Energy Systems Laboratory
A Division of TEES: The Engineering Agency of the State of Texas

TEXAS A&M UNIVERSITY

Integration of CC®, IAQ, and EM for an Optimum and Proactive Energy Performance at **Alamo Colleges, San Antonio, Texas.**

Norma L. Rangel, Stephen O'Neal, and Joseph T. Martinez;
Energy Systems Laboratory

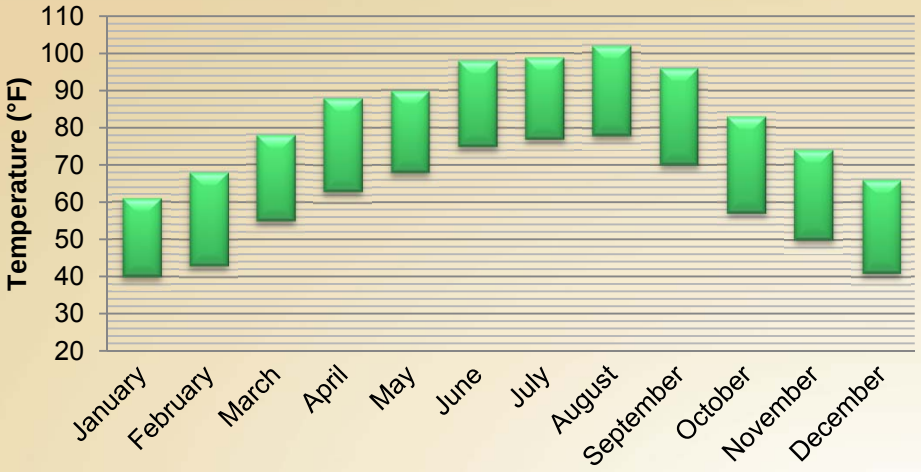
John W. Strybos
Alamo Colleges

12th International Conference for Enhanced Building Operations
October 24th, 2012. Manchester, UK.

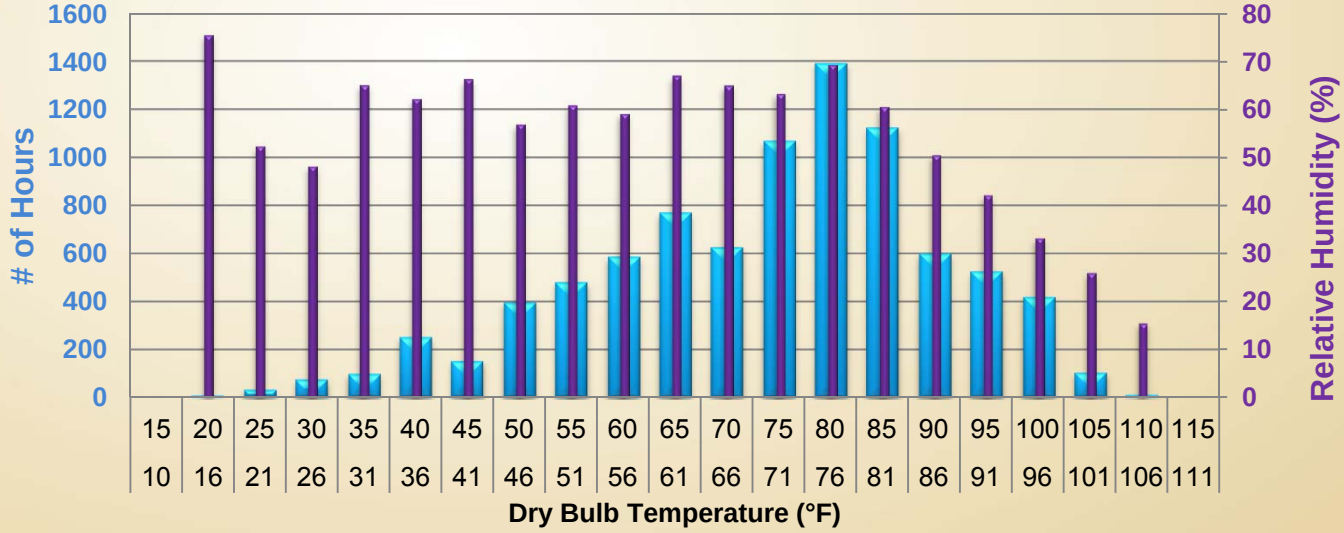
Outline

- Alamo Colleges, San Antonio, TX.
- Continuous Commissioning® Measures
- Indoor Air Quality Efforts
- Energy Management
- Integration Tool: Alerts System
- Savings Analysis
- Return on Investment

San Antonio, Texas



There are 2391 operational hours used for "free cooling" in San Antonio, TX.



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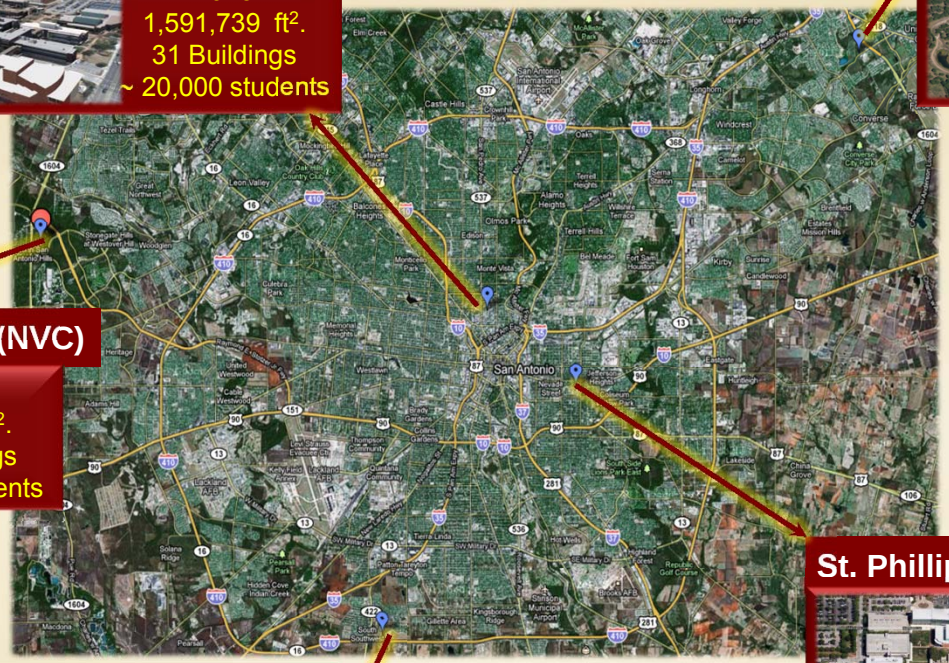
Alamo Colleges: 4,539,334 sq.ft.



Outline

- Alamo Colleges, San Antonio, TX.
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- Indoor Air Quality Efforts
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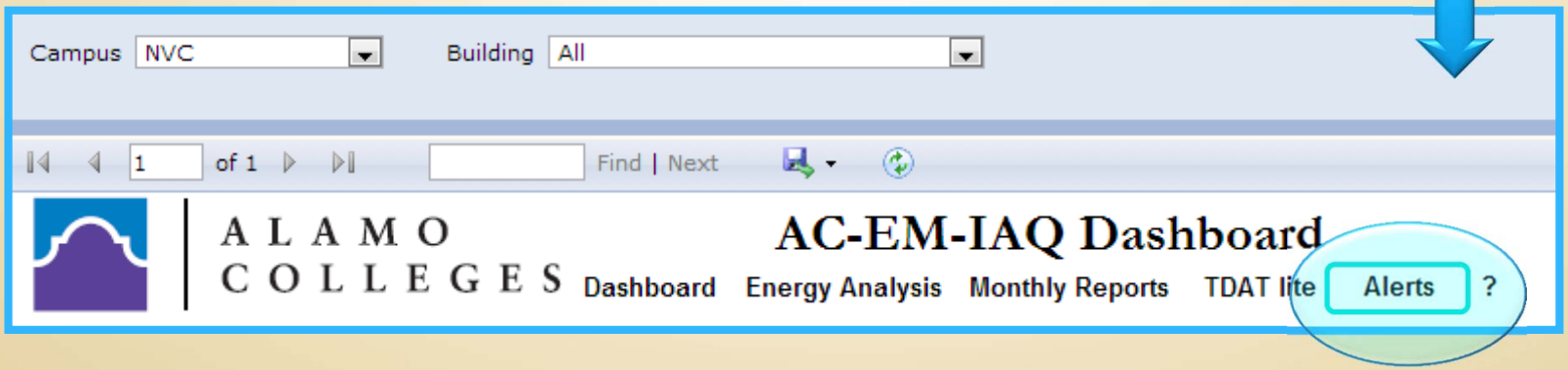
ESL – Alamo Colleges

Continuous Commissioning

Indoor Air Quality

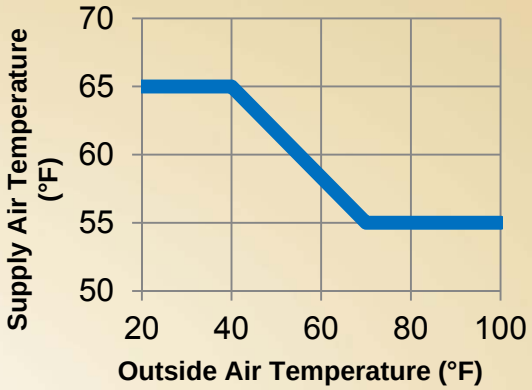
Energy Management

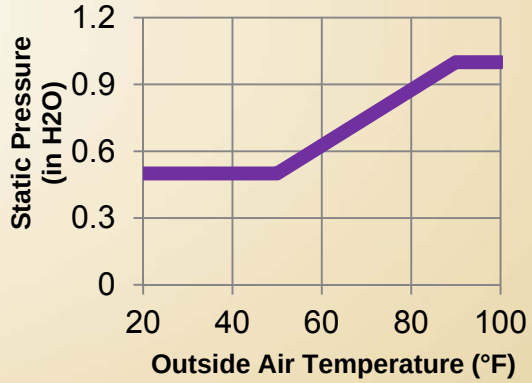
Dashboard



Continuous Commissioning®

- Air Handler Optimization
  - Occupied/unoccupied schedules
  - Supply air temperature reset schedule
  - Duct static pressure reset schedule
  - Economizer mode
  - Humidity control
- Terminal Box Optimization
  - Minimum flow setting
  - Air flow calibration/verification
- Central Plant Optimization
  - Chilled and hot water reset schedules
  - Chiller staging





Training of Facilities Personnel!

