

SMUD Energy Efficiency Benchmarking Demonstration Project

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Agenda

- Project Overview and objectives
- Provide overview of SynapSense Energy Efficiency Benchmarking Results
- Discussion and lessons learned

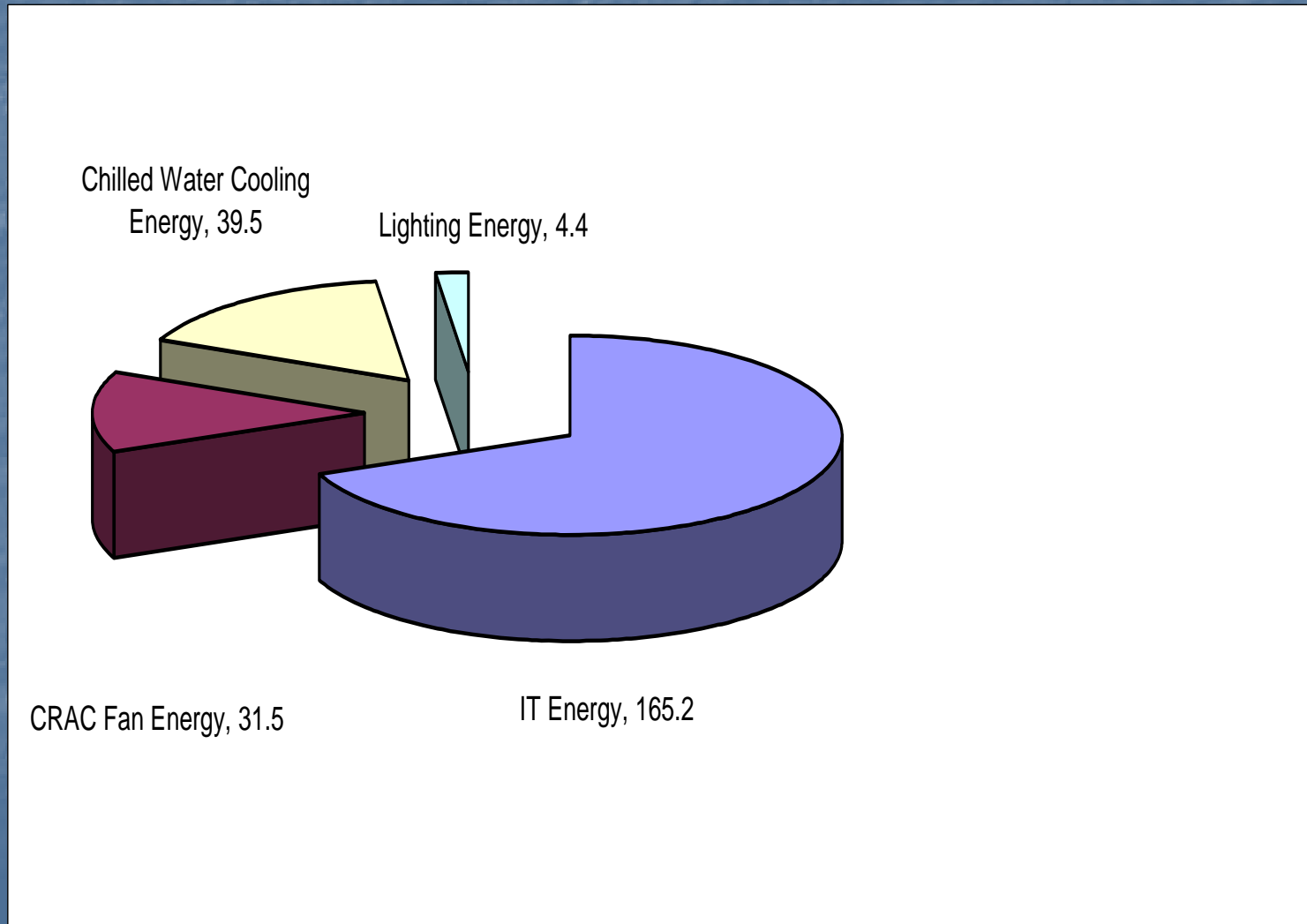
Project Overview

- District is considering this technology as a new program for service territory data centers
- Pilot programs at local data centers in service area
- No current Energy Efficiency programs in this sector
- 40-60% of typical office energy use is consumed in a data centers
- Data Centers are overcooled to meet the cooling requirements of the hottest running server

