Implemented Continuous Commissioning® Measures for Schools, Hospitals, and Office Buildings in the U.S.

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Introduction

An overview of 32 projects from 1999 to 2013

- 43 Schools, 68 Hospitals, 4 Office Buildings, and 11 Other Buildings

Achieved Energy Savings by Building Type from 32 projects

Building Type	# of Buildings	Conditioned Square Feet	Savings $/ Year	Savings$/ Year,Sqft
Schools	43	4,526,962	1,112,604	0.25
Hospitals	68	3,554,897	960,863	0.27
Offices	4	187,506	143,465	0.77
Other (Courthouse, Research center, Cultural center, etc.)	11	1,255,484	523,631	0.42
Grand Total	126	9,524,849	2,740,563	0.29

Achieved Energy Savings by Location and Climate from 32 projects

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State	City	ASHRAE Climate Zone	Building Type	# of Buildings	Conditioned Square Feet	Savings $/ Year	Savings $/ Year,Sqft
TX	Austin	2A (Hot & Humid)	School	15	1,765,264	265,703	0.15
			Office	3	106,550	72,119	0.68
			Other	7	604,020	375,301	0.62
TX	Brenham	2A (Hot & Humid)	Hospital	30	362,249	48,888	0.13
TX	College Station	2A (Hot & Humid)	School	1	61,658	61,828	1.00
TX	Corpus Christi	2A (Hot & Humid)	School	13	826,300	127,587	0.15
TX	Dallas	3A (Warm & Humid)	Office	1	80,956	71,346	0.88
TX	Kerrville	3B (Warm & Dry)	Hospital	18	316,700	179,600	0.57
TX	Laredo	2B (Hot & Dry)	School	3	408,000	276,434	0.68
TX	Lubbock	3B (Warm & Dry)	School	6	800,000	132,012	0.17
TX	Prairie View	2A (Hot & Humid)	School	3	278,291	112,464	0.40
TX	San Antonio	2A (Hot & Humid)	Hospital	5	1,468,592	329,437	0.22
TX	Terrell	3A (Warm & Humid)	Hospital	13	499,356	159,386	0.32
TX Subtotal				118	7,577,936	2,212,105	0.29
CA	Edwards	3B (Warm & Dry)	Other	3	281,464	41,500	0.15
GA	Fort Benning	3A (Warm & Humid)	Hospital	1	398,000	69,552	0.17
MN	Minneapolis	6A (Cold & Humid)	Hospital	1	510,000	174,000	0.34
PA	State College	5A (Cool & Humid)	School	1	37,449	86,000	2.30
UT	Salt Lake City	5B (Cool & Dry)	School	1	350,000	50,576	0.14
			Other	1	370,000	106,830	0.29
Other Subtotal				8	1,946,913	528,458	0.27
Grand Total				126	9,524,849	2,740,563	0.29

CC® Measure Category

In general, most commissioning measures are categorized by non-standard groups.

- However, a standard grouping is necessary to better understand and apply commissioning measures.
- Therefore, this study presents standard annotations to categorize the implemented CC® measures.

CC® Measure Category

- In order to apply standard annotations, the implemented CC® measures were categorized by two types: system type and measure type.
- The system type consists of Air-Side HVAC System, Water-Side Central Plant, and Other.

Categorization by System Type

1st Level System Type	2nd Level System Type	3rd Level System Type
Air-Side HVAC System	Single Zone (SZ) AHU	Constant Air Volume (CAV)/ Variable Air Volume (VAV)
	Multi Zone (MZ) AHU	Single Duct (SD) CAV/ SD VAV/ Dual Duct (DD) CAV/ DD VAV
	Terminal Box	CAV/VAV
Water-Side Central Plant	Chilled Water (CHW) System	N/A
	Heating Hot Water (HHW) System	N/A
	Steam HW System	N/A
	Domestic Hot Water (DHW)	N/A
Other	N/A	N/A

CC® Measure Category

- The other approach for categorizing the implemented CC® measures is by measures type that uses standard annotations.

Categorization by Measure Type

1st Level Measure Type	General Description for the 1st level	2nd Level Measure Type
Operation	Turn off system or reduce system quantity/volume or change operation	N/A
BAS Control/ Optimization	Optimize sequence of operation to take advantage of variable loads	**Standard Annotation**
Maintenance	Restore or repair components of systems to correct operation	N/A

CC® Measure Category

- Process variables were used to categorize the 2nd level measure type of BAS Control/Optimization with the standardized approach.