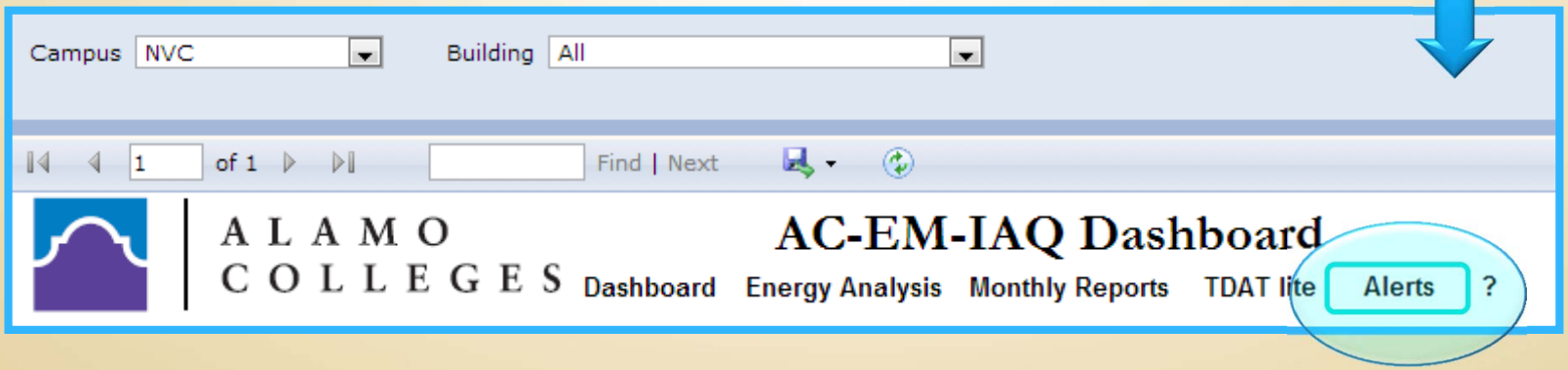
ESL – Alamo Colleges

Continuous Commissioning

Indoor Air Quality

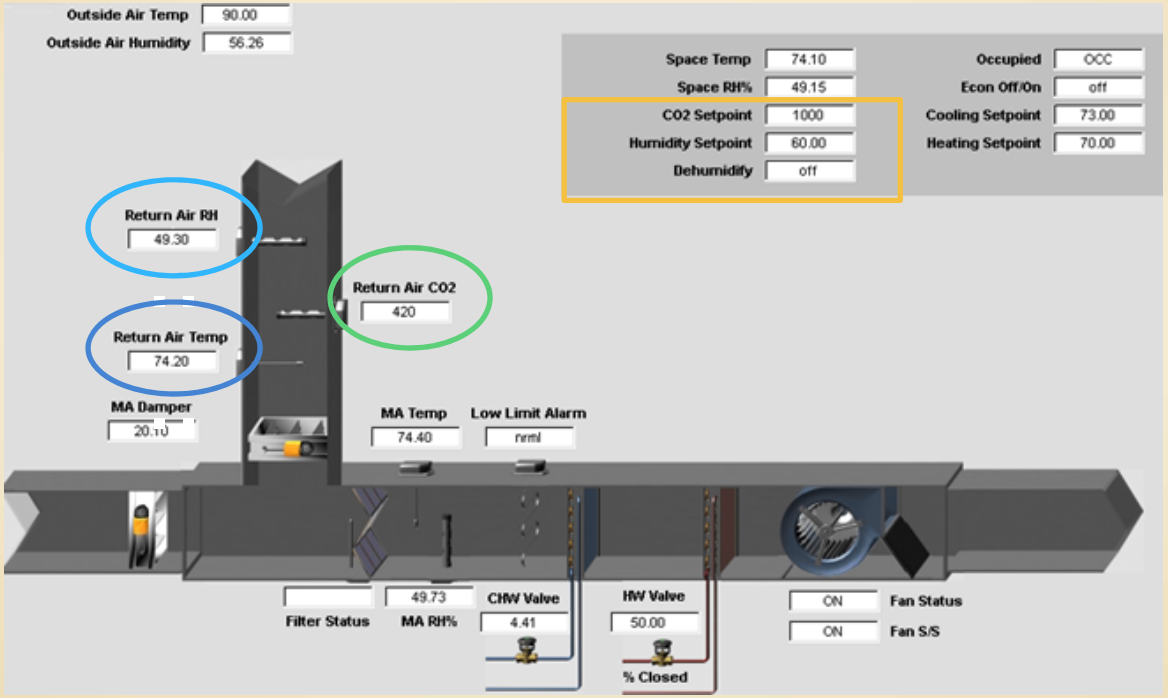
Energy Management

Dashboard



Indoor Air Quality (IAQ)

- Installation of IAQ sensors connected to the EMCS
- Monitoring of CO_2 levels, return air temperature and humidity



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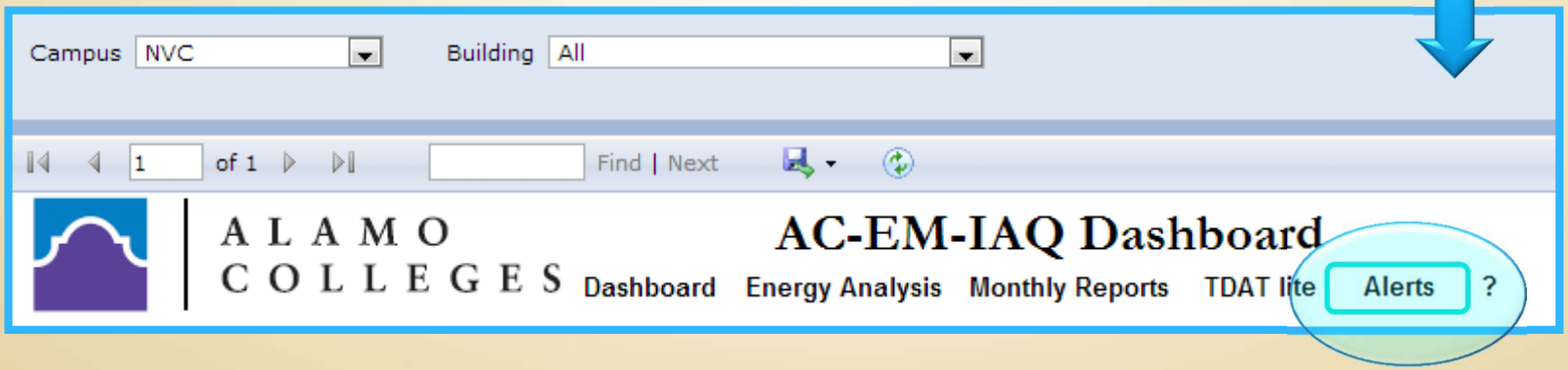
Continuous Commissioning

Indoor Air Quality

Energy Management

Dashboard



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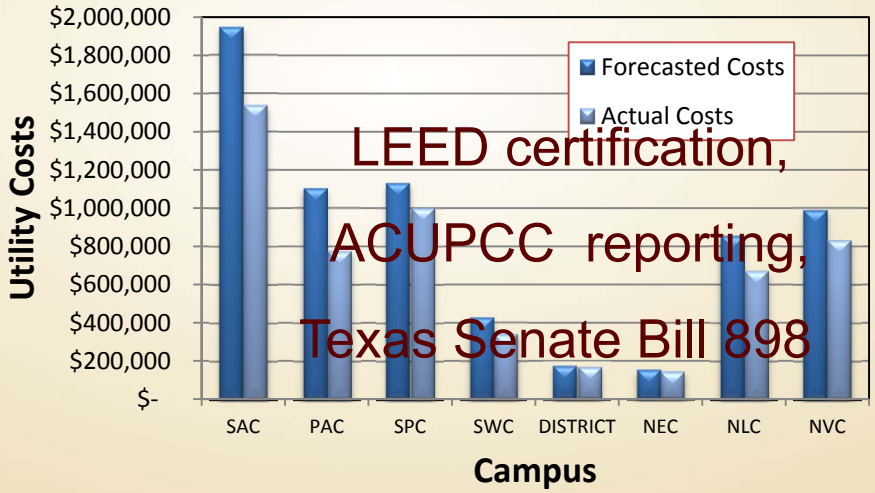
Energy Management

- Technical assistance
- Utility forecasting
- Sustainability and green initiatives

Call the ESL!

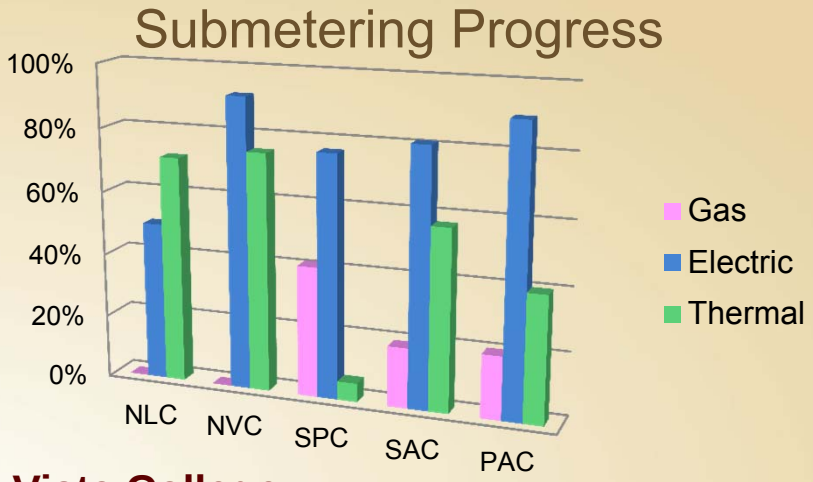


Energy Management

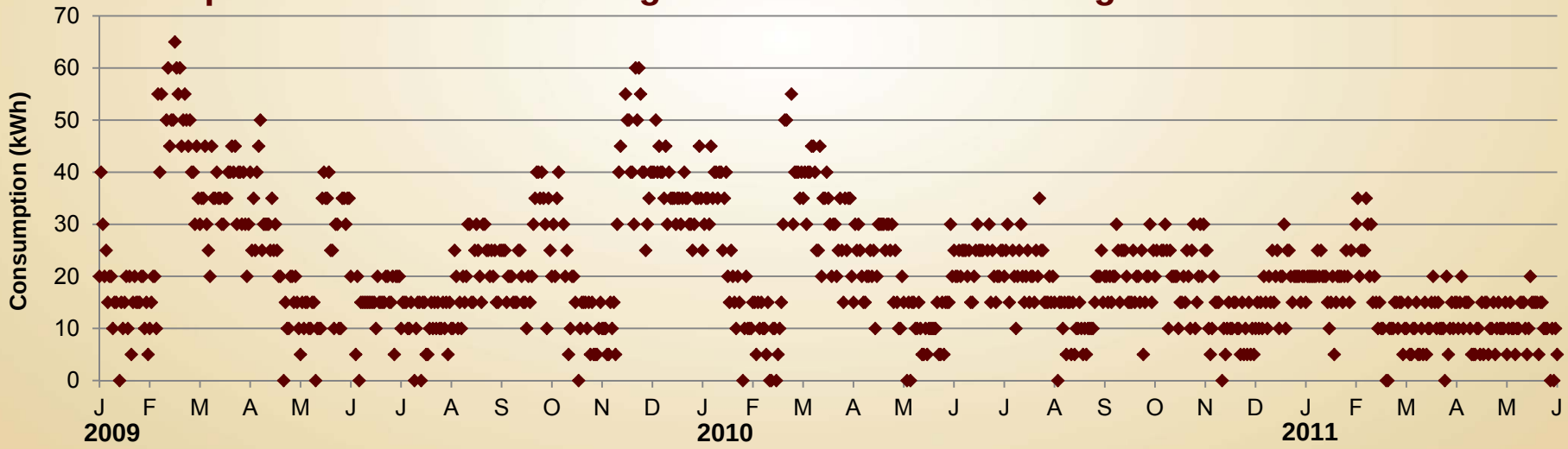
- Technical Assistance
- Utility forecasting
- Sustainability and Green initiatives
- Building Sub-metering

Campus Submetering

- Electric, water and gas meters are being installed in each building at every location.
- Set and monitor trend data for electric, gas and water consumption



