Texas A&M Utility Master Plan Implementation

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CampusEnergy2016: The Changing Landscape

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INTRODUCTION

Texas A&M University System Overview

Campus Size

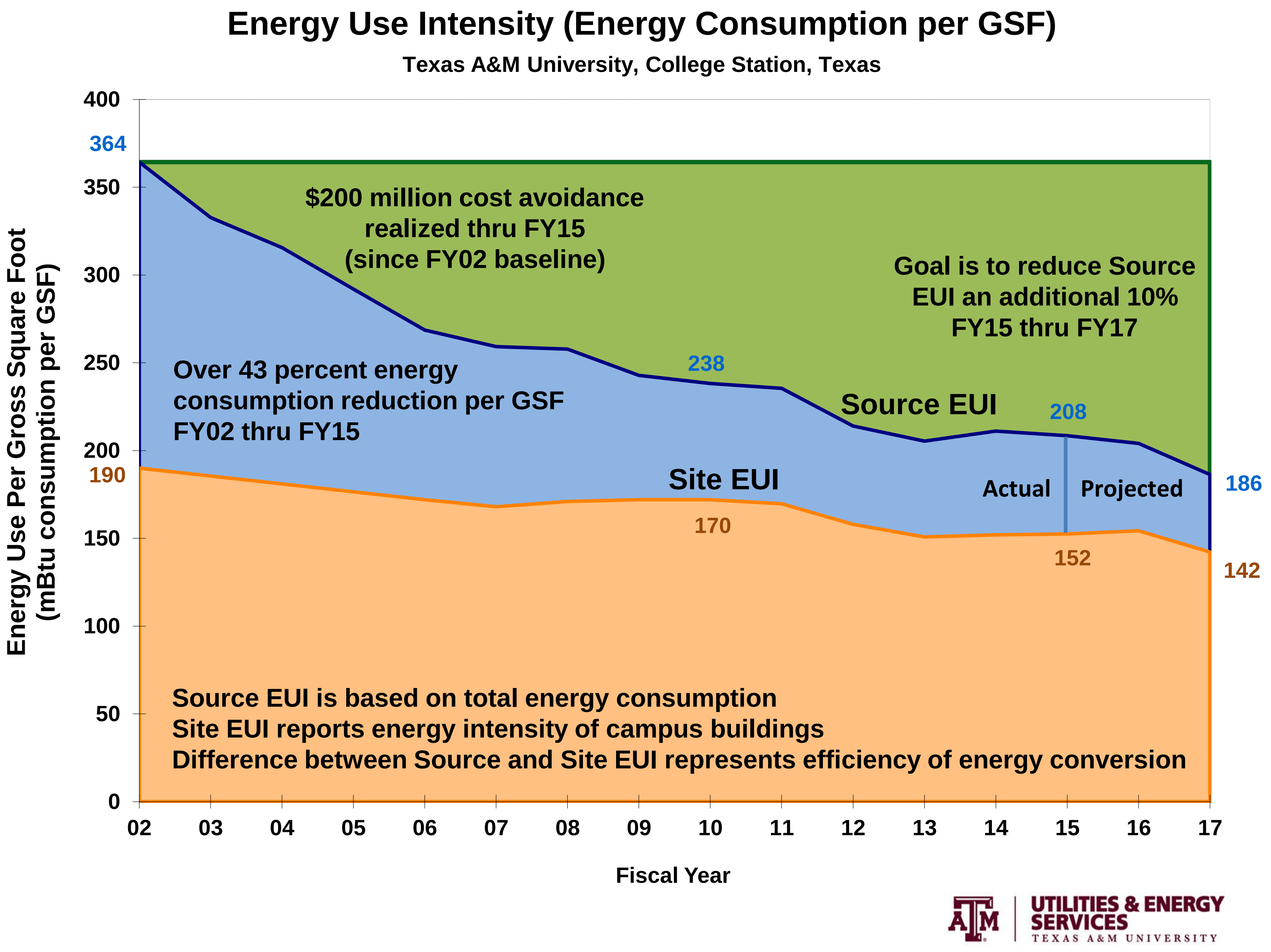
- 58,000 students
- Over 24 million GSF served
- Increasing to 28 million GSF within three years