Process Variables for Standard Annotations

System Type	Process Sensor Location	Process Sensor Medium	Process Sensor Type	Process Function	Modify the _____ Setpoint for the Process Variable	If Applicable, Add _____
AHU/ Terminal Unit/ CHW System/ HHW System/ DHW System/ Heat Pump/ Heat Recovery Unit	Outside/ Preheat Coil Leaving/ Supply/ Reheat Coil Leaving/ Space/ Return/ Exhaust	Air/ Water	Flow/ Temperature/ Pressure/ Humidity	Cooling/ Heating/ Cooling&Heating/ Preheat/ Reheat/ Bypass/ Economizer/ Dehumidification/ Ventilation	Min/ Operation/ Lockout	Setpoint Adjustment/ Control Sequence Optimization

CC® Measure Category

Examples of Standard Annotations

Indicator	System Type	Process Sensor Location	Process Sensor Medium	Process Sensor Type	Process Function	Modify the _____ Setpoint for the Process Variable	If Applicable, Add ____	Standard Annotation
c	AHU	Supply	Air	Temperature	Cooling	Operating	Setpoint Adjustment	AHU Supply Air Temperature Cooling Operating Setpoint Adjustment
i	AHU	Outside	Air	Flow	Ventilation	Operating	Setpoint Adjustment	AHU Outside Air Flow Ventilation Operating Setpoint Adjustment
p	Terminal Unit	Space	Air	Temperature	Cooling & Heating	Operating	Setpoint Adjustment	Terminal Unit Space Air Temperature Cooling & Heating Operating Setpoint Adjustment
r	Terminal Unit	Space	Air	Flow	Reheat	Lockout	N/A	Terminal Unit Space Air Flow Reheat Lockout
v	CHW System	Supply	Water	Flow	Cooling	Operating	Control Sequence Optimization	CHW System Supply Water Flow Cooling Operating Control Sequence Optimization