Consumption in Palmetto Building at Northwest Vista College



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Continuous Commissioning

Indoor Air Quality

Energy Management

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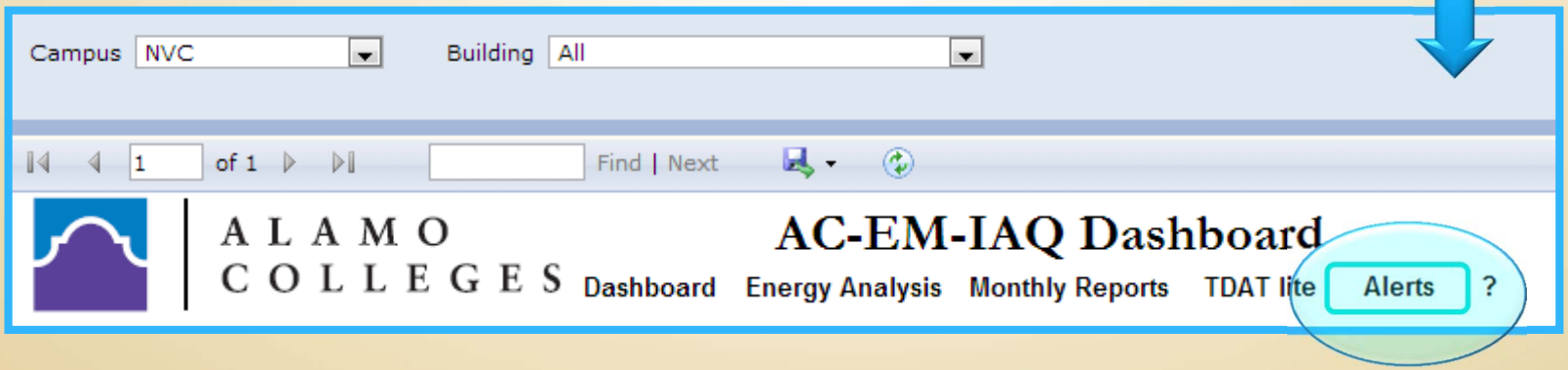
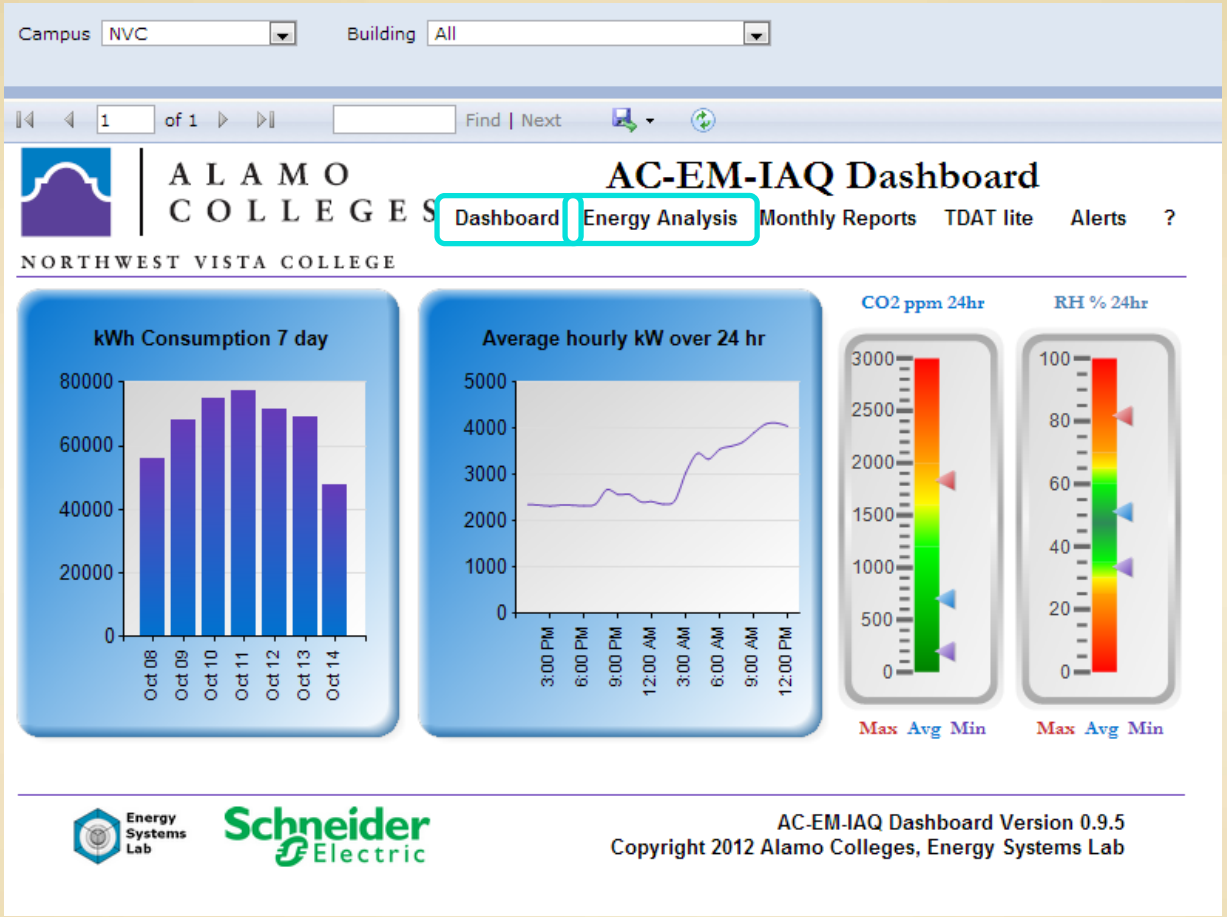


Dashboard



District online access: http://ac-em-iaq/

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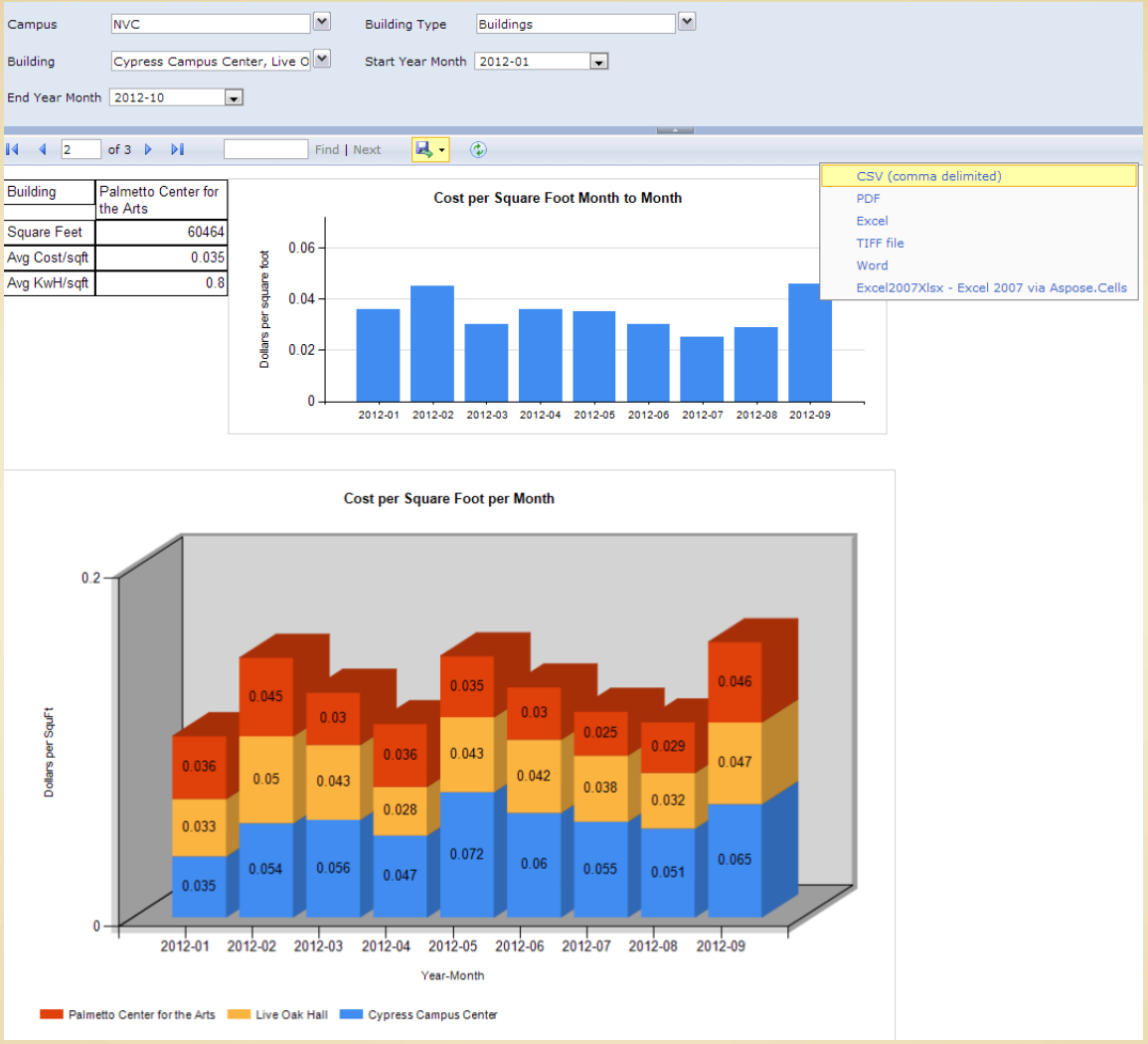
Energy Analysis



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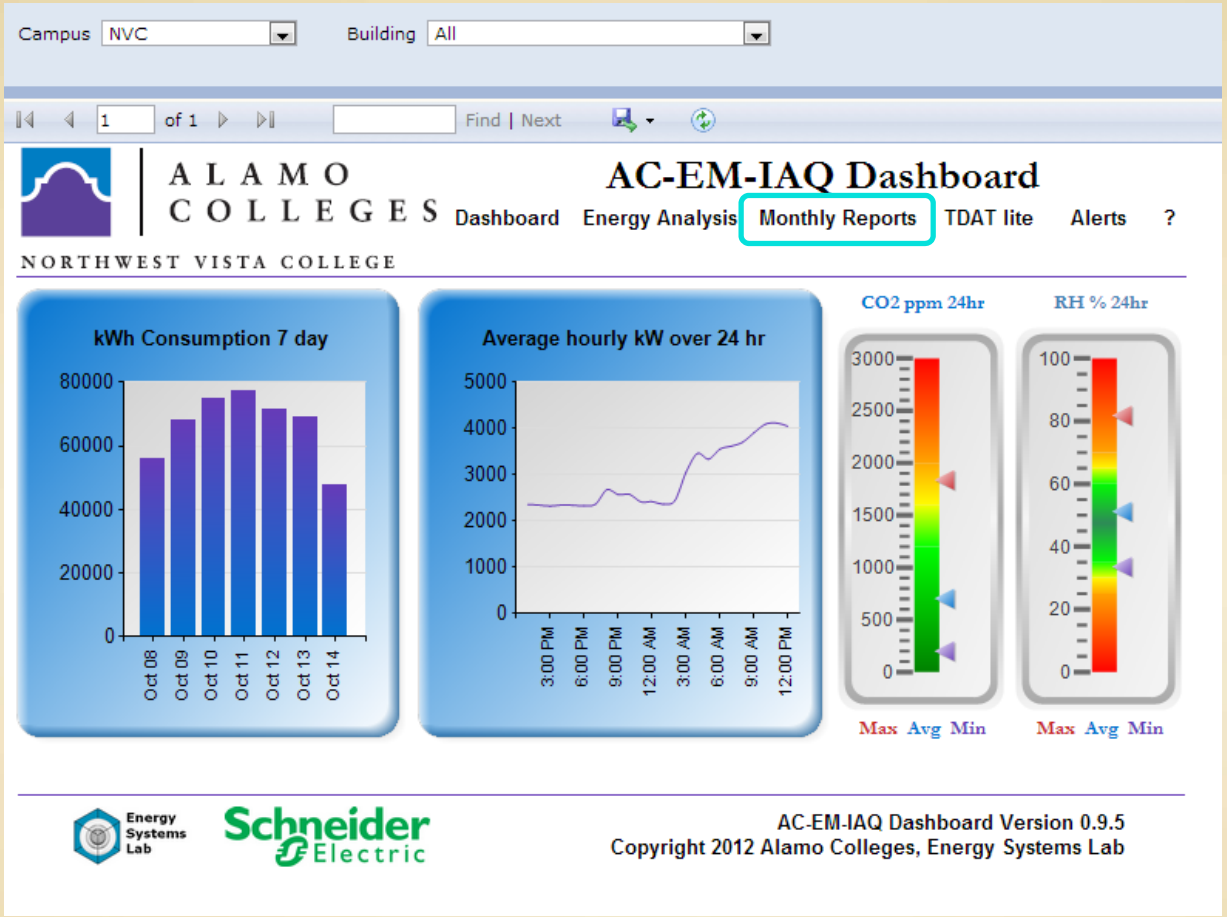

