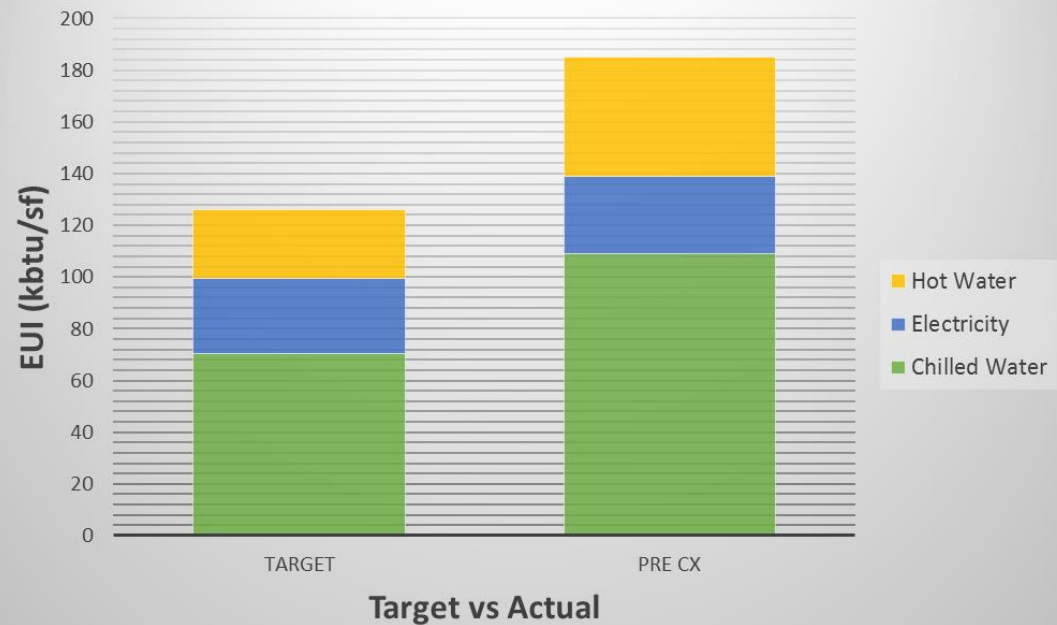
As the heart of the Dell Medical School and front door for the Medical District, the Health Learning Building is the primary home for students and faculty. But it isn't just a place where things happen — it's a place that makes things happen.