Thermal systems divided between east/west campus

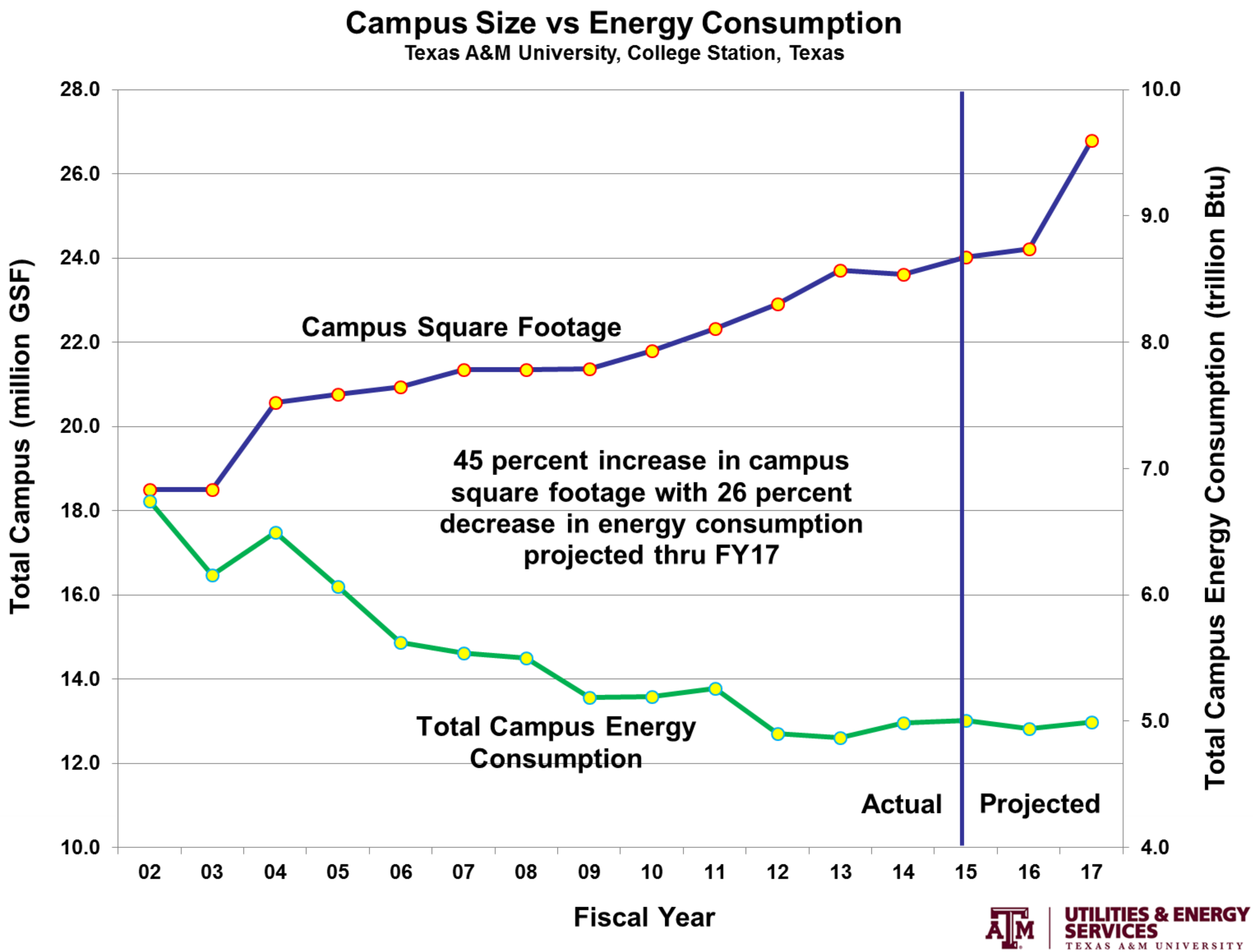
Four utility plants - CUP, SUP1, SUP2, SUP3

Capacities

- 50 MW power generation
  - 34 MW gas turbine
  - 16 MW with two steam turbines
- 60,000 tons of cooling (both electric & steam)
- 440,000 pph of steam
- 450 million Btu/hr of heating hot water