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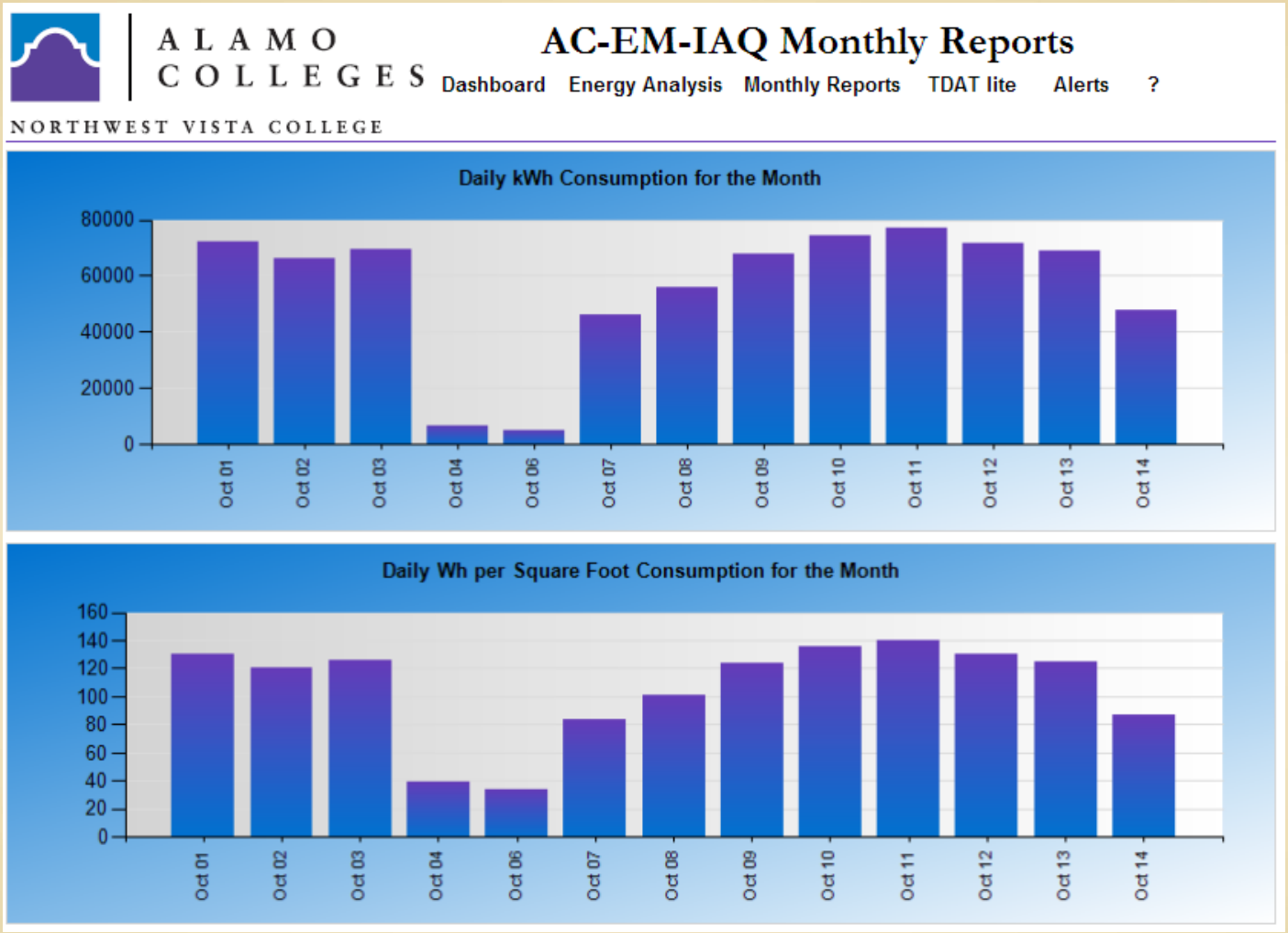
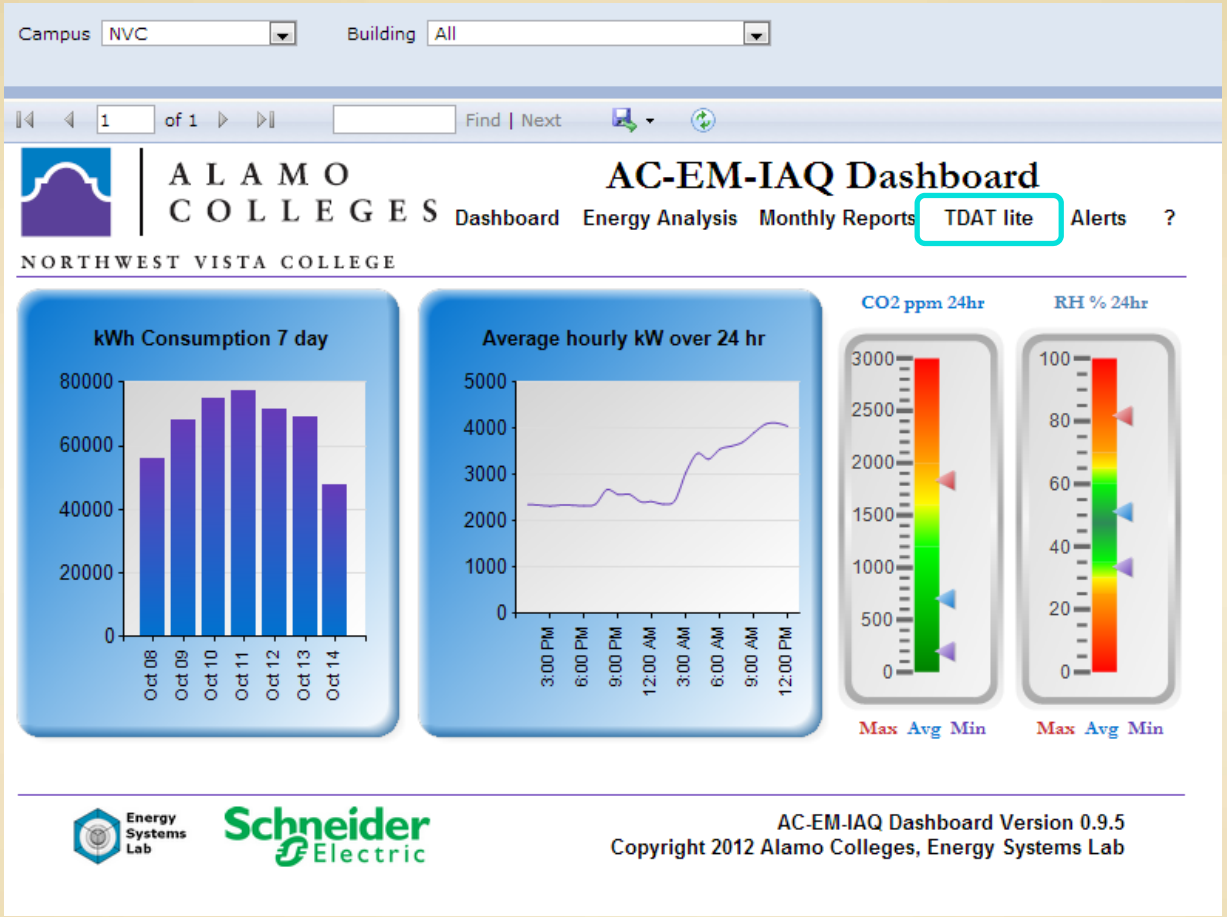
Monthly Reports



Dashboard



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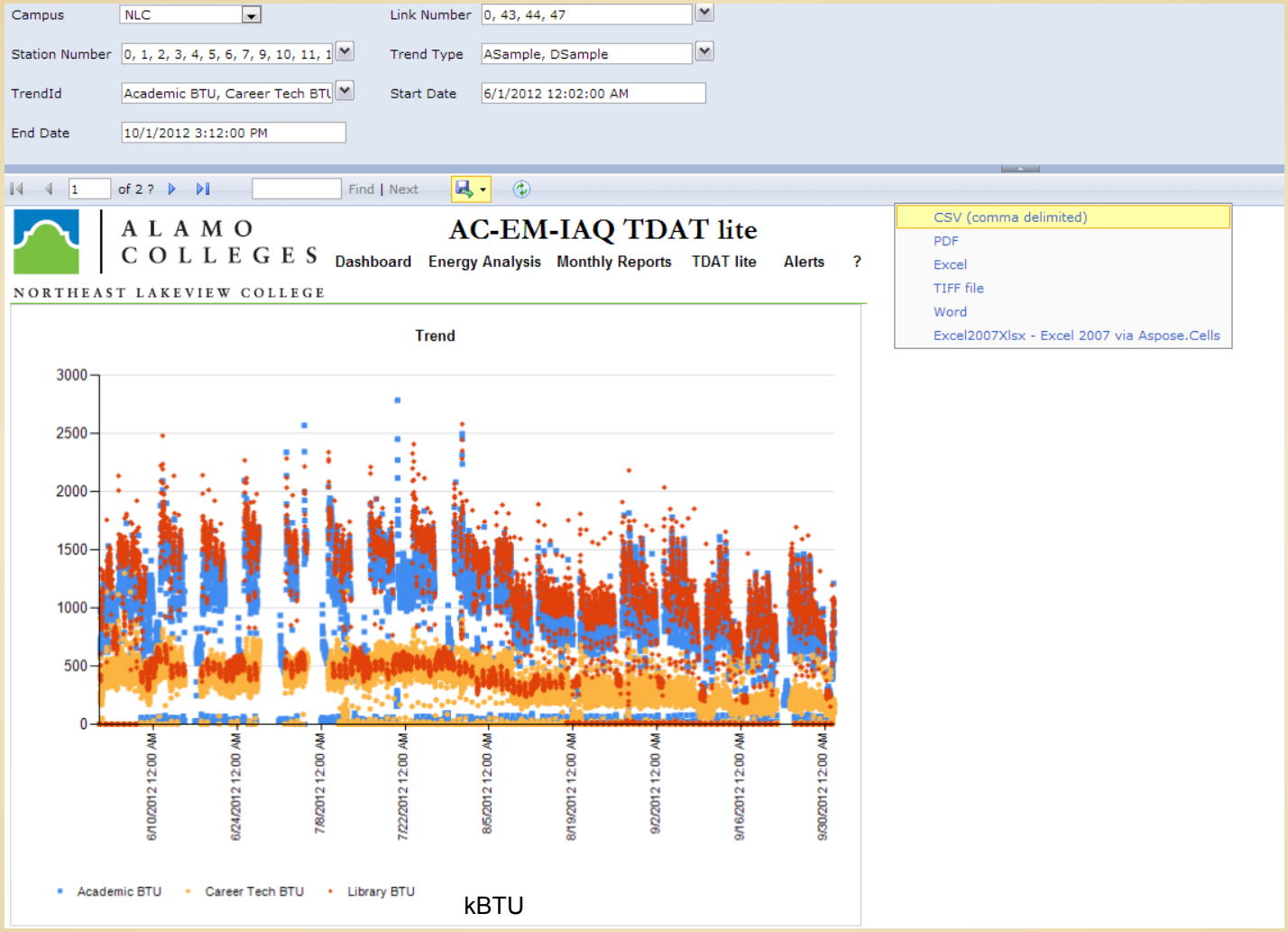
Trend Data Analysis Tool Lite



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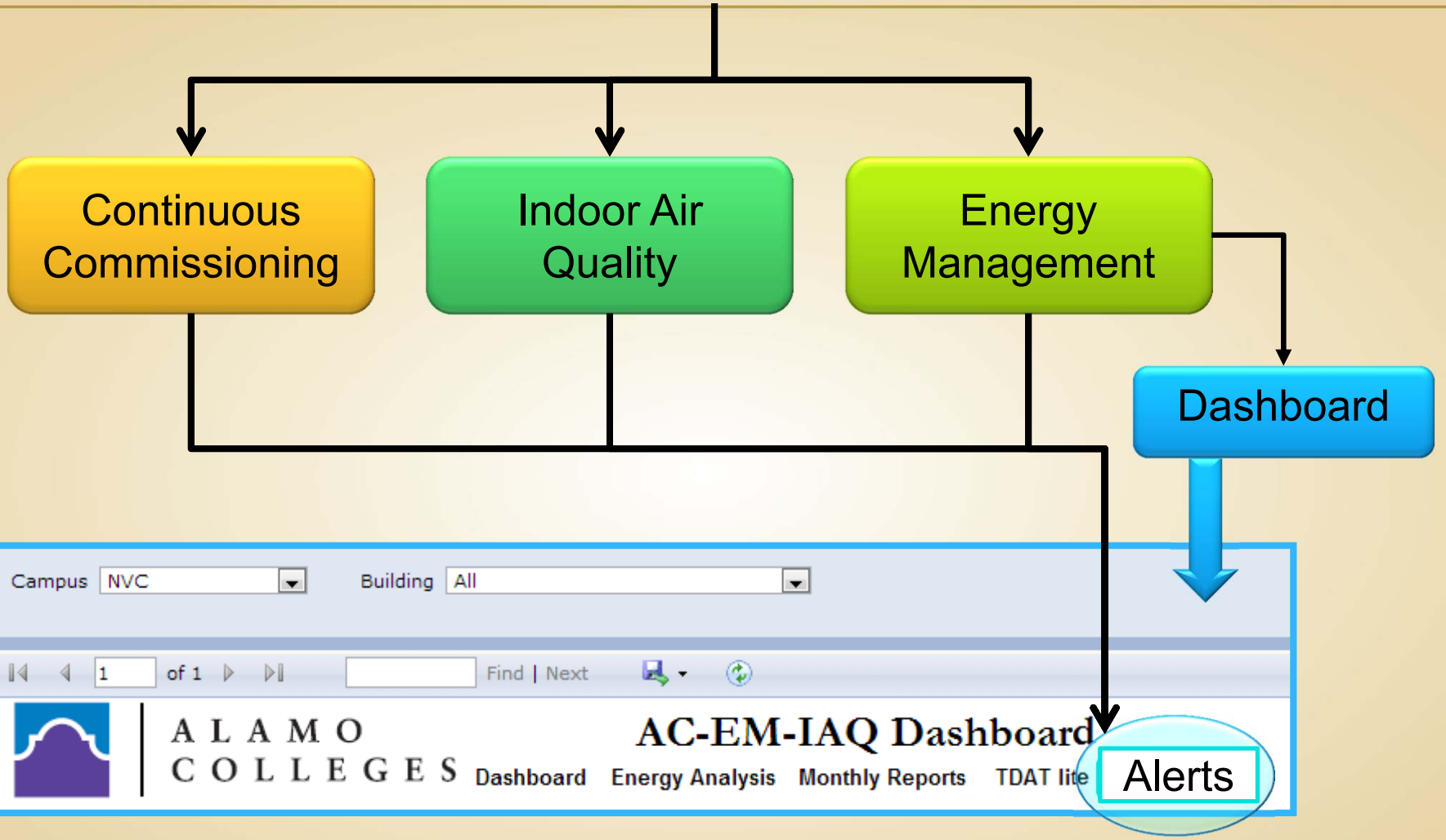

