

How Did We Get Here?

A RETROSPECTIVE ON BUILDING ENERGY EFFICIENCY

PRESENTED BY PETE SALMON, CAROL DOLLARD, SAM CRISPIN AND
FROSTY SELMER

Warmup Trivia Question #1

In the energy efficiency industry, EUI stands for _____.

- A. Efficiency Use Identifier
- B. Electromagnetically-Controlled Unit Injector
- C. End User Information
- D. Energy Use Intensity

Warmup Trivia Question #2

On a typical higher education campus, the building type that has the highest EUI is _____.

- A. Laboratories
- B. Dining Facilities
- C. Athletic/Aquatic Facilities
- D. Residence Halls

Warmup Trivia Question #3

The oldest mechanical or control equipment still in use at all three represented campuses was installed in the _____.

A. 1920s

B. 1930s

C. 1940s

D. 1950s

Warmup Trivia Question #4

At local campuses, building square footage increased ~30% from 2010 through 2018. During that time, the campuses saw a _____ net change in campus energy consumption.

A. -10%

B. 0%

C. +15%

D. +30%

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Rocky Mountain APPA September 2018



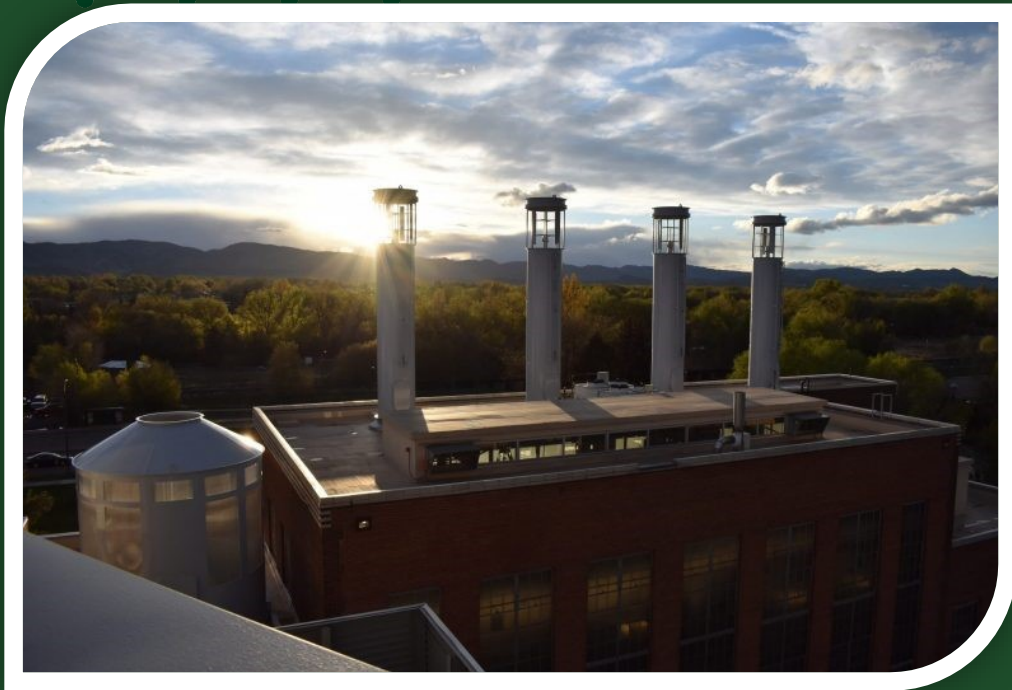
Colorado State University

Why I do this work.....