TARGET EUI FOR HEALTH LEARNING BUILDING

Space Use Type

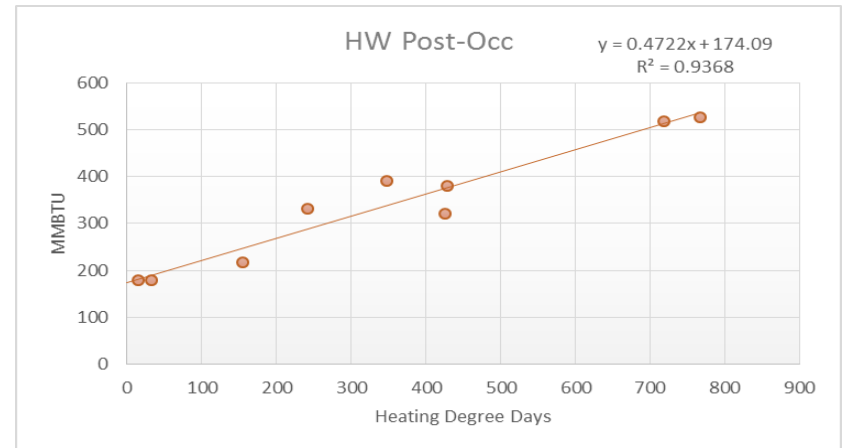
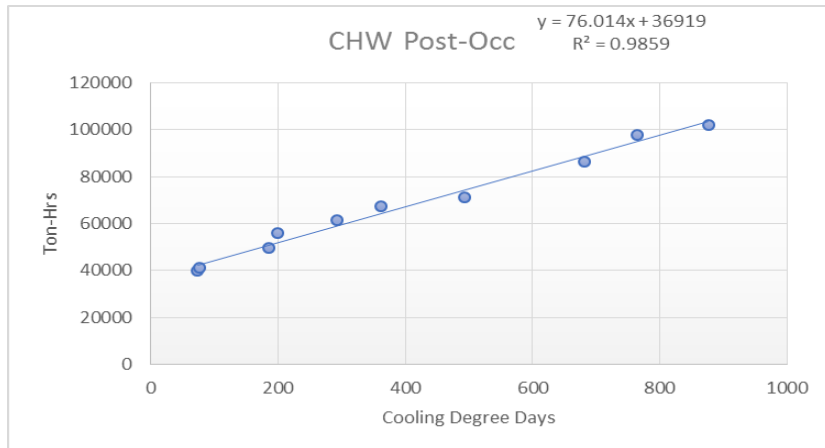
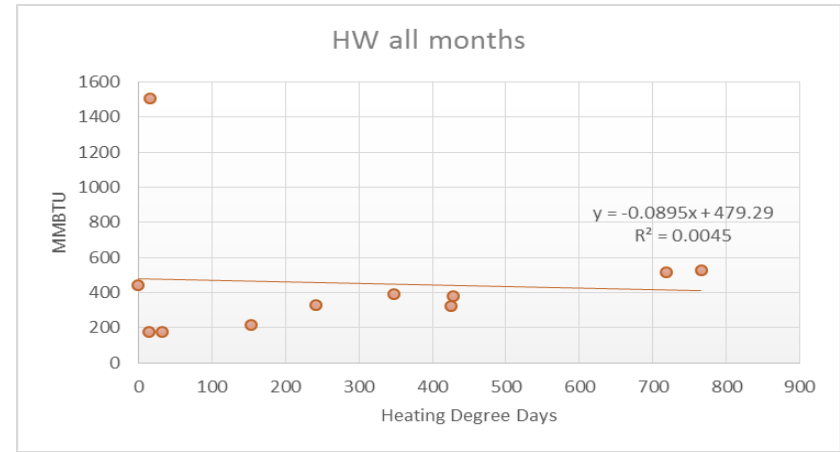
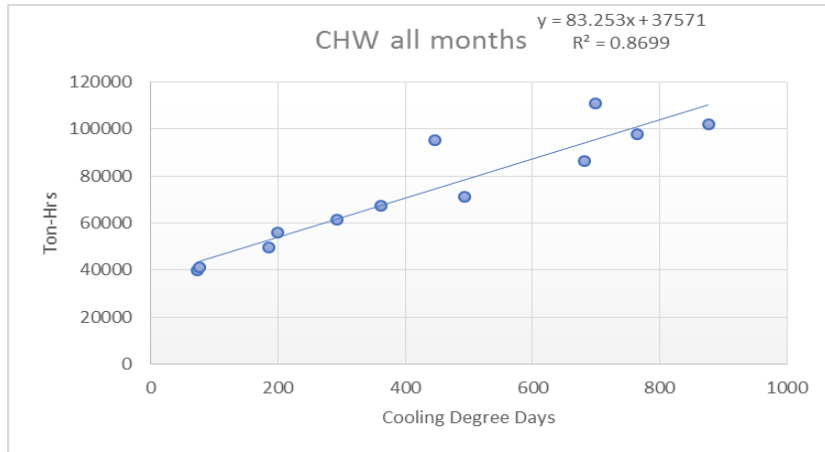