The Most Frequent CC® Measures

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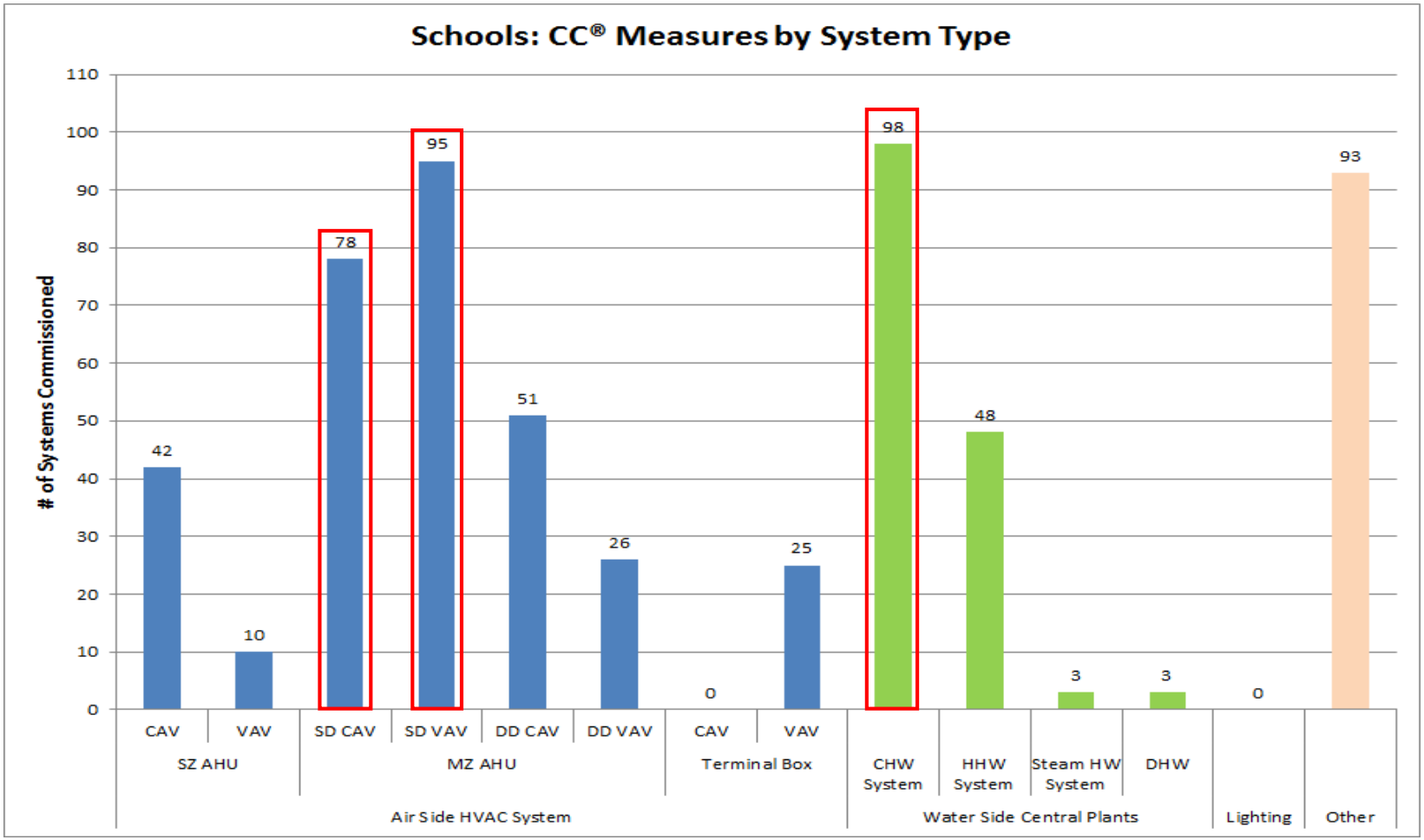
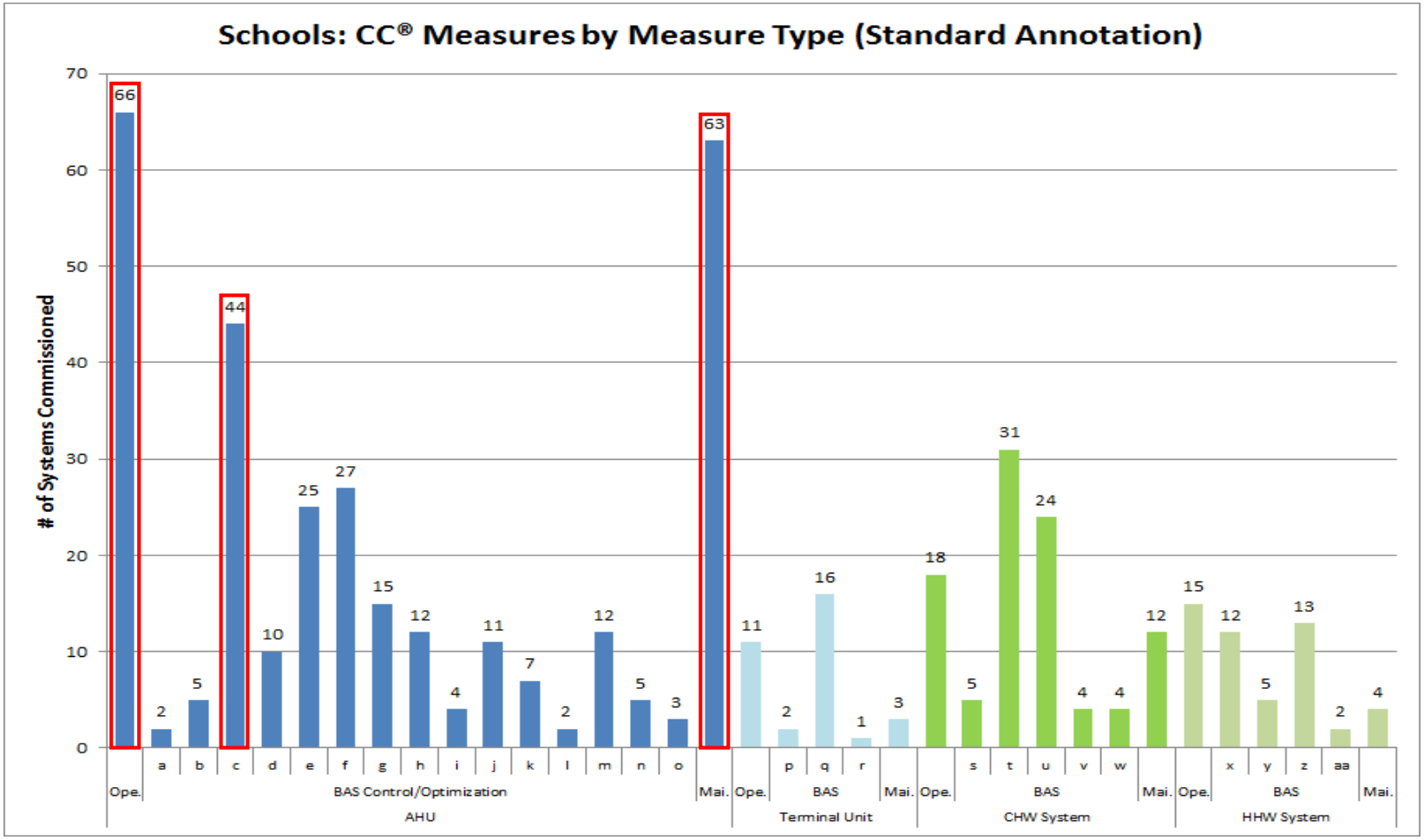