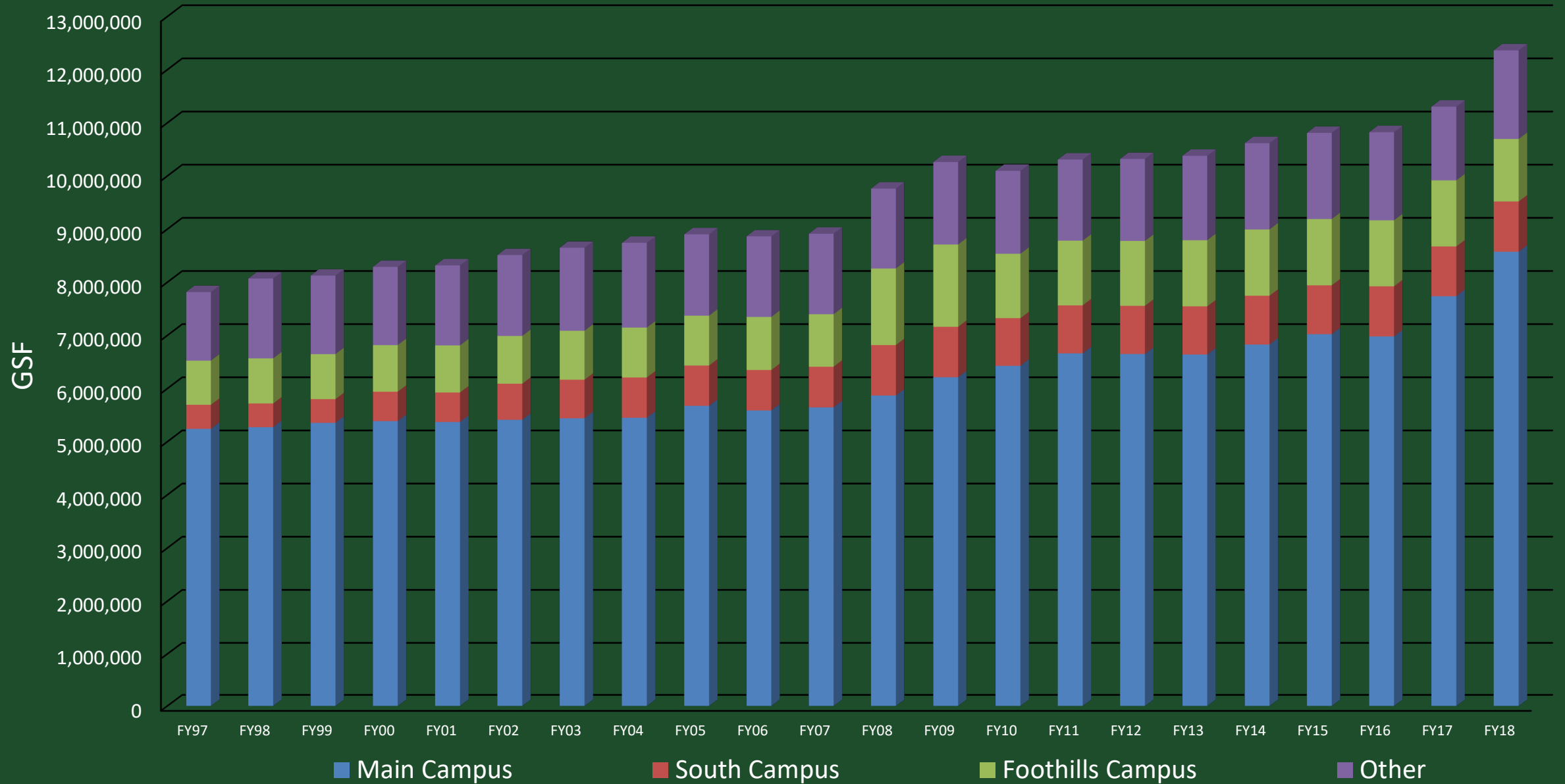
Colorado State University



- 32,000+ Students
- 7,000 Faculty & Staff
- Buildings = 12.3 M gsf (~750 buildings)
- \$20 M Annual Utility Costs
- District Energy Plants:
 - Steam = 360 klbs/hr (210 klbs/hr firm capacity)
 - Chilled Water = 7,400 tons
- All Campuses Electric Usage = 170,800 GWh/yr
- Main Campus Peak Electric Demand = 19.5 MW
- 200,000 MTCO₂e GHG Emissions
- Carbon Commitments:
 - 100% renewable electricity by 2030
 - 100% carbon neutral by 2050