HLB EUI

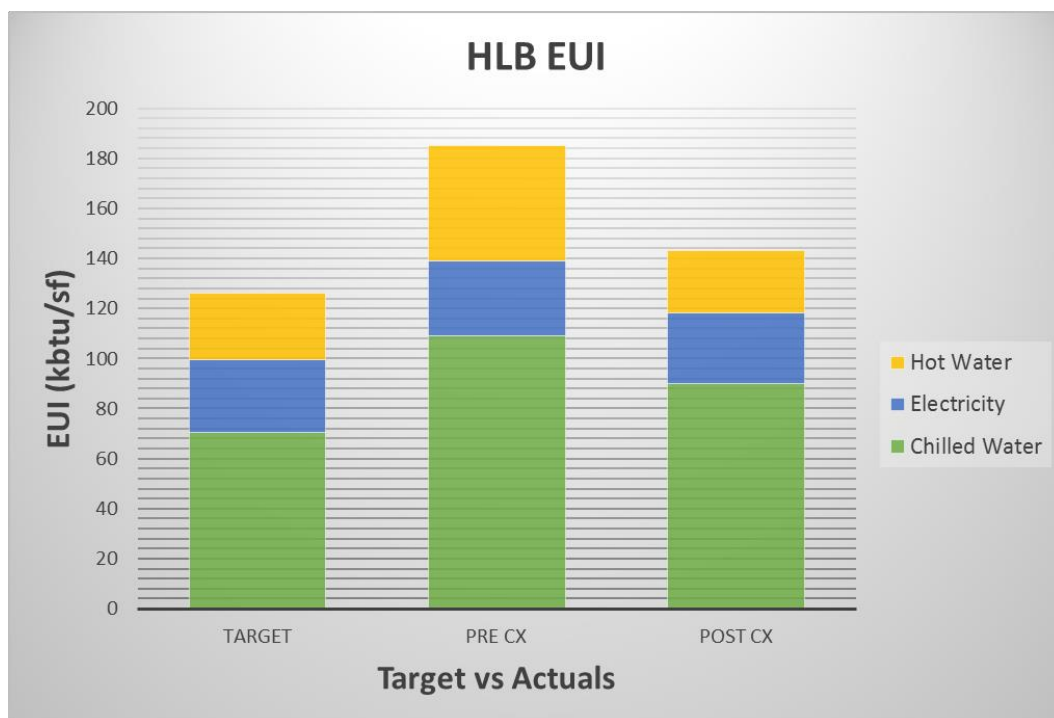


EUI CALCULATION FOR NEW BUILDING

Key Question: When did building start normal operation?



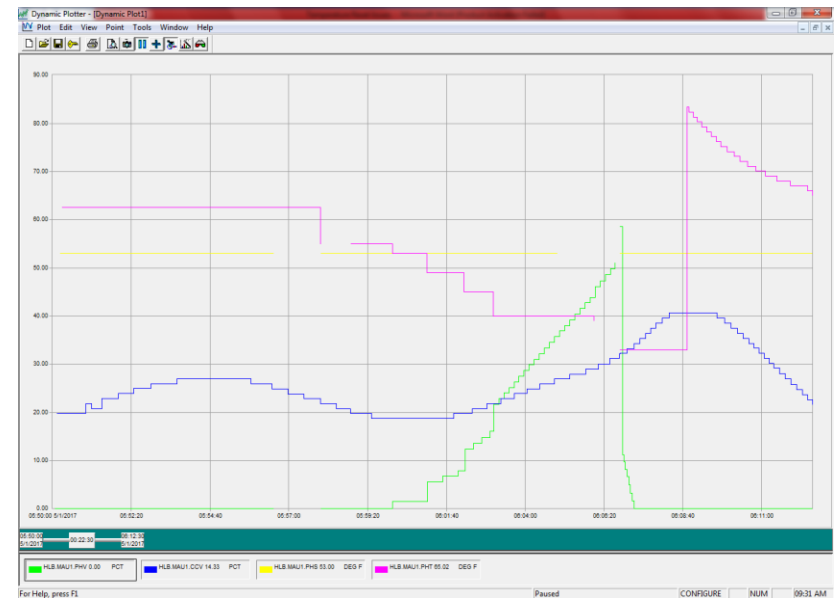
ONGOING COMMISSIONING RESULTS



	Chilled Water	Electricity	Hot Water	Total Building
Target EUI	71	29	26	126
Pre Cx	109	30	46	185
Post Cx	90	28	25	143
Avoided mmbtu	1,724	156	1,836	3,716
Avoided %	18%	6%	46%	23%

HEALTH LEARNING BUILDING CASE STUDY

- Evaluated programmed sequences of operations and current building behavior
- Developed 27 recommendations to improve system interactions and overall efficiency
- Facilitated meeting between the EOR, CM, Controls Contractor, Utilities & Energy Management Group to review recommendations.
- Tested the implemented recommendations to verify proper functionality.
- Analyzed trend data to verify systems improvements.
- Re-evaluated trend data on a monthly basis to further fine tune the building.