Energy Use Intensity (Energy Consumption per GSF)
Texas A&M University, College Station, Texas
Energy Use Per Gross Square Foot (mBtu consumption per GSF)
400
350
300
250
200
150
100
50
0
364
190
$200 million cost avoidance realized thru FY15 (since FY02 baseline)
Goal is to reduce Source EUI an additional 10% FY15 thru FY17
Over 43 percent energy consumption reduction per GSF FY02 thru FY15
238
Source EUI
208
Site EUI
Actual
Projected
186
170
152
142
Source EUI is based on total energy consumption
Site EUI reports energy intensity of campus buildings
Difference between Source and Site EUI represents efficiency of energy conversion
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
Fiscal Year
UTILITIES & ENERGY SERVICES
TEXAS A&M UNIVERSITY


Campus Size vs Energy Consumption
Texas A&M University, College Station, Texas
28.0
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
Total Campus (million GSF)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
Total Campus Energy Consumption (trillion Btu)
Campus Square Footage
45 percent increase in campus square footage with 26 percent decrease in energy consumption projected thru FY17
Total Campus Energy Consumption
Actual
Projected
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
Fiscal Year
UTILITIES & ENERGY SERVICES
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UTILITY MASTER PLANNING

	2012	YEAR 5	YEAR 30	AVG GROWTH/YR
AREA (MGSF)	22.5	24.6 (9%)	35.2 (56%)	1.5%
CHW Peak (ktons)	37.6	41.5 (10%)	64 (70%)	1.7%
HHW (MMBtu)	222	242 (9%)	372 (68%)	1.6%
DHW (GPM)	295	324 (10%)	581 (97%)	2.2%
Electricity (MW)	70	80 (14.3%)	100 (43%)	1.4%

Contributed to 43% energy reduction per GSF achieved since 2002 and $200 million in cost avoidance

Improved safety and reliability

Reduced capital and operating cost with proactive program

Delayed savings are LOST savings

MAJOR PRODUCTION EQUIPMENT UPGRADES

CUP	CAPACITY	EQUIPMENT
POWER	50 MW	GTG1, STG2, STG4
STEAM	440 mlb/hr	B1, B2, B12
CHW	24,700 tons	CHLR3, 4, 5, 6, 7, 8, 9, 10
SUP1	**CAPACITY**	**EQUIPMENT**
HHW	1,000 BHP	B104, 105, 106, 107, 108, 109
CHW	10,000 tons	CHLR103, 104, 105, 106
SUP2	**CAPACITY**	**EQUIPMENT**
HHW	500 BHP	B201, 202, 203, 204, 205, 206, 207, 208
CHW	11,000 tons 24,000 ton hours	CHLR201, 202, 204, 205, 206, 207 Thermal Energy Storage
SUP3	**CAPACITY**	**EQUIPMENT**
HHW	1,000 BHP	B303, 304, 305, 306, 307, 308, 309
CHW	6,400 tons	CHLR301, 302, 304

MASTER PLANNING BENEFITS

Improved safety

Higher reliability

Improved operating efficiency

- Significant cost avoidance
- Capital expenditure offset
- Energy consumption reduction
- Reduced GHG emissions

Better management of capital investment

Operational flexibility

Enhanced economic dispatch capability

- Respond promptly to changes in market conditions
- Achieve demand reduction and greater cost avoidance

TAMU 2012 MASTER PLAN
$32 MM in LCC savings
151,000 MTCO2e annual carbon reduction

MASTER PLANNING STEPS

Identify obvious needs and priorities
Hire capable engineering firm
Document capabilities and limitations
Define and document specific needs
Complete engineering and financial analysis
Document upgrades and investment required
Identify funding source (well-defined cost recovery model)
Complete thorough justification
Develop implementation plan
Obtain necessary approvals
Proceed with design and project implementation
Effectively measure and report results achieved