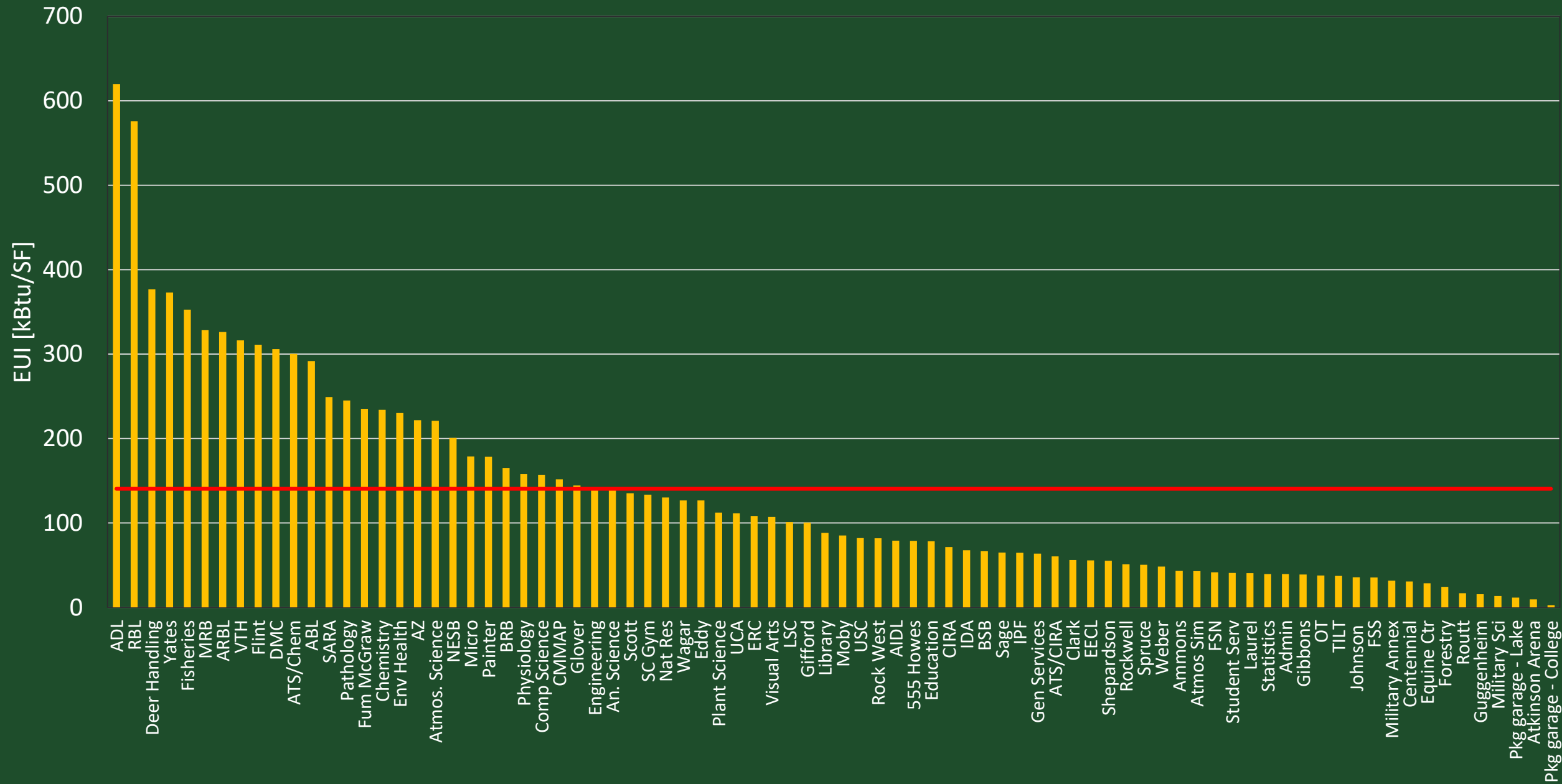


Campus Building Growth



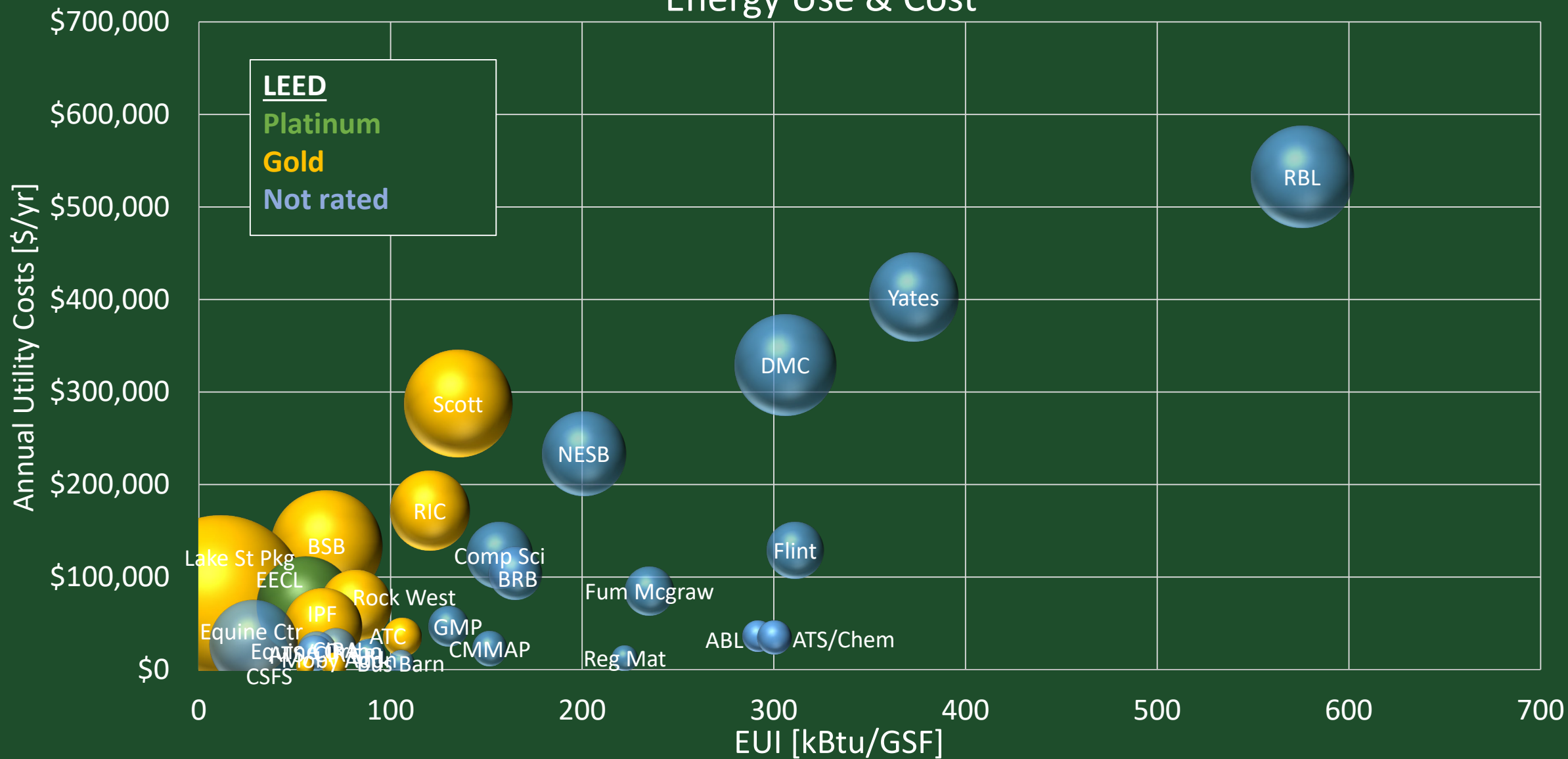


FY17 Energy Use Index



CSU Buildings < 25 Years Old

Energy Use & Cost



Tale of Two New Buildings....



Student Rec Center – Remodel Done Right

- Remodel/Addition in 2009
- Original Building 1980s vintage
- GSF Doubled (100K to 200K)
- Utility Costs – NO CHANGE
- LEED GOLD



Thank you

Carol.Dollard@colostate.edu



Colorado State University

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Why I Do What I Do



>120

Buildings

6,000

Students

**2.65
Million**

GSF Campus
Building Area

140

Average kBtu per
Square Foot

**6.5
MW**

Campus Electrical
Demand

**> \$5
Million**

Annual Utility
Budget

We keep growing, and growing, and growing....

- Over 12 major building additions in the last 10 years and more to come!
- Over 30% growth in square footage since 2008!



How do we control costs with all this growth?