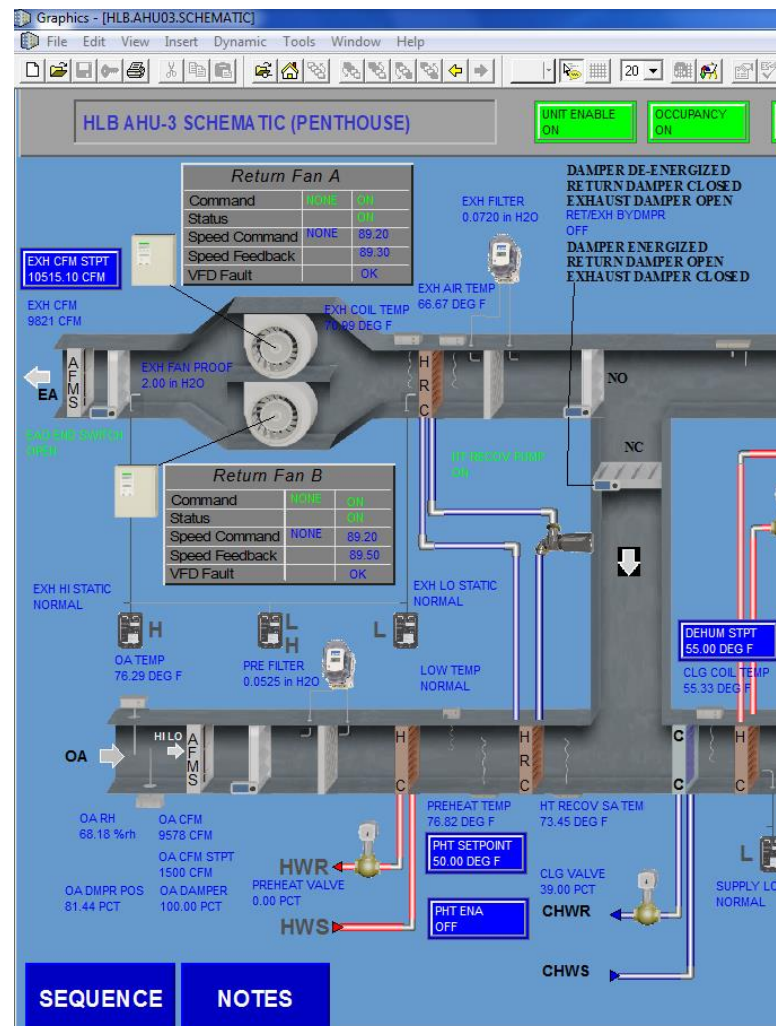


DISCHARGE AIR TEMPERATURE RESET

- Existing Condition: Reset Based on Linear Relationship with OAT
- Recommendation: Reset Based on Building Demand
- Implementation: Reset Based on Cooling Request
 - Cooling Request = Room Temperature > Cooling Set Point + 1° F
 - Cooling Request > 3 then Reset Temperature Down
 - Cooling Request = 0 then Reset Temperature Up