Project Objectives

- Validate value of new technology
- Demonstrate energy savings potential
- Reduce energy consumption and improve efficiency
- Include cross discipline teams
- Pursue a new incentive program for customers

Figure 11 – SMUD Data Center: Baseline Energy Consumption (kW)



Data Center Deployment

- 10 CRAC supply & return air temperature and supply air relative humidity sensors
- 200 Sensors at the rack inlet air temperature of the top, middle and bottom of representative racks
- 100 Humidity Sensors
- 37 hot aisle temperature sensors at the top of rack
- 6 Sub-Plenum pressure differential sensors

Benchmarking Results

- Operational Best Practices
 - Every data center needs to go thru a phased analysis approach to improving energy efficiency
- Data Center Metrics:
 - PUE: 1.5 (on a scale of 1 to 3)
 - CSI: Several racks with a CSI index >50%;susceptible to over-heating.
 - 10% Data Center square footage reclaim equivalent to ~ \$290K
- Overall Resiliency Improvements:
 - Monitoring to comprehend risks, & improve airflow management
- Energy Savings:
 - 7% kWh equivalent to \$13,215 and 5% energy reclaim
- Carbon Footprint Reduction:
 - 143,416 kWh savings and SMUD's .436 lbs/CO2 intensity per kWh, (ref: CARMA.Org)