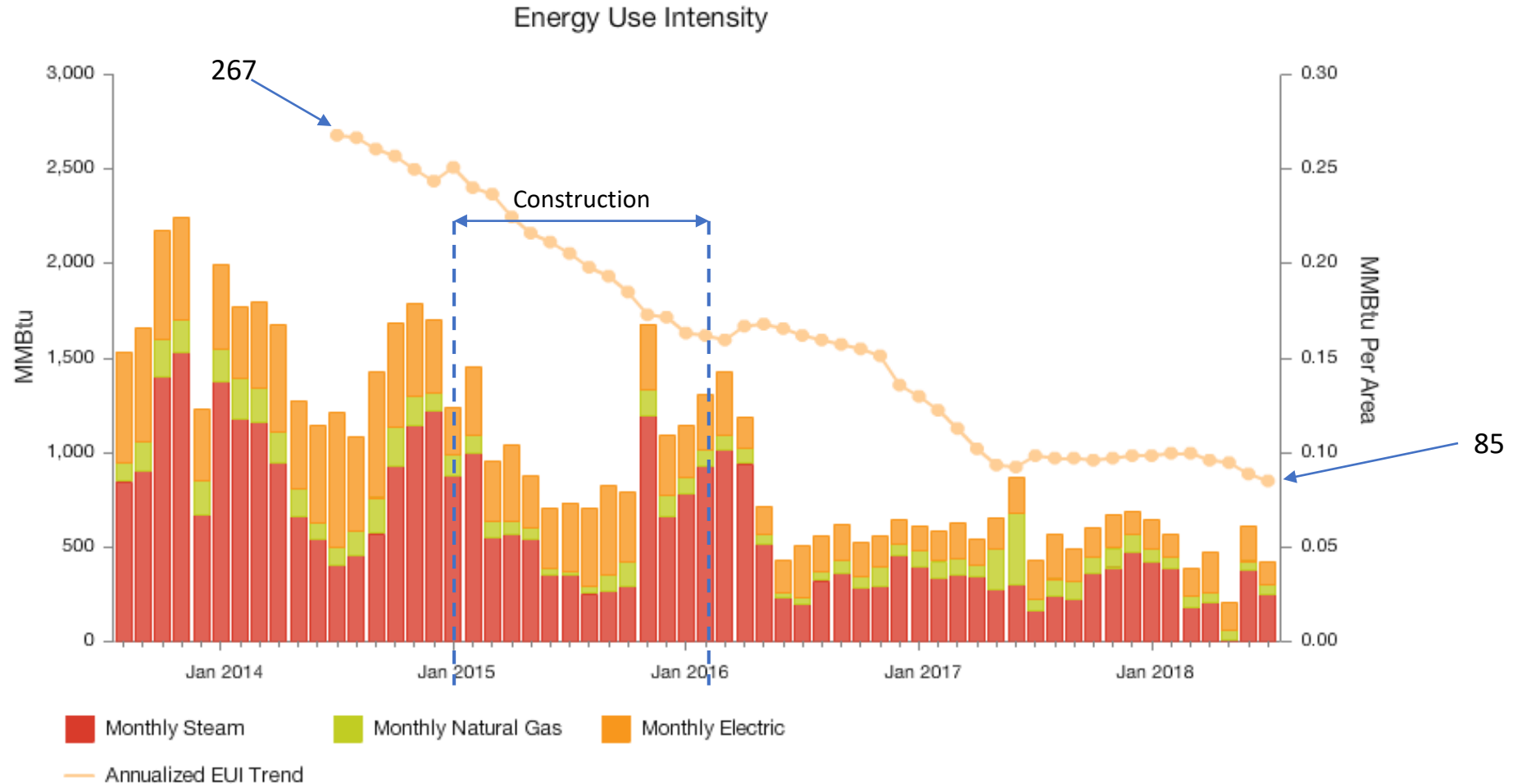
- Since buildings never die (almost never) we must renovate!