The Most Frequent CC® Measures



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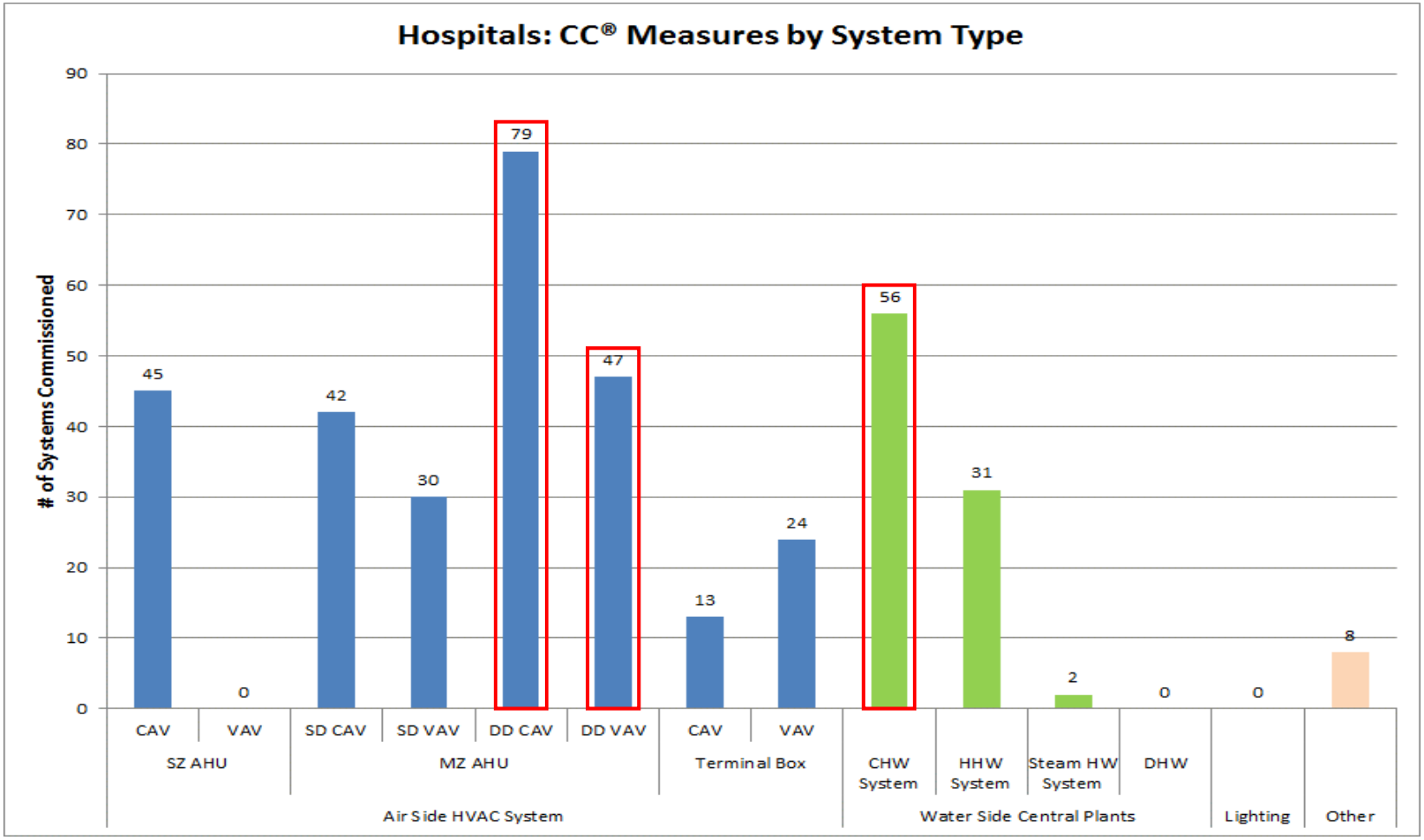