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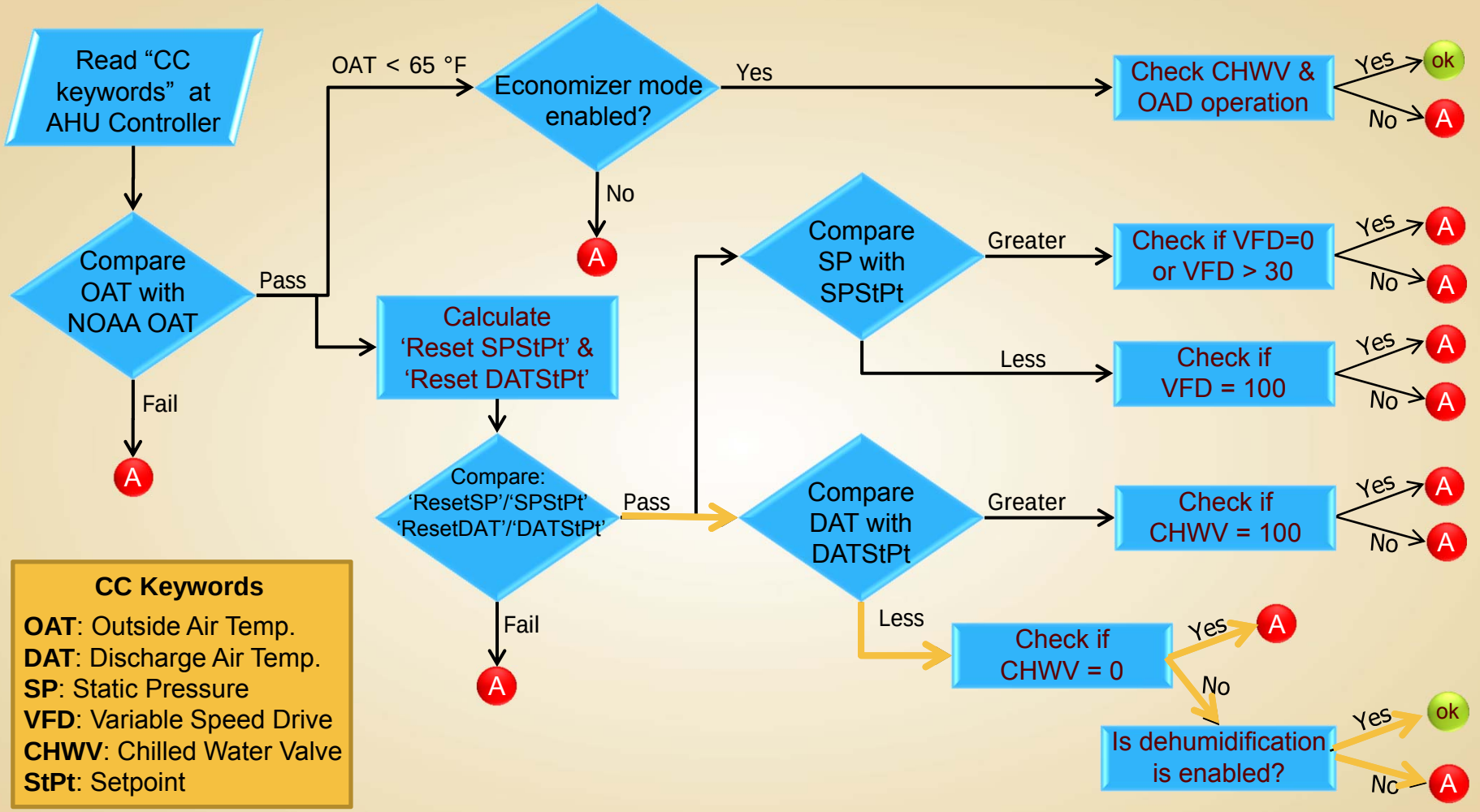
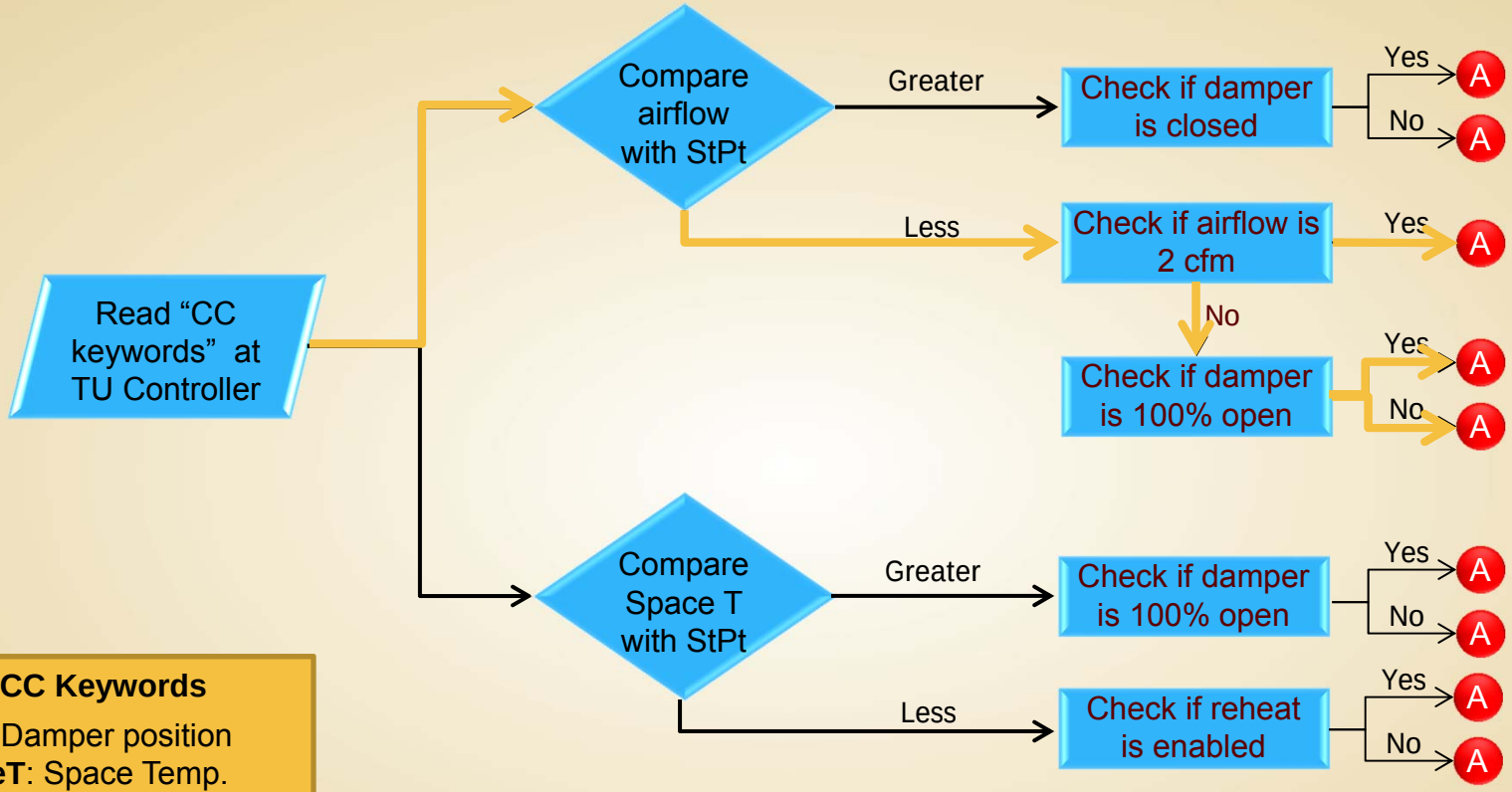
Alerts System: Air Handler Units



Alerts System: Terminal Units (Undisclosed)



CC Keywords

Dmp: Damper position
SpaceT: Space Temp.
PriFlow: Primary airflow
H Pos: Reheat Position

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Alerts

Campus NVC

1 of 2 ? 100% Find | Next

ALAMO COLLEGES
NORTHWEST VISTA COLLEGE

AC-EM-IAQ Alerts

Dashboard Energy Analysis Monthly Reports TDAT lite Alerts ?

Detected Alerts in the past 48 Hours

Campus	Controller	First Alert	Alert Package	Error	Count
NVC	3112	10/18/2012 8:00:00 AM	SP > SP StPt	SP > SPStPt however the fan is running above 40%. Current Fan Speed is at 100	44
NVC	3112	10/18/2012 8:45:00 AM	SP < SP StPt	The Fan does not appear to be on when SP < SPStPt. Current Fan Speed is at 0	41
NVC	3112	10/19/2012 7:00:00 AM	SP > SP StPt	SP > SPStPt however the fan is running above 40%. Current Fan Speed is at 100	5

Trends Failing to report in the past 48 Hours

College	Trend Id	Name	Link	Station	Point Address
Northwest Vista	294	CT1.3 Act. Speed	3	5	03053000 AO
Northwest Vista	2322	Manzanillo TU-1-4-Space T	3	22	03220407 AI

Trends Stuck at a Single Value

College	Trend Id	Name	Link	Station	Point Address
Northwest Vista	104	Texas Persimm AHU-1 CHW Valve	3	3	03033101 AO
Northwest Vista	106	Texas Persimm AHU-1 DA Temp	3	3	03030001 AI
Northwest Vista	107	Texas Persimm AHU-1 OA Damper	3	3	03033103 AO

Future Work

- Disclosure of the terminal units engine
- Research and development of alarm systems for central plants
- Performance testing and evaluation
- Generation of work orders using dashboard and alarm systems.
- Facilities training and final delivery