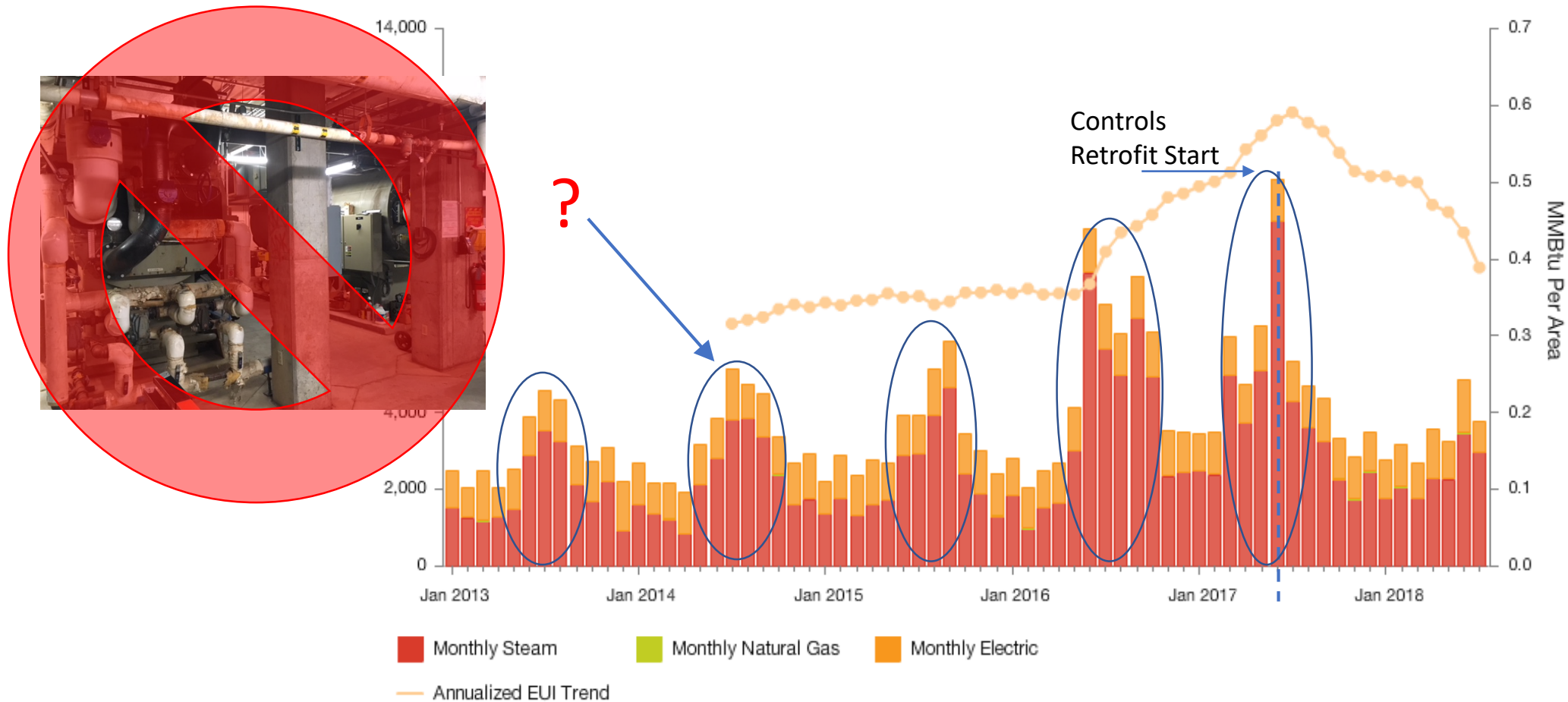
These two
really needed
some work!



Student Center Renovation Success Story



Hill Hall is a work in progress (but we have high hopes)



Thank You!





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The Central Energy Plant (CEP) – the single steam and chilled water plant for core campus.



CEP production fleet inventory:

3 - 60,000 PPH IBW boilers, 125 psig discharge, NG, Coal or Fuel Oil

1 - 30,000 PPH, 125 psig Keeler boiler, NG & Fuel Oil

2 - 1200 Ton VSD York Centrifugal Compressor Chillers



CORE CAMPUS:

- 87 Bldgs.' on CEP Steam = 5,977,183 GSF
- ~19 Buildings added in the last 10 years adding +1,000,000 GSF
- Average EUI for CEP connected buildings ~108 KBTU/GSF-Yr. Ten years ago this was 146.

RMA 2018 - Mile High Motivation - Innovate. Integrate.



