

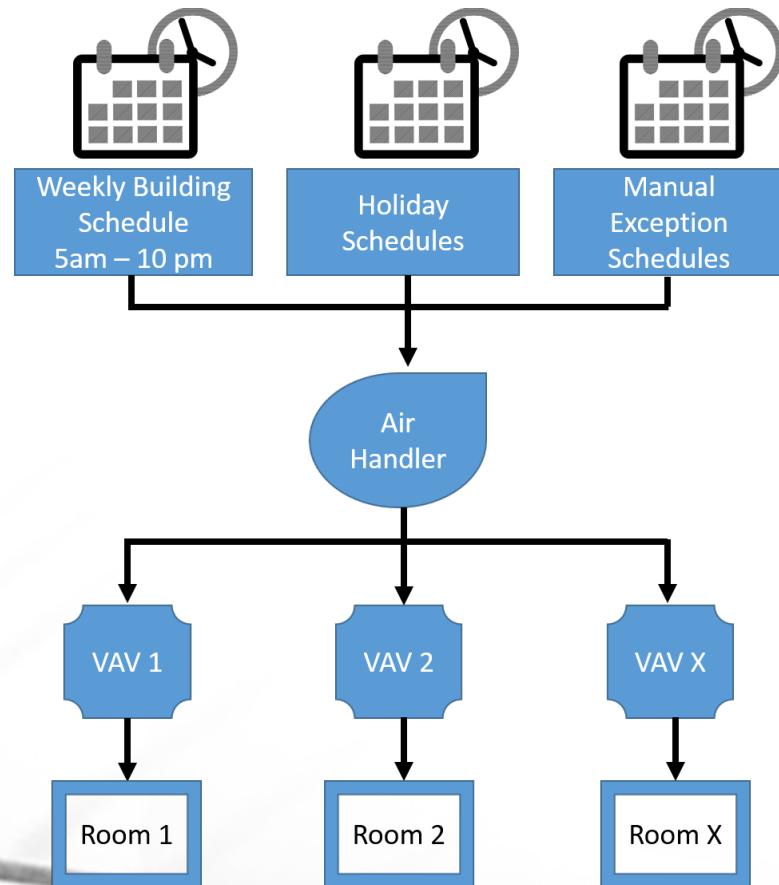
# **How Much Can a Campus Save by Integrating Room Schedules to HVAC?**