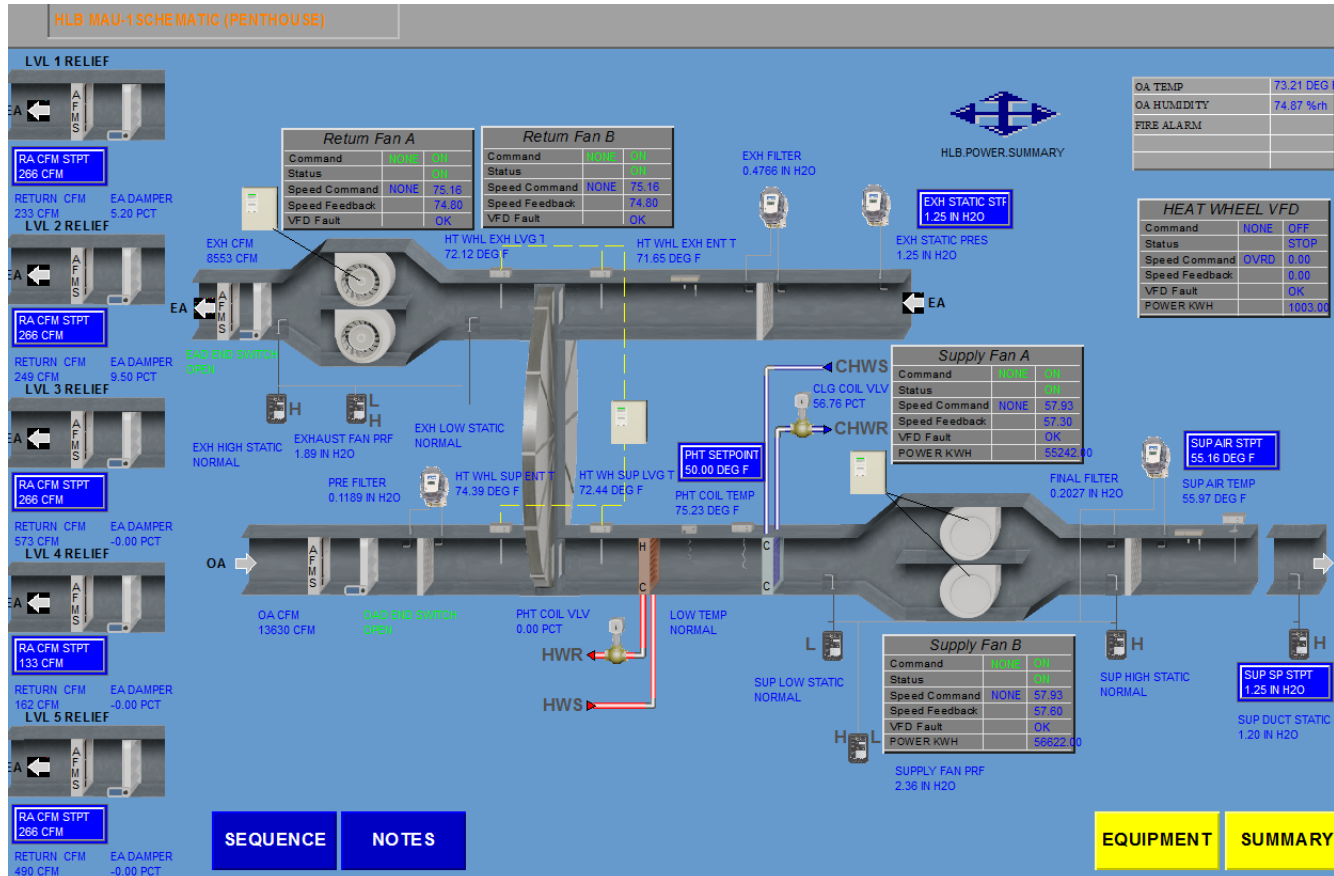
HEAT RECOVERY PUMP

- Existing Condition: AHU-03 HRP Enable/Disable
 $48^{\circ}\text{F} < \text{OAT} > 78^{\circ}\text{F}$
- Colder Return Air Temperature from Anatomy Lab
- Implementation: Enable HRP
 $\text{OAT} > \text{EAT}$ and $\text{OAT} - \text{EAT} \geq 5^{\circ}\text{F}$



MAKE UP AIR UNIT

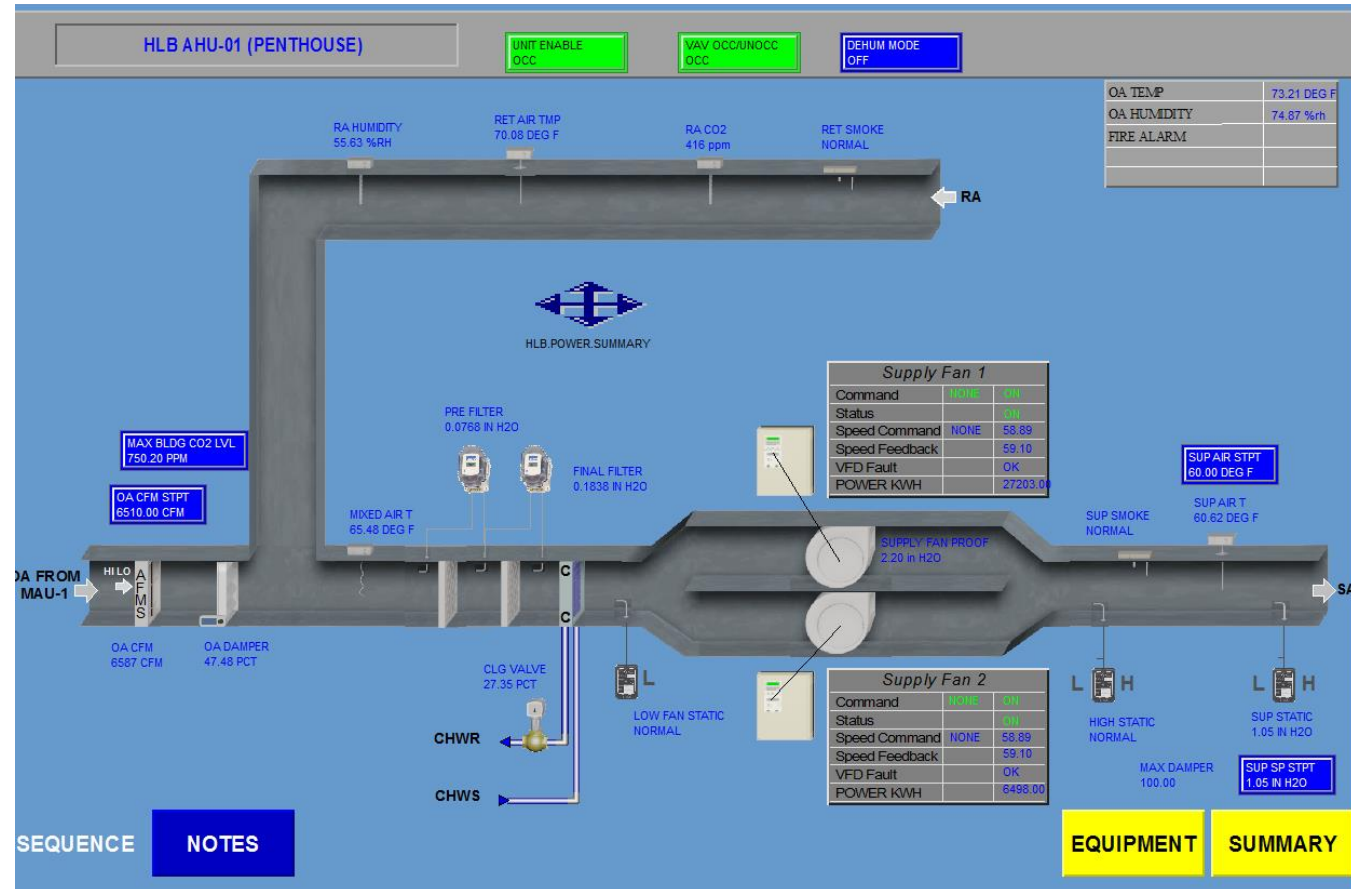
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- Existing Condition:
Preheat Temperature Set Point = 53 F
- Unit Discharges @55 F