CORE CAMPUS AERIAL VIEW – 2017



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UNIVERSITY
OF WYOMING

BEST PERFORMER – MAJOR RENOVATION: BIOLOGICAL SCIENCES

Back before FY2013 the building had an EUI of ~75-86 with poor lab air quality. After a major HVAC upgrade complete with new controls, fume hoods and AHU's it dropped to ~55. After further fine tuning dropped it to 46.



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WORST PERFORMER – ENERGY INNOVATION CENTER

This building came on line in the summer of 2012. The EUI's have been as high as 205 with the most recent at 141. Problems included poorly sized evap cooling for both the exhaust and intake, poor AHU layout, common return for 2 AHU's, heat recovery coils with extremely high air pressure drop which made face and by-pass impossible to control, high pressure loss lab air valves, too much glazing and a poor exterior envelope.

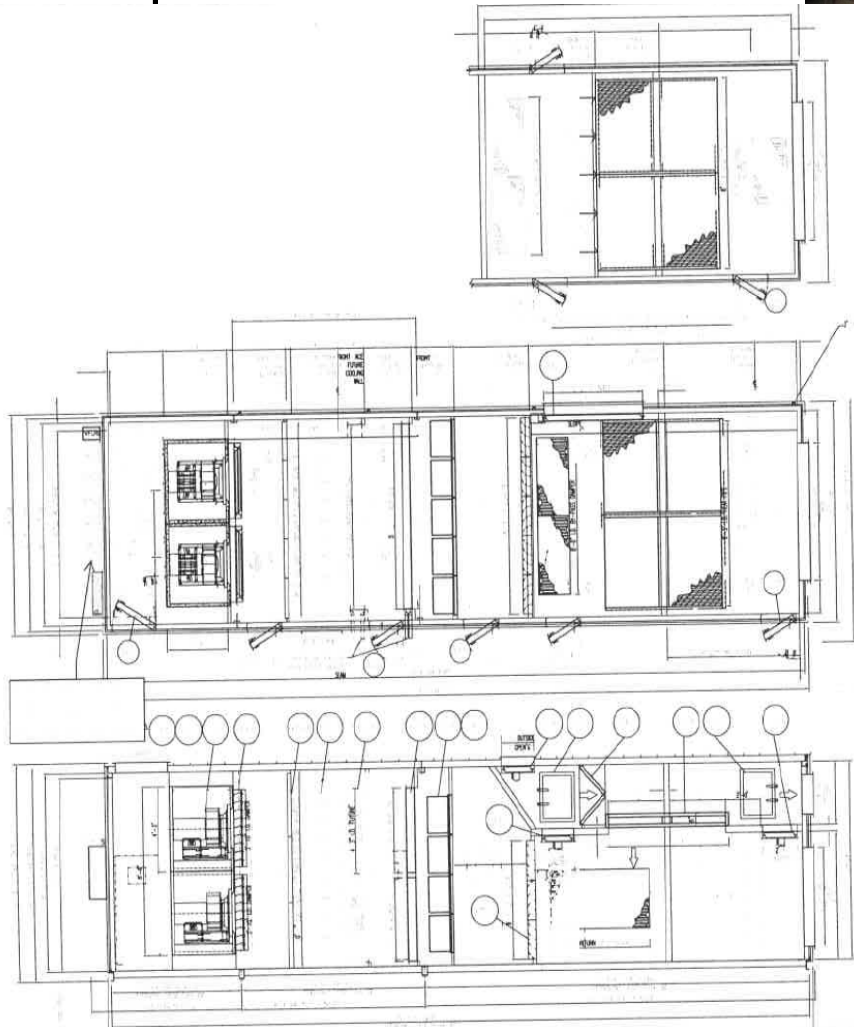


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WORST PERFORMER – Energy Innovation Center

More pictures of EIC



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KEY LESSONS LEARNED:

1. Keep HVAC system right sized with air pressure drops kept to a minimum. Most institutions have buildings that will last 50 years and the life cycle cost becomes huge. Don't solve things with horsepower (i.e. fan laws). Most building electrical use is due to motors.
2. Have a system set up where operations is a major partner in the plan development, with lots of input from the key operational staff. This includes a good set of design and construction standards to give the consultants and a good method of contract delivery.
3. Commissioning needs to have owner involvement.
4. Need to have very good relations with consultants.
5. Best bang for the buck for UW was getting a very pro-active Building Automation Group to provide input into the design documents.

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Thank You!