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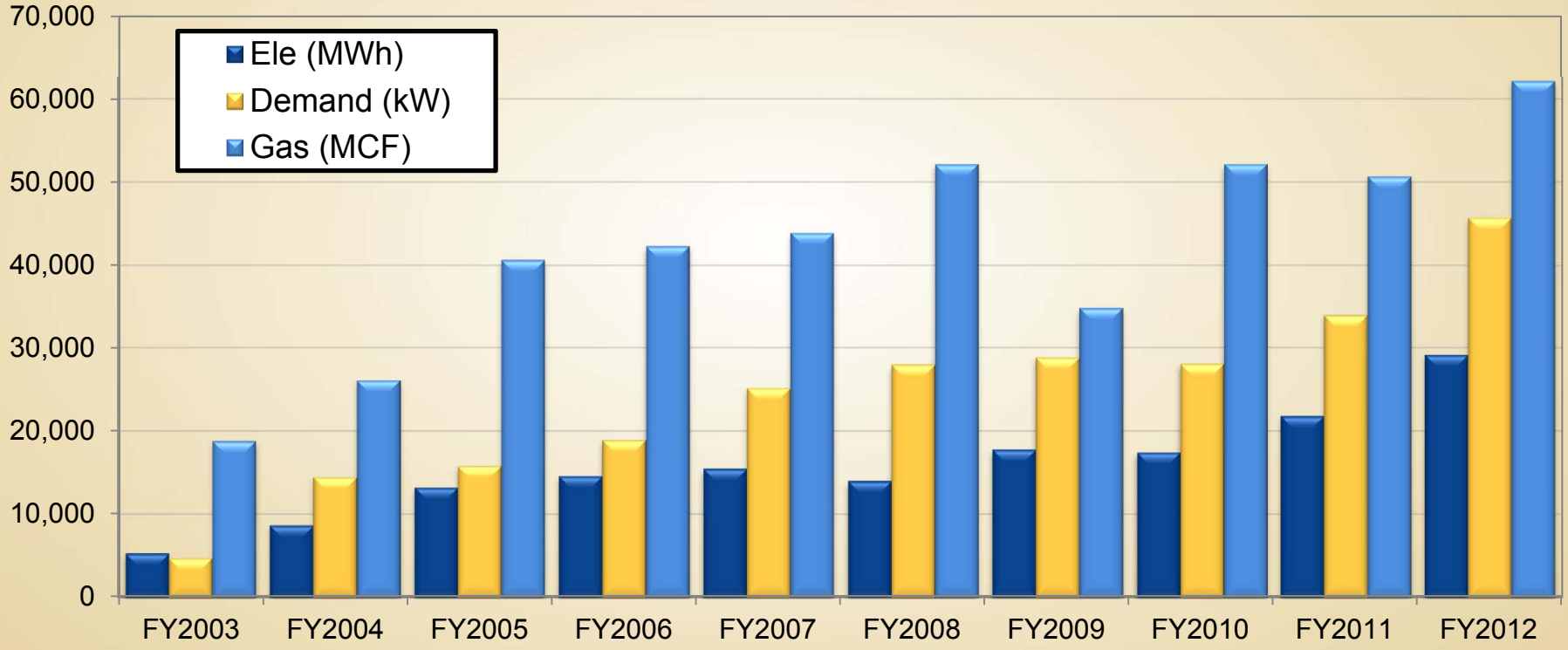
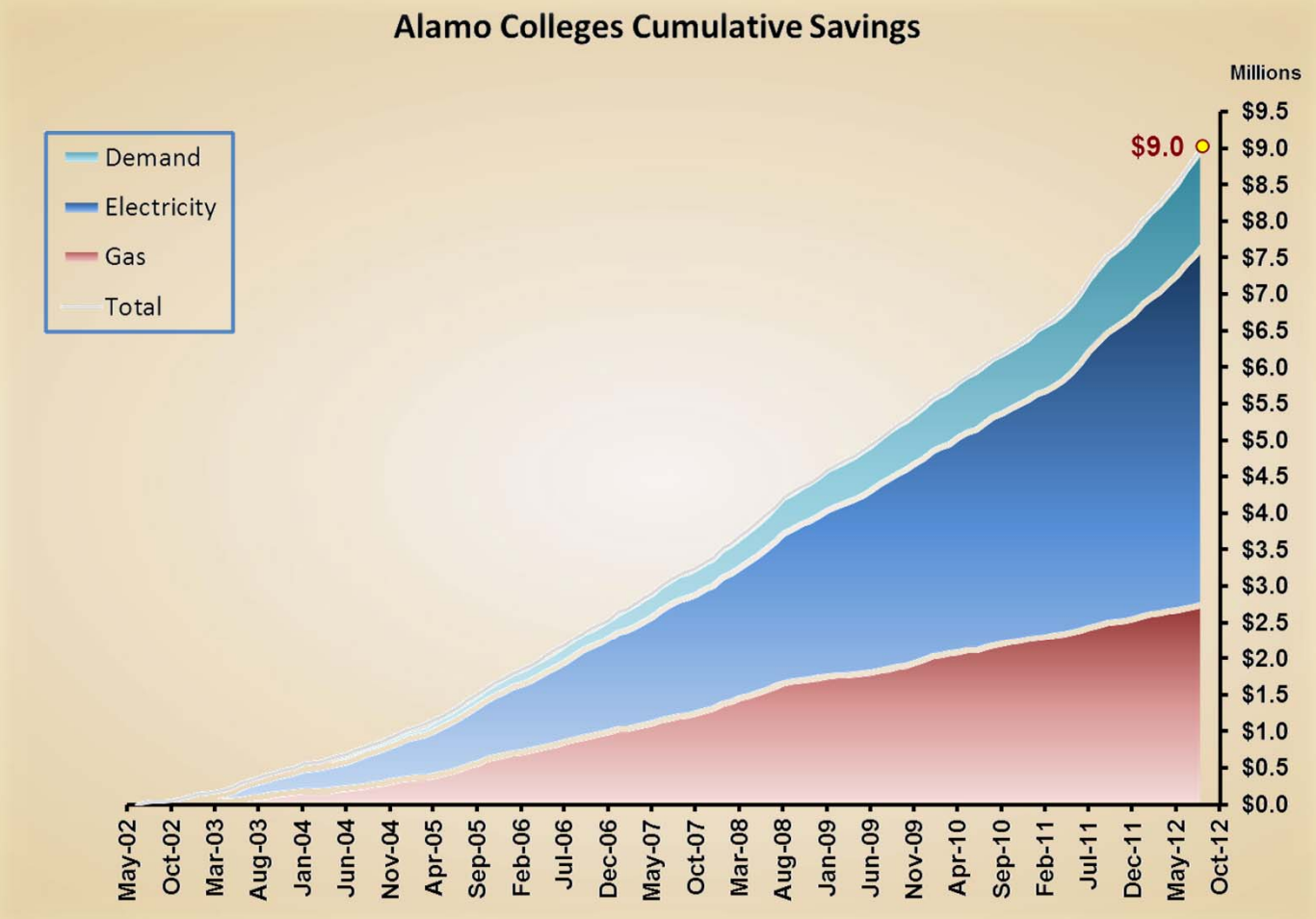
Alamo Colleges Energy Savings

Items	Total Energy Savings
Electricity Usage (MWh)	157,505
Electric Demand (kW)	243,686
Gas Use (MCF)	424,019



Annual Savings

Cumulative Savings



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Return on Investment

The Return on Investment for fiscal year 2012:

$$ROI = \frac{(2012\ Net\ Savings)}{Total\ Project\ Investment} \times 100$$

$$ROI = \frac{2{,}189{,}485}{2{,}752{,}041} \times 100$$

$$\boldsymbol{ROI = 80\%}$$

Conclusions

- The Dashboard Alerts tool is a set of algorithms based on a combination of CC® HVAC and IAQ principles that sends notifications and helps troubleshoot possible scenarios of improper performance.

- Alamo Colleges are a model for educational institutions, and continue to exceed the community expectations in environmental responsibility, energy reduction, efficiency and sustainability.

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Acknowledgments

Alamo Colleges

John W. Strybos

Associate Vice Chancellor of Facilities Operation and Construction Management

Facilities:

Superintendents, Facilities Foreman and HVAC Foreman

Energy Systems Laboratory

PI: Joseph Martinez, PCC.

Ian Nelson (PhD student)

Agnes Almeida (MSc student)

Ahmet Ugursal, PhD

Norma Rangel, PhD

Data Analysis:

Juan-Carlos Baltazar, PhD

Alaina Jones (PhD student)

Dashboard Admin:

Stephen O'Neal

Energy Management Control Systems

Schneider Electric

Johnson Controls


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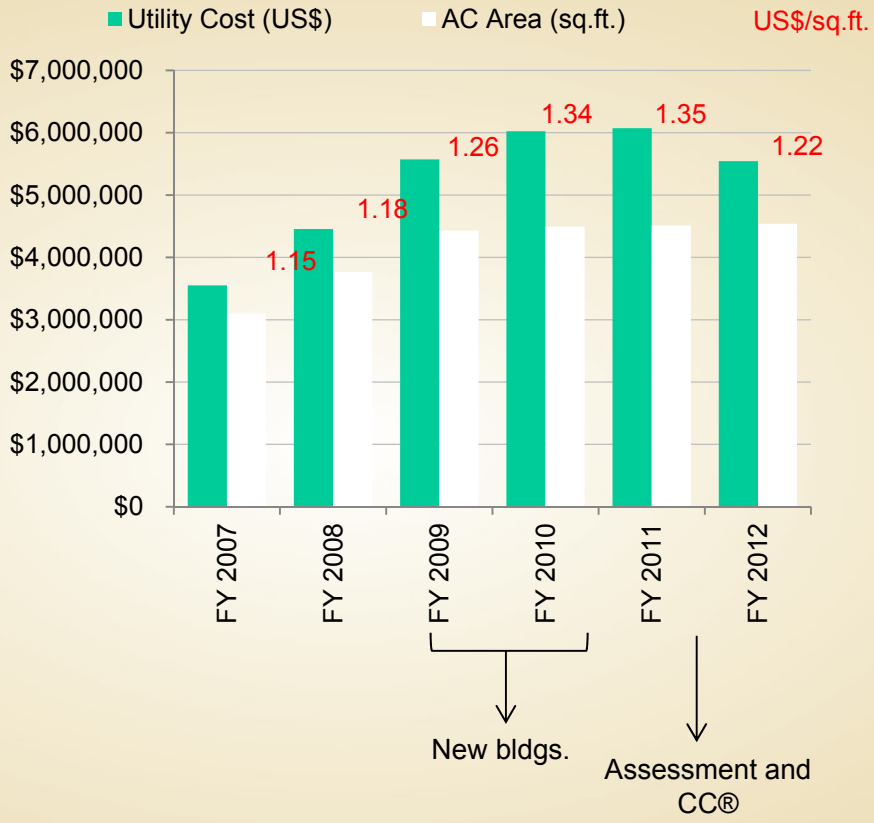
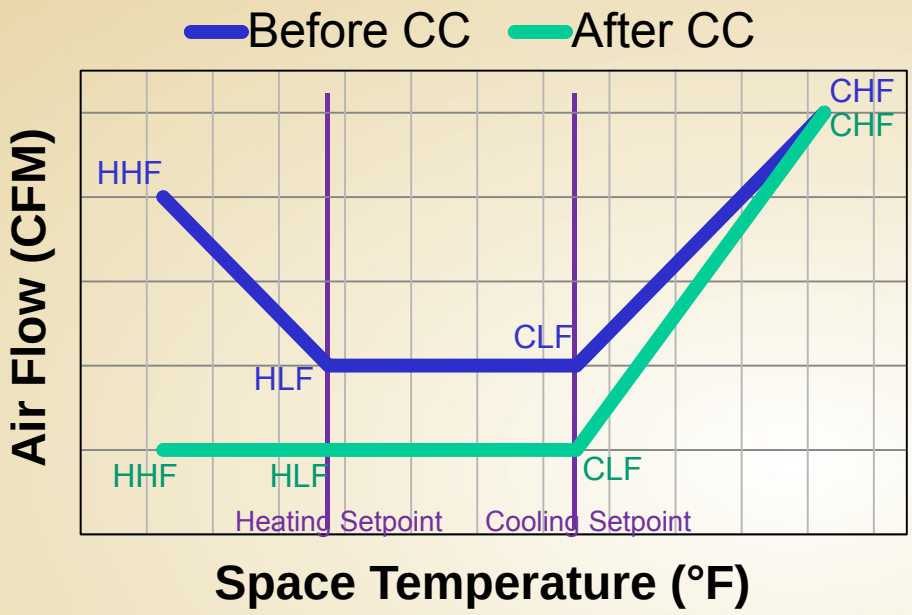
Thanks!
Questions?

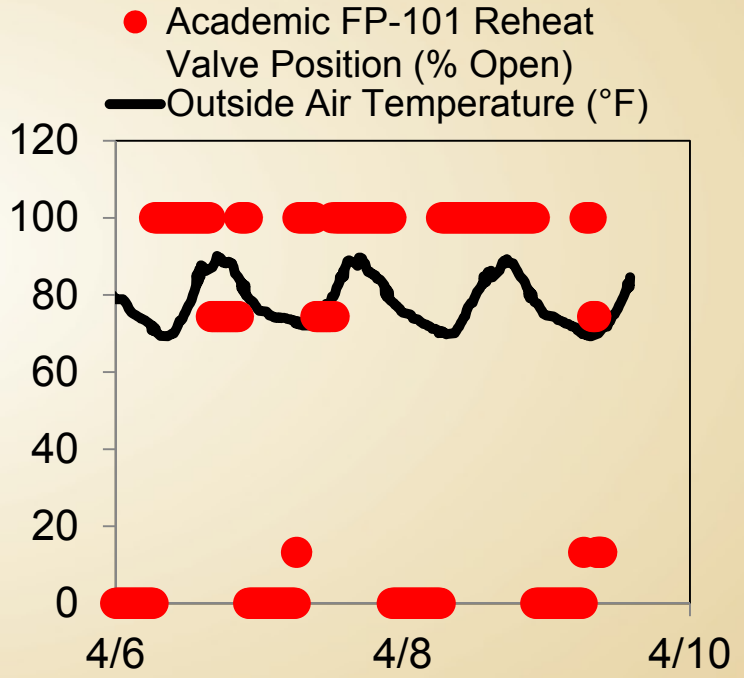

Utility Cost (US$)
AC Area (sq.ft.)
US$/sq.ft.
$7,000,000
$6,000,000
$5,000,000
$4,000,000
$3,000,000
$2,000,000
$1,000,000
$0
1.15
1.18
1.26
1.34
1.35
1.22
FY 2007
FY 2008
FY 2009
FY 2010
FY 2011
FY 2012
New bldgs.
Assessment and CC®