RESULTS

Centrifugal Chiller replacements – efficiency improvements

Tag	Original Install Year	Original Drive/Type	Original Nominal Capacity (Tons)	Original Efficiency, Full Load	New Drive/Type	New Nominal Capacity (Tons)	New Efficiency, Full Load NPLV
CHLR007	1971	STM/CNTRF	3,350	4.71 COP	ELEC/CNTRF	3,350	0.61 kW/ton 0.39 kW/ton
CHLR010	1978	ELEC/CNTRF	3,350	0.76 kW/ton	ELEC/CNTRF	3,150	0.60 kW/ton 0.35 kW/ton
CHLR103	1979	ELEC/CNTRF	2,000	0.76 kW/ton	ELEC/CNTRF	2,500	0.58 kW/ton 0.36 kW/ton
CHLR201	1984	ELEC/CNTRF	1,334	0.61 kW/ton	ELEC/CNTRF	2,500	0.61 kW/ton 0.37 kW/ton
CHLR301	1989	ELEC/CNTRF	1,100	0.62 kW/ton	ELEC/CNTRF	2,500	0.61 kW/ton 0.37 kW/ton
CHLR302	1989	ELEC/CNTRF	1,100	0.62 kW/ton	ELEC/CNTRF	2,500	0.61 kW/ton 0.37 kW/ton

RESULTS

Heat Recovery Chiller addition - savings and benefits

Serve simultaneous heating and cooling loads

Increased electrical consumption, reduced NG and water consumption

Increased operational flexibility and redundancy

12/22-12/26 performance

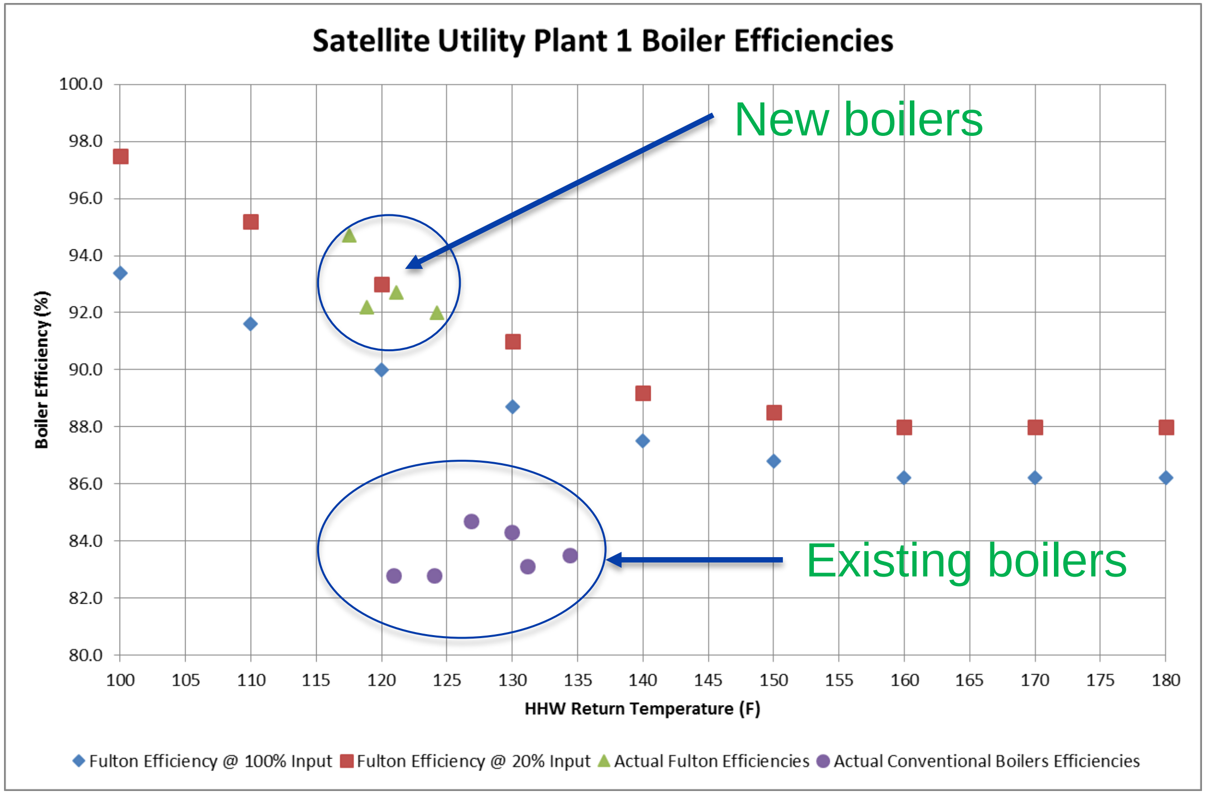
- Heat recovery chiller was only HHW production at SUP2
- $8,000 cost avoidance over 5 days