David Thorson, University of Colorado Denver

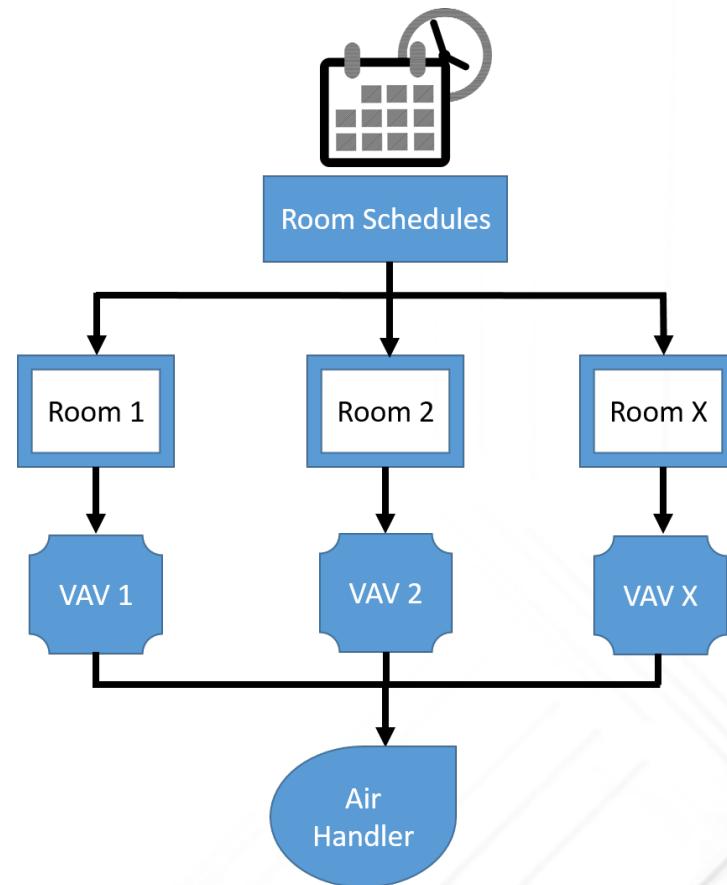
Tonya Russell, Streamside Solutions

# What Does Schedule Integration Look Like?

Typical HVAC Scheduling



Integrated HVAC Scheduling

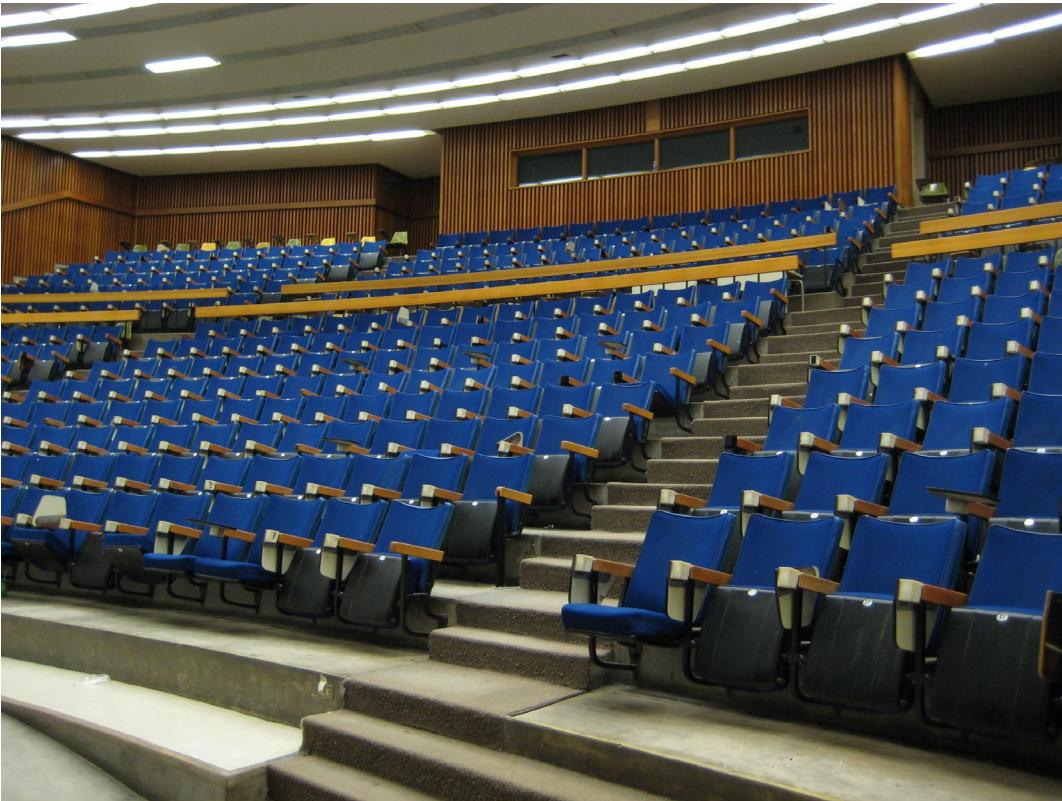


## **Let's Start with Classrooms**

- 2002 APPA study of 25 public universities showed classroom utilization during the day, Monday–Friday, was 39.3% to 65.2%
- Gold standard = 67% utilization, 8 am to 5 pm, Monday-Friday
- Unoccupied 33% of the day

## Recent Examples

- University of Colorado Denver,  
58% classroom utilization in 2014
- Purdue University, 59.7%  
classroom utilization in 2015
- University of North Carolina  
campuses, 52% classroom  
utilization in 2016



# Johnson County Community College

**SCHEDULE**

02/22/2018 

   Show Disabled

ACTIONS 

	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM			
<a href="#">CLB 240</a>	UnOccupied						Occupied																UnOccupied				
<a href="#">CLB 301</a>	UnOccupied							Occupied															UnOccupied				
<a href="#">CLB 303 (AD)</a>	UnOccupied									Occupied					UnOccupied												
<a href="#">CLB 305</a>	UnOccupied								Occupied														UnOccupied				
<a href="#">CLB 307 (AD)</a>	UnOccupied									Events2HVAC Schedules				Occupied			UnOccupied			Occupied			UnOccupied				
<a href="#">CLB 309 (AD)</a>	UnOccupied										Occupied			Occupied									UnOccupied				
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<a href="#">CLB 409</a>	UnOccupied													13 E2H controlled zones, 89.75 rm-hrs vs 195 rm-hrs baseline (avg 54% reduction)	Occupied										UnOccupied		
<a href="#">CLB 411 (AD)</a>	UnOccupied																Occupied			UnOccupied							
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<a href="#">CLB 434</a>	UnOccupied																				Occupied				UnOccupied		

# Not Just for Classrooms

How often are these spaces empty but running HVAC?