MAKE UP AIR UNIT AND AIR HANDLER INTERACTION

- MAT Mid to High 60's
- Simultaneous Heating and Cooling
- Implementation: PHDAT Set Point for MAU-01 = 50°F



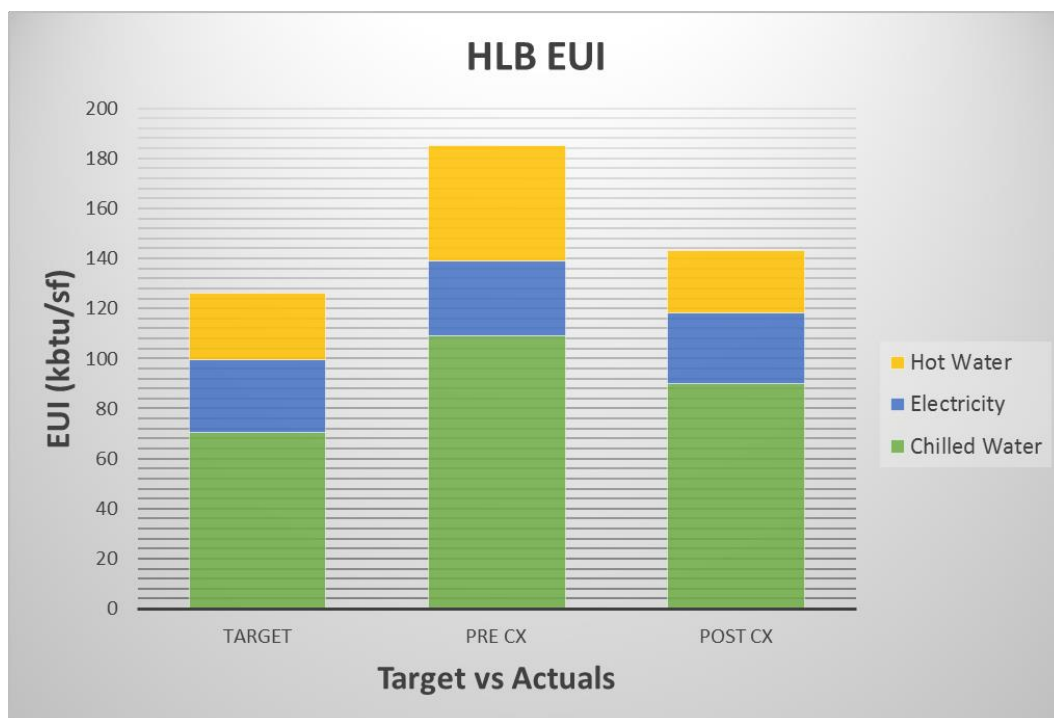
STATIC PRESSURE RESET

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Rooms Can Change Purpose



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