RESULTS

Condensing Boiler addition - savings and benefits

6 MMBtu HHW Boilers

Offsets existing non-condensing boiler loads; less efficient boilers used only for peaking 3 months out of the year, as needed



HHW Return Temperatures (% of total annual hours)

<130 °F 75.6% <125 °F 67.3% <120 °F 23.5%

RESULTS

Thermal Energy Storage Tank projected savings and benefits

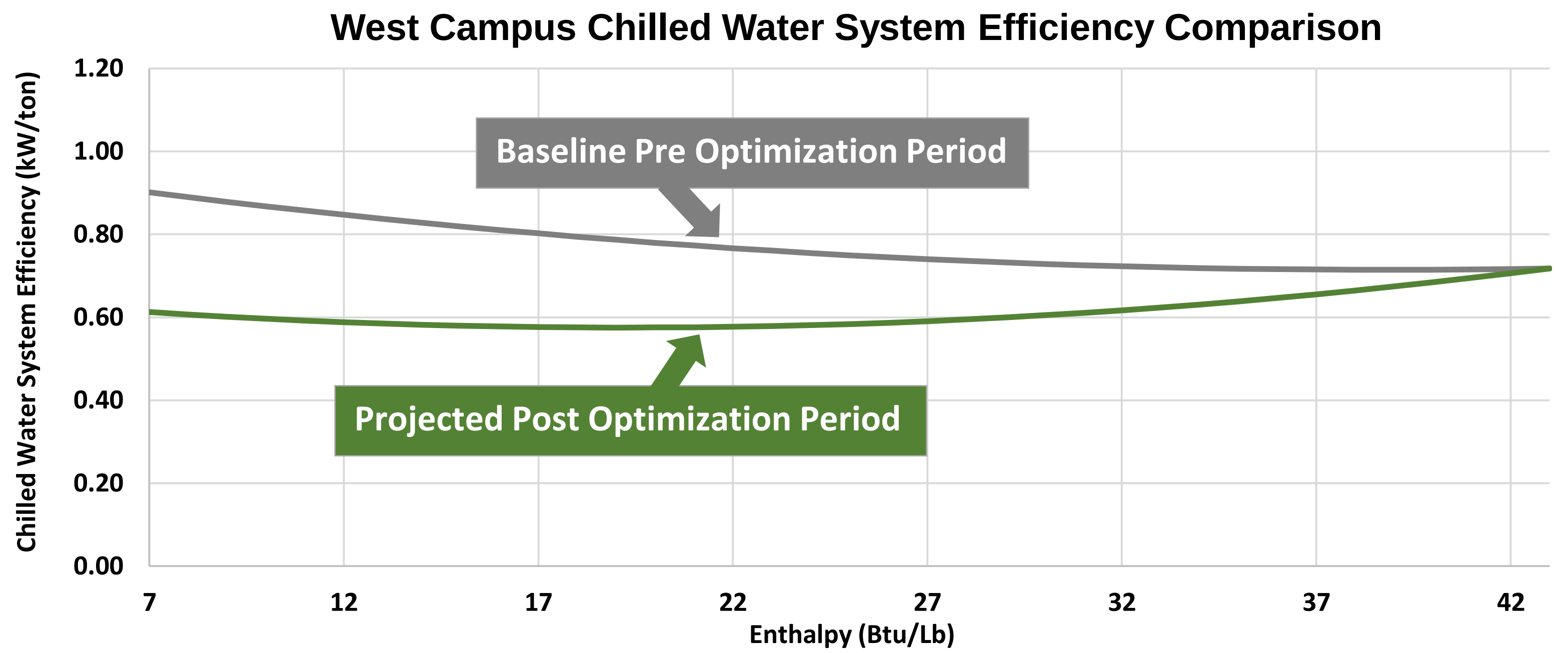
Capital offset (avoid chiller installation)