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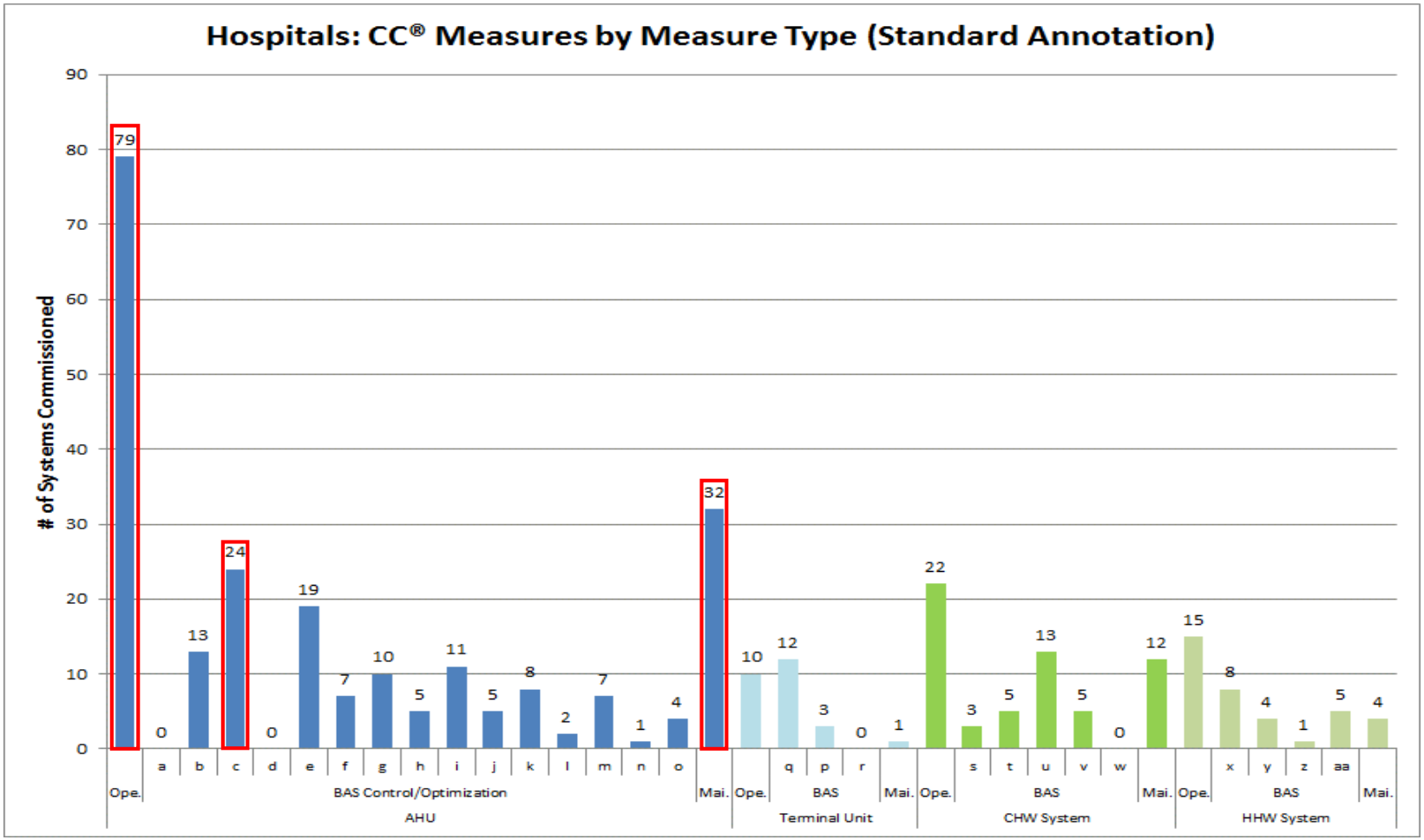