Minimum Airflow



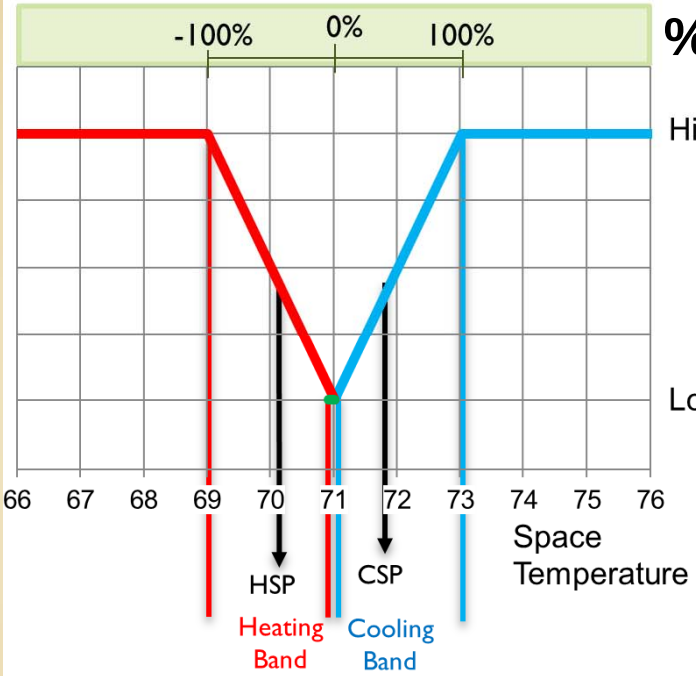
HHF: High Heating Flow **CHF**: Cooling High Flow

HLF: Heating Low Flow **CLF**: Cooling Low Flow

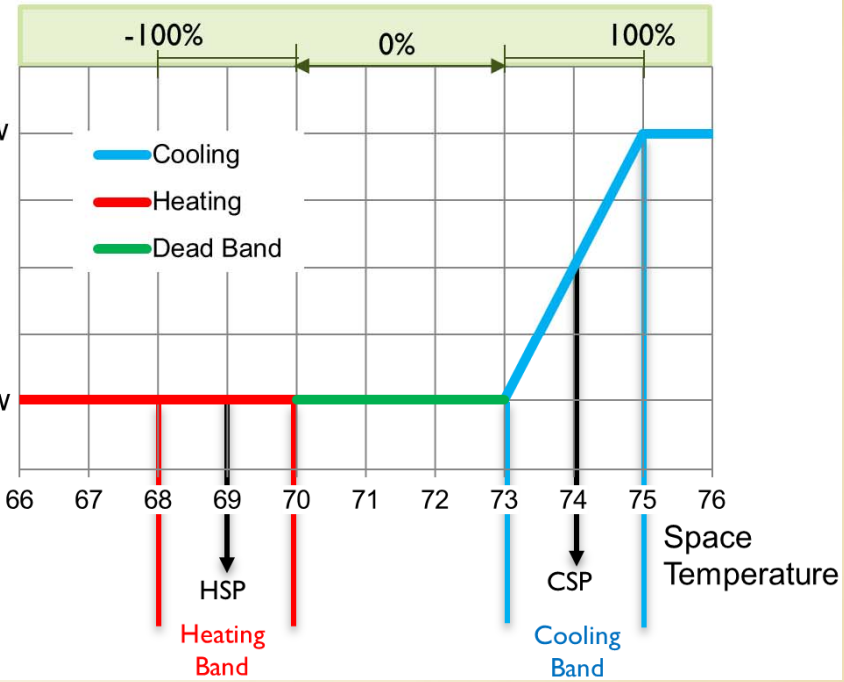


Space Temperature Setpoints and Loads

Before

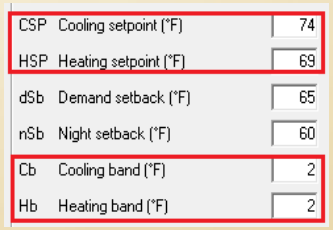


Currently being implemented



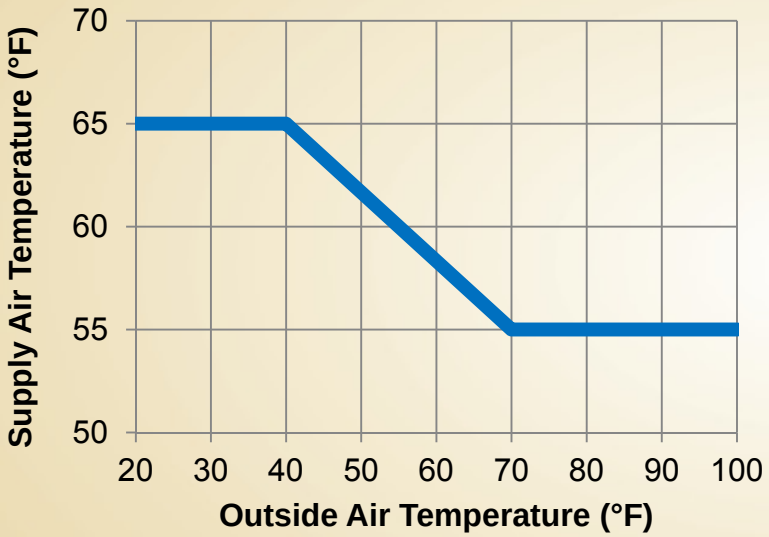
Energy Conservation Code 503.2.4.2:

Maintain the temperature range or deadband of at least 5 °F

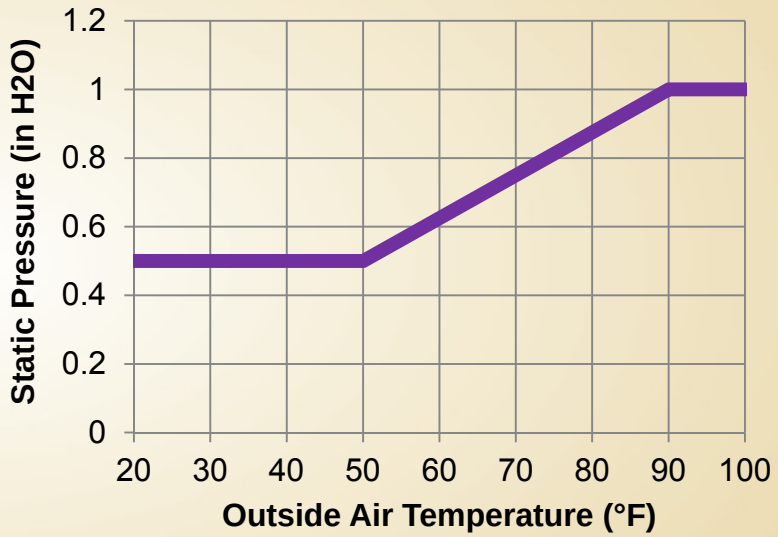


Resets Based on Outside Air Temperature

Supply air temperature reset schedule based on outside air temperature



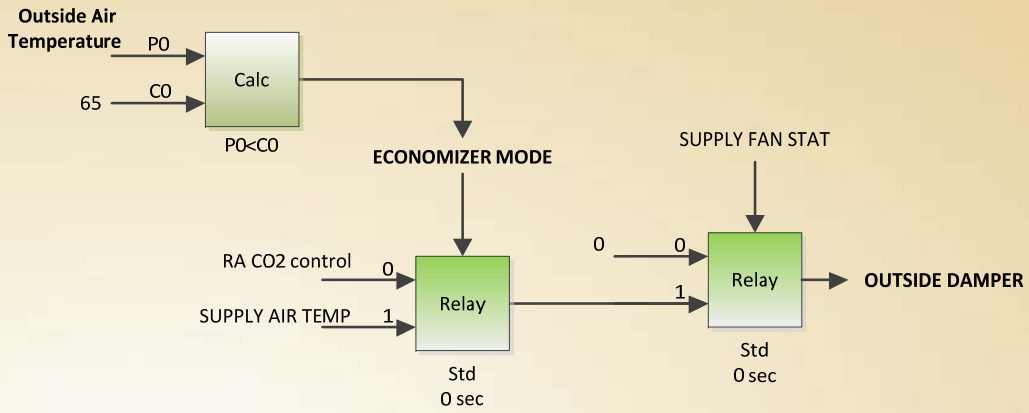
Supply air static pressure reset schedule based on outside air temperature

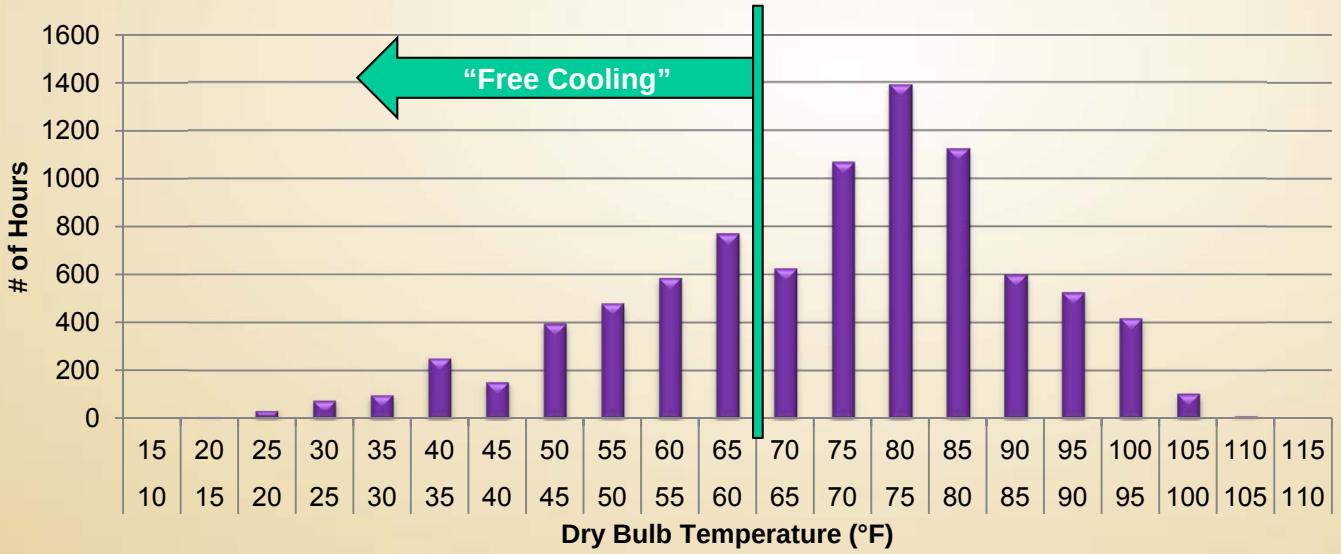


Economizer Mode “Free Cooling”

- Economizer mode is enabled when the outside air temperature is below 65 °F

- There are 2391 operational hours used for “free cooling” San Antonio.