Operational flexibility

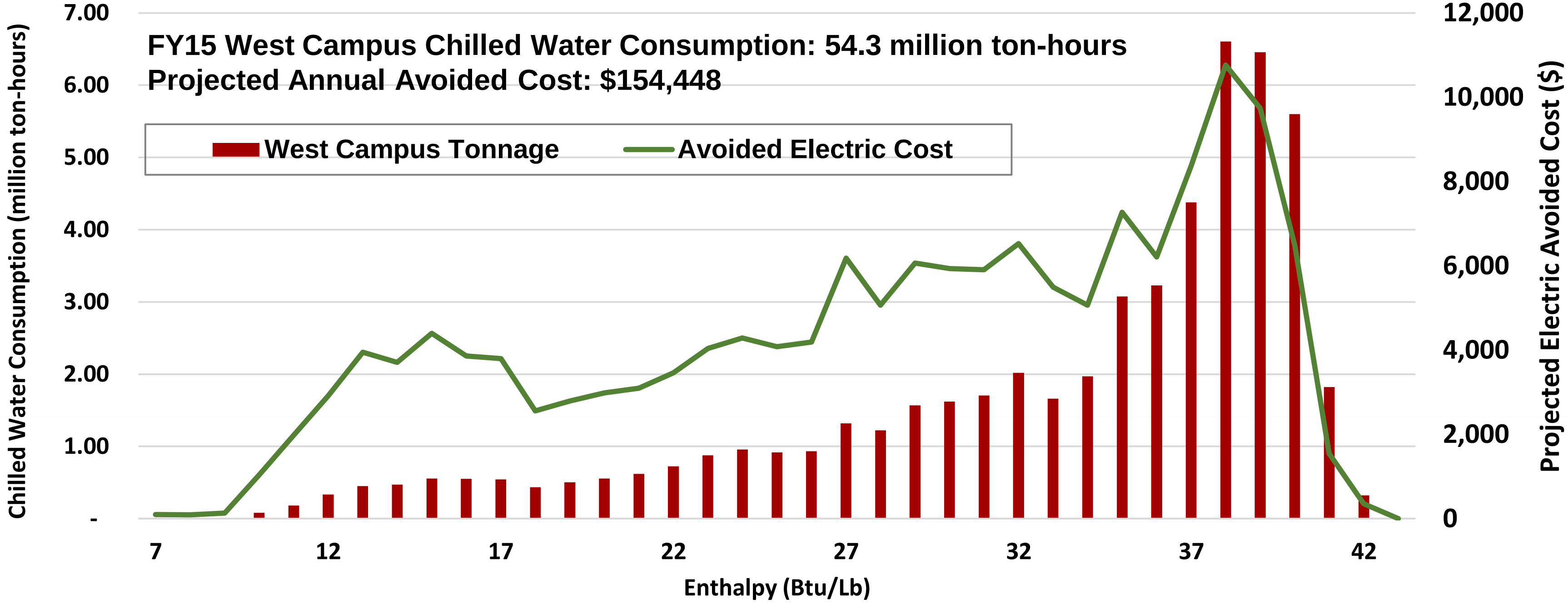
Economic Dispatch

- Shift load from peak to off-peak
- Respond to 4CP demand periods
- $250k/year cost estimated cost avoidance

RESULTS



West Campus Chilled Water System Efficiency Comparison
Chilled Water System Efficiency (kW/ton)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Baseline Pre Optimization Period
Projected Post Optimization Period
7
12
17
22
27
32
37
42
Enthalpy (Btu/Lb)



FY15 West Campus Chilled Water Consumption: 54.3 million ton-hours
Projected Annual Avoided Cost: $154,448
West Campus Tonnage
Avoided Electric Cost
Chilled Water Consumption (million ton-hours)
7.00
6.00
5.00
4.00
3.00
2.00
1.00
-
Projected Electric Avoided Cost ($)
12,000
10,000
8,000
6,000
4,000
2,000
0
7
12
17
22
27
32
37
42
Enthalpy (Btu/Lb)

NEXT STEPS

Utility Master Planning

Renew and update plan every five years

- Ensure alignment with institution and business mission
- Develop utility and energy design standards
- Include safety, reliability, efficiency and environmental goals
- Document 5-year and 20-year plan
- Include following components:
  - campus growth and development projections
  - all production and distribution systems
  - existing system age and condition

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