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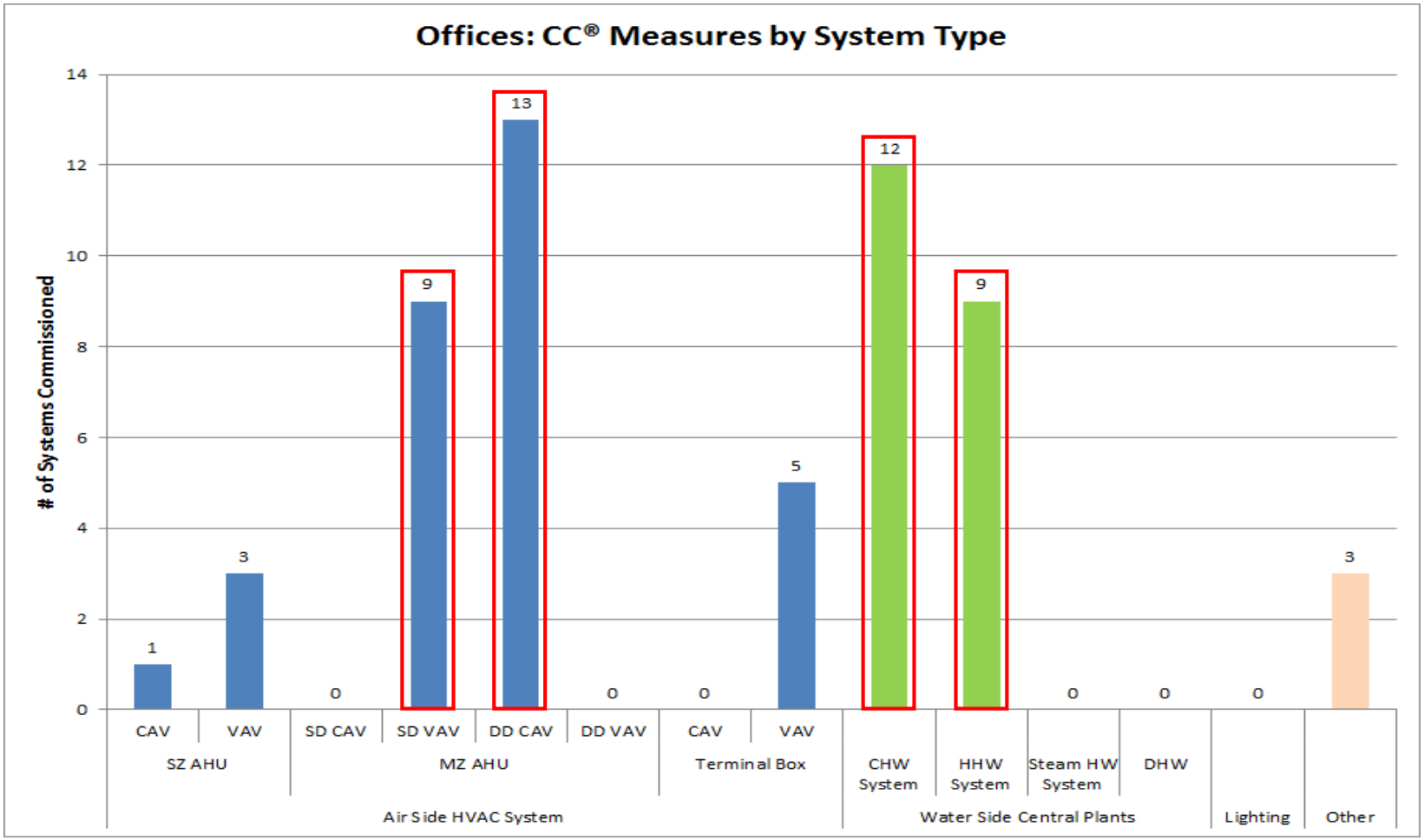