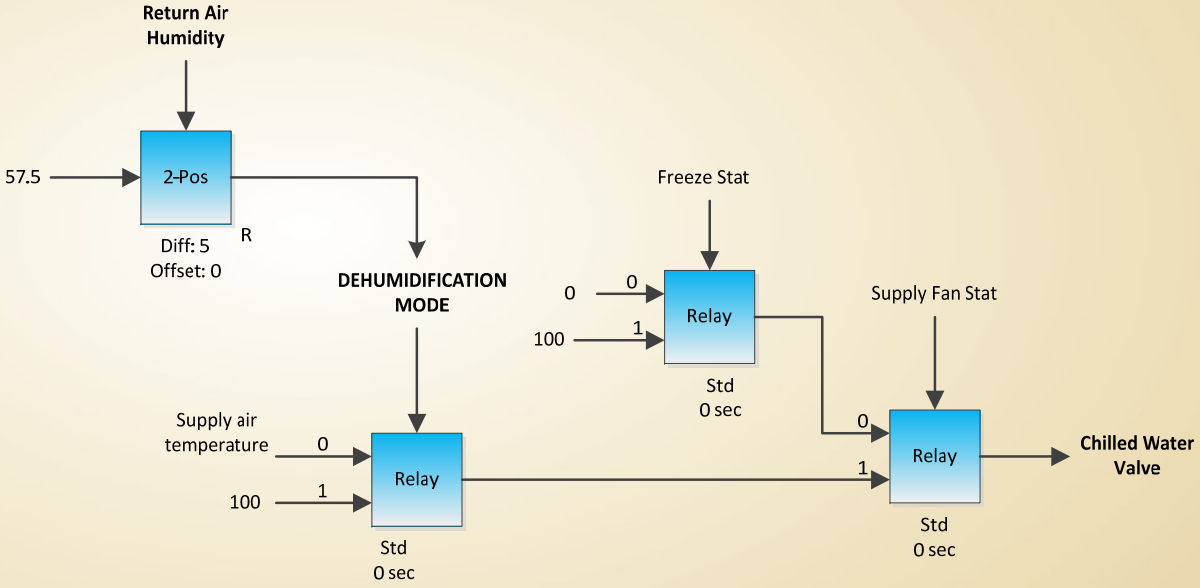


Humidity Control

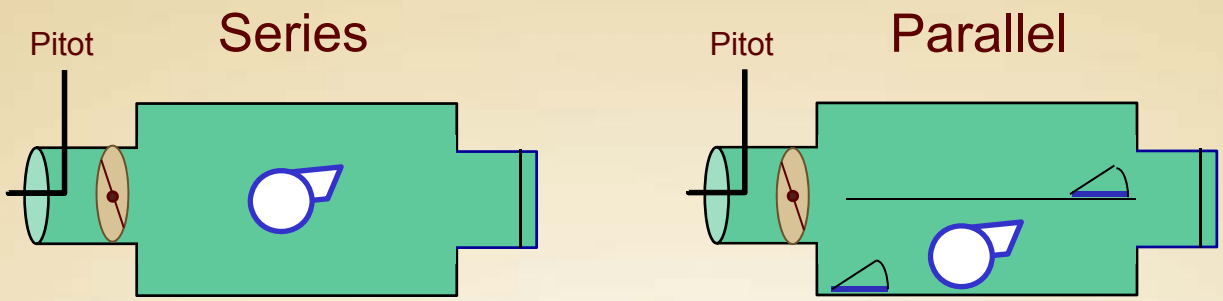
Humidity sensors calibrated and verified

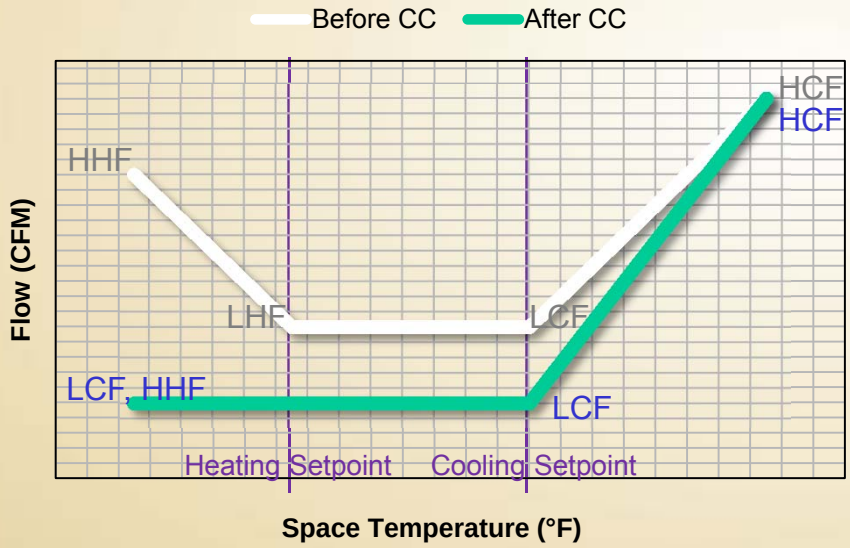
Implemented humidity control sequences

- Return air humidity is controlled by opening the chilled water valve
- Reheat may be needed to maintain space temperature



Terminal Box Optimization



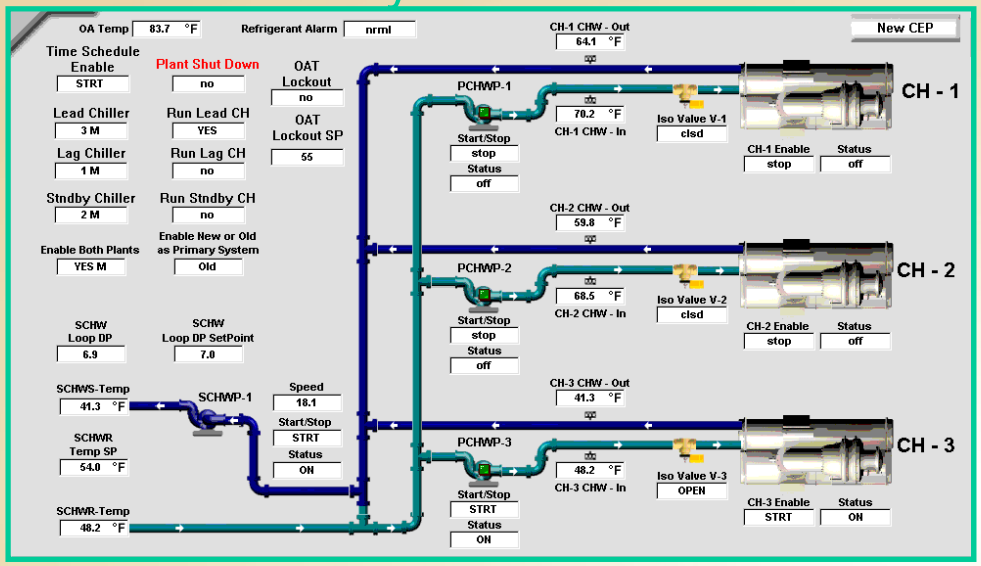


- Control the space temperature with airflow and heating stages
- Series: Fan located in the same stream as the supply air
- Parallel: Fan is located parallel to the supply air stream
- CC® Measures:
  - Air flow verification/calibration
  - Minimum flow setting

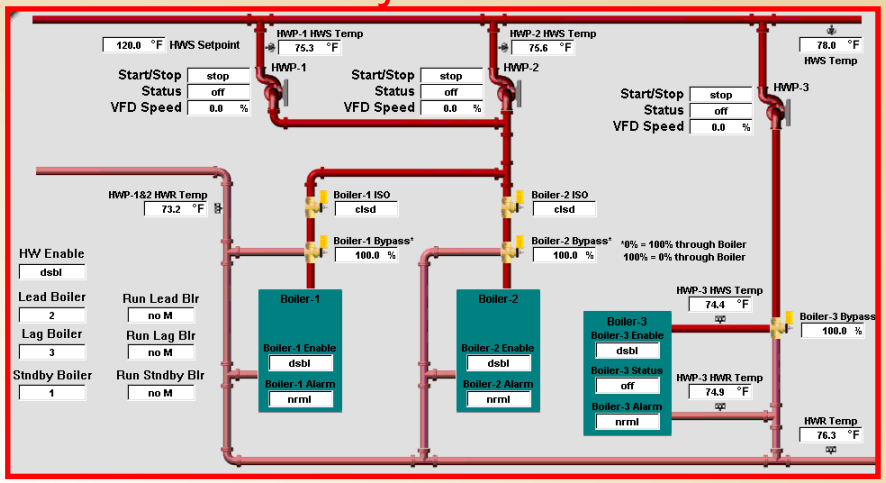
HHF: High Heating Flow
LHF: Low Heating Flow
HCF: High Cooling Flow
LCF: Low Cooling Flow

Central Plant Optimization

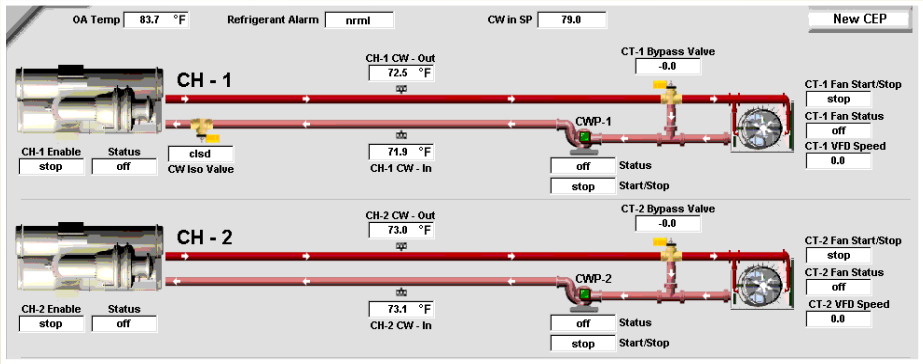
Chilled Water System



Hot Water System



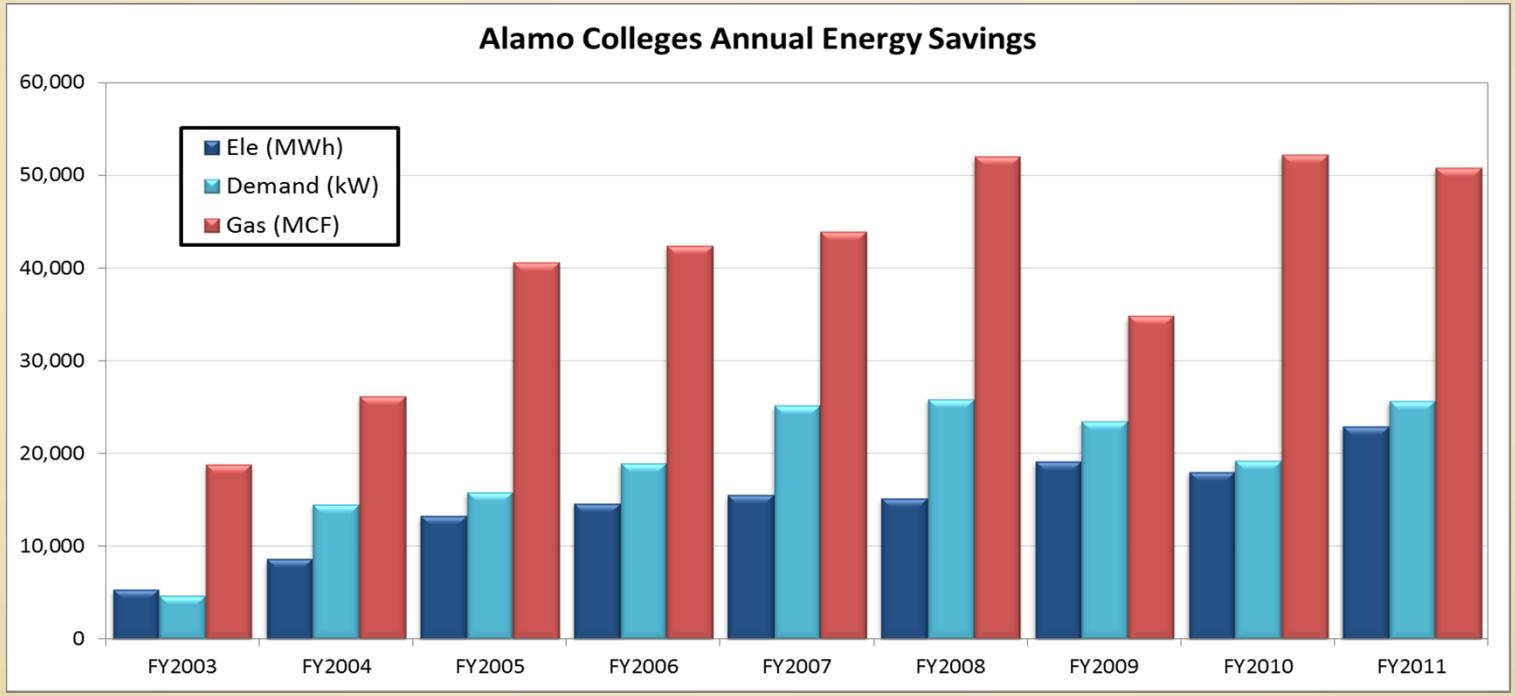
Condenser Water System



- Chilled and hot water reset schedules
- Cooling tower optimization
- Chiller Staging

Alamo Colleges Energy Savings

Items	Total Energy Savings
Electricity Usage (MWh)	132,359
Electric Demand (kW)	173,113
Gas Use (MCF)	361,502



FY2012 Investment and Savings

Year	Project	Paid to TEES (cost)	Savings (return)
2011-2012	Work Order #10	$ 300,156.00	
	Cost for Energy Manager w/ Analysis Team		$ 200,000.00
	Specifications for EMCS upgrade/ project management		$ 60,000.00
	Specifications for IAQ sensor installation		$ 20,000.00
	Utility dash board development		$ 40,000.00
	ACUPCC liaison for 5 campuses		$ 200,000.00
	Work Order #9	$ 331,159.00	
	Maintain savings from previous CC work (July 2010- June 2011)		
	Savings from CC meaures implemented on new construction projects (pending analysis)	–	$ 1,669,485.00
	Work Order #8		
	Energy conservation/alternative energy study for Northwest Vista College	$ 47,995.00	
	Work Order #3	$ 49,063.00	
	Total	$ 728,373.00	$ 2,189,485.00