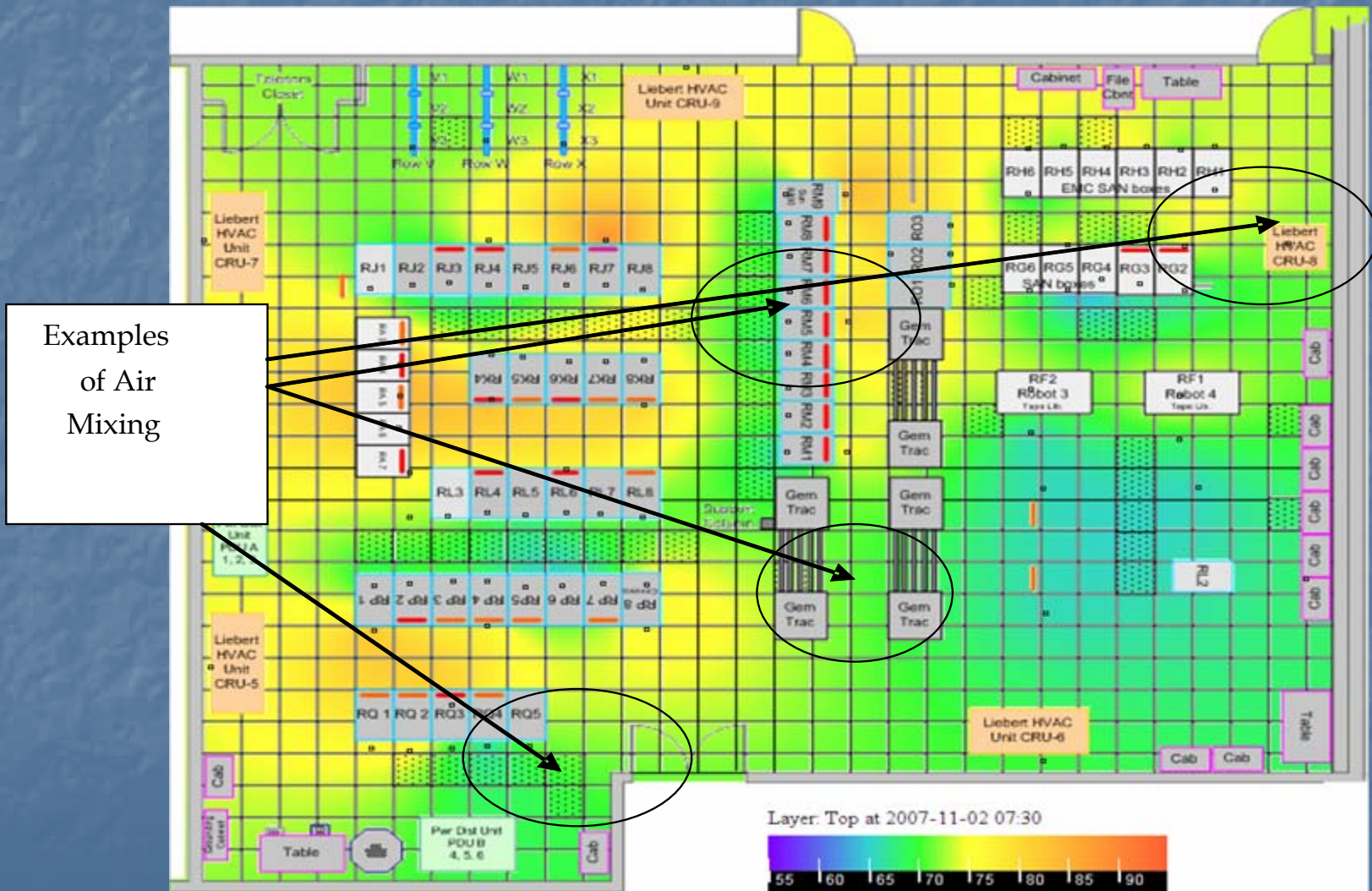
Racks outside of ASHRAE Range

The following racks are outside of the ASHRAE recommended range:

Rack	ASHRAE Violation
RG East	Middle & Top of Rack Below ASHRAE
RG West	Top, Middle & Bottom of Rack Below ASHRAE
RH East	Hot Aisle is within ASHRAE; (i.e. too low)
RJ West	Bottom of Rack Below ASHRAE
RK East	Top, Middle & Bottom of Rack Below ASHRAE
RK South	Hot Aisle within ASHRAE; (i.e. too low)
RL Center	Middle and Bottom of Rack Below ASHRAE
RM Middle	Middle and Bottom of Rack Below ASHRAE
RM South	All Rack Readings Below ASHRAE
RP East	Hot Aisle Within ASHRAE (i.e. too low)

Air Mixing

Figure 2 - SMUD Data Center: Red Circles show areas of air mixing



Operational Improvements

- Improve air flow loss from 50% to 36% by better managing the data center airflow
 - Improve sub floor pressure & reduce air mixing
- Increase the CRAC supply air temperature from 59 to 63 degrees
- Turn off one CRAC unit
- Continue monitoring to make changes to data center with confidence
- Improve overall energy efficiency in Phase 1 by 7% -12%.

ROI Analysis

SMUD Data Center Energy Loss Due to Air Mixing

Parameters	Values	
Electricity rate (\$/kwh)	0.09	
Total number of hours used	8,760	
Data Center Floor Area (square feet)	2,932	
Load (Watt/square feet)	56	
Total IT Load (KW)	165	
IT Load (% of total electricity load)	69%	
Fan Load (% of total electricity load)	13%	
Chiller Load (% of total electricity load)	16%	
Chiller savings for each 1 deg Supply temp increase	1.5%	
Design Outlet Temp - Inlet Temp (Server) (Degrees)	28	
	Analysis	
	Before	Recommendation
Total IT Load (KW)	165	165
Total Data Center Load (KW)	241	224
IT Load (% of Data Center Load)	69%	74%
Fan Load (KW)	32	18
Chiller Tons	49	53
Chiller Load (KW)	40	37
CRAC Delta T (Return Temp - Supply Temp - Degrees)	14	18
Total Fan kWh/yr	275,940	153,300
Total Chiller kWh/yr	346,265	325,489
Total Cooling System kWh/yr	622,205	478,789
Excess Airflow loss	50%	36%
		14%
Energy savings from turning off over-provisioned CRACs (KW)		14
Average CRAC Supply Air Temp	59	63
Chiller Savings from increasing CHWS Temp (in KW)		2.4
Total Savings (in KW)		16.4
Total% Energy Savings		7%
Reclaim: Additional IT energy availability		5%
Total Annual Energy savings (in \$)		\$ 13,215
Sq Ft reclaim		290
% Sq Ft reclaim of current space		10%
Benefit vs new real estate at \$1k/sq ft		\$ 290,497
SynapSense Wireless Datacenter Solution Cost		\$ 17,592
	<i>SF</i>	\$ 6.00
ROI Analysis for SynapSense solution (# of months to payback)		16.0
	143,416 kWh savings 0.08 Utility incentive - .09 cents per kWh 11,473 EE Incentive Rebate - Capped at 50% 8,796 6,119 Price after incentive	
	Months	5.60

Discussion and Next Steps

- SMUD Data Center:
 - Phase 1: Monitor, Improve, Validate energy savings using ongoing Wireless Green Data Center Solution
 - Phase 2: Pursue ongoing data center energy efficiency by achieving adaptive cooling and containment
- Provide incentives to customers to further the energy efficiency opportunities in the data center