< CC® Measures by System Type from Office Buildings>

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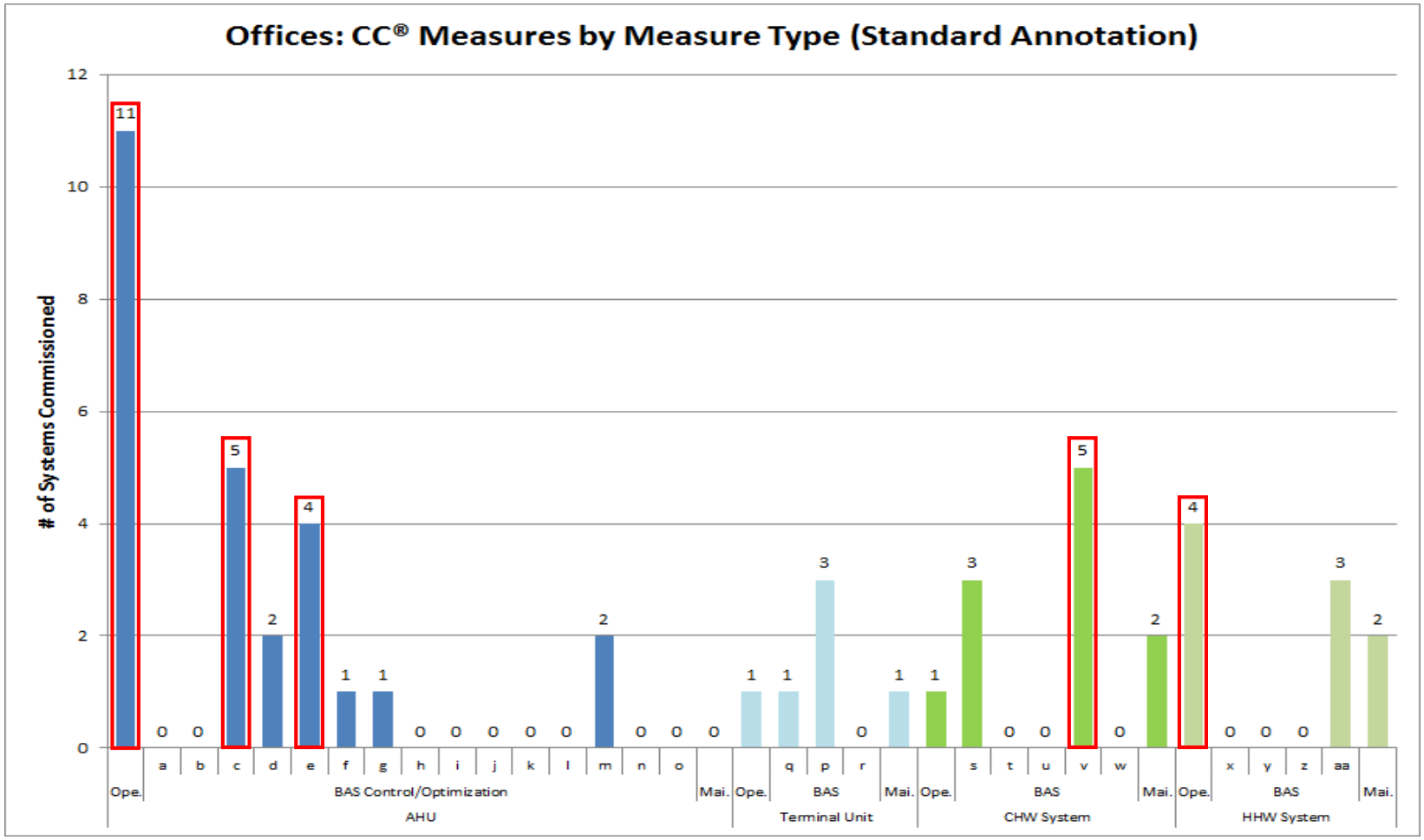
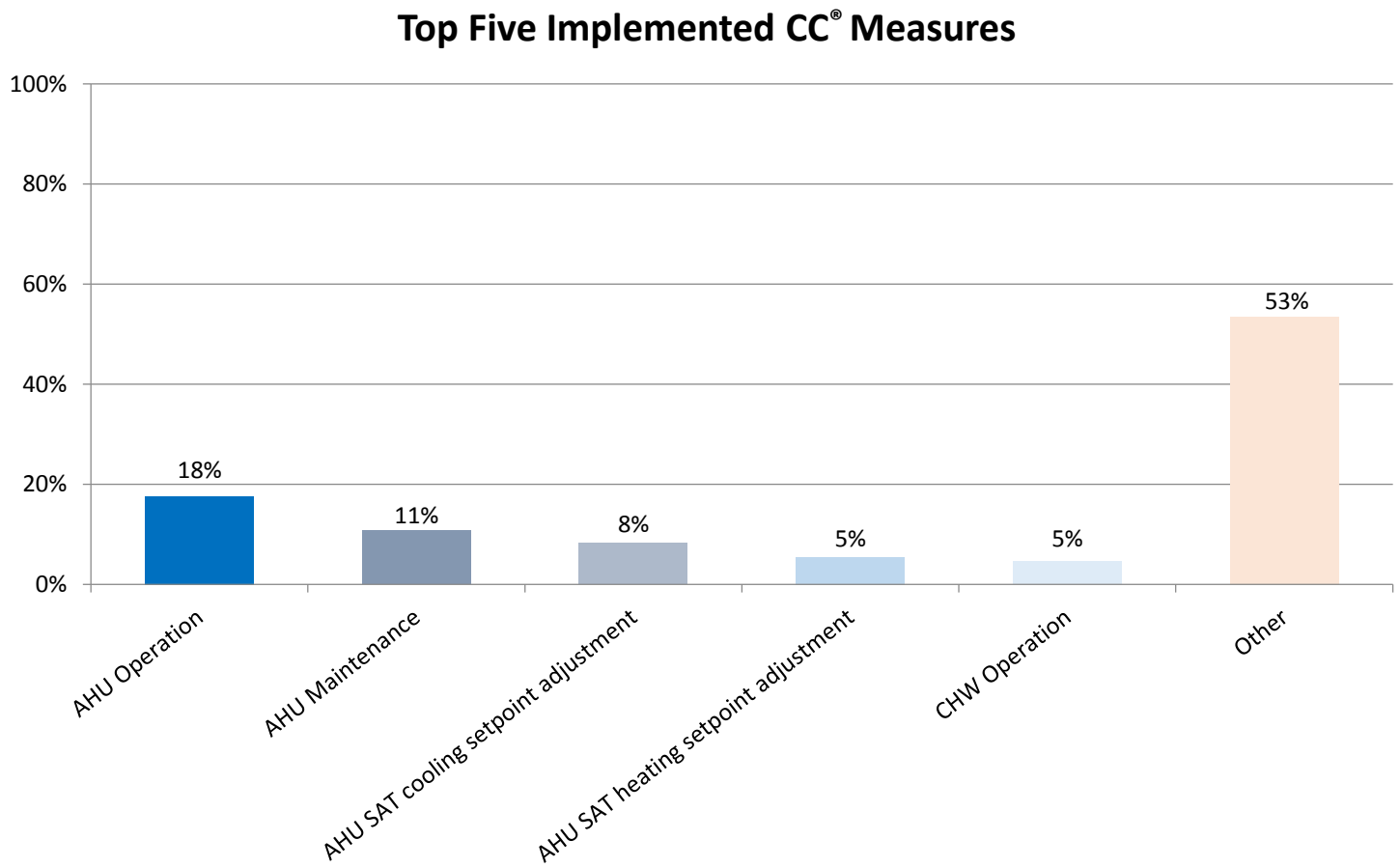


< CC® Measures by Measure Type from Office Buildings >

The Most Frequent CC® Measures



Summary

- This study analyzed the implementation of CC® measures in 115 buildings (excluding 11 buildings of the "other" type) based on the final reports of the projects on file at the ESL.

- The standard grouping was applied to better understand and make use of the implemented CC® measures.

- The five most frequent CC® opportunities used in schools, hospitals, and office buildings were: Air Handling Unit (AHU) operation, AHU maintenance, AHU supply air temperature cooling and heating setpoint adjustment, and Chilled Water (CHW) system operation. These measures account for 47% of the total implemented measures.

Thank you