- Sports arenas
- Theaters
- Special event spaces
- Conference rooms
- Student unions

How much time is spent on exception schedules for after-hours events?

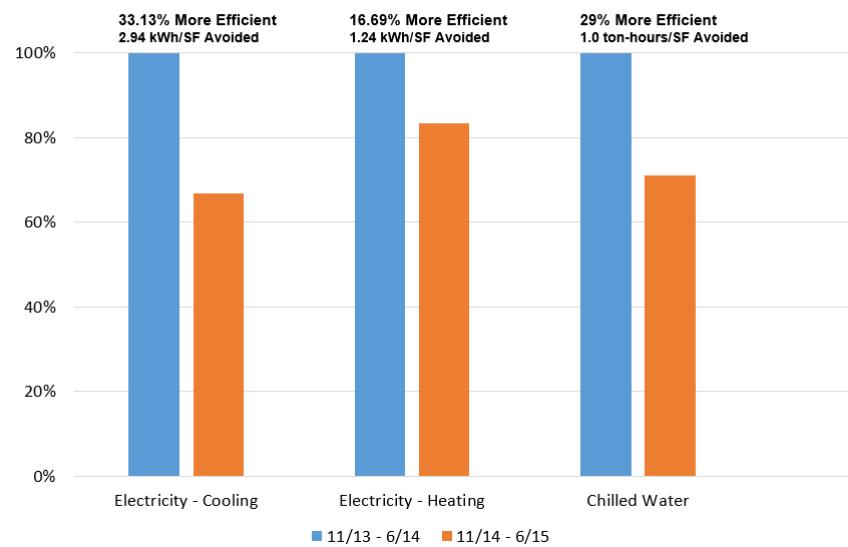
# Wicomico County Public Schools (MD)

- 435 rooms across 24 schools
- 17,000 – 19,000 after-school events each year
- Previously 20 hours per week to schedule HVAC
- After integration, only 20 minutes every 2 weeks
- 99% reduction of scheduling time



# Carolina Union – UNC Chapel Hill

Carolina Union Energy Efficiency (Summary)



- 26 rooms; 12,000-14,000 meetings/year
- Previously running HVAC 6 am – 12 am
  - Cooling electricity reduced 33%
  - Heating electricity reduced 17%
  - Chilled water reduced 29%
  - Energy savings to power 63 average homes each year

# How Does Reducing Runtime Save Energy?

1. Reduction in VAV room CFM
2. Reduction in AHU power consumption
3. Reduction in heating and cooling load

Example: 20% CFM reduction at AHU VFD => 50% Reduction of input power.

- $hp_2 = hp_1 \times (\text{Flow}_2/\text{Flow}_1)^3$  (var. torque loads)
- kW = 0.746 kW/hp/motor efficiency

# 3 Ways to Estimate Energy Savings

1. Focus on Fans:
  - A. Determine average runtime savings (# runtime hours saved).
  - B. Find horsepower ratings for AHUs and/or CFM ratings for VAVs.
  - C. For AHUs, convert horsepower ratings to KW, and multiply by runtime savings.
  - D. For VAVs, use equation on previous screen, and multiply by runtime savings.
  - E. Add up savings for all pieces of equipment. (Does not include boiler/chiller savings.)
2. Have your energy manager or a consultant perform a detailed energy analysis based on your average runtime savings.
3. Test this solution on your campus and get real data. Compare results to baseline data and utility bills from previous years.

# Resources

## Classroom Utilization

- Classroom Use and Utilization, 2002, APPA:  
<https://www.appa.org/files/FMArticles/classroomspace.pdf>
- Classroom and Class Laboratory Utilization Analysis, University of Colorado Denver, 2014:  
[http://www.ucdenver.edu/about/departments/InstitutionalPlanning/CampusPlanning/Documents/CUDenver\\_Utilization-Analysis\\_FINAL\\_2015-01-13.pdf](http://www.ucdenver.edu/about/departments/InstitutionalPlanning/CampusPlanning/Documents/CUDenver_Utilization-Analysis_FINAL_2015-01-13.pdf)
- Instructional Space Utilization, Purdue University, 2015:  
[https://www.purdue.edu/oirae/documents/OIRAE\\_Briefings/Space\\_Utilization\\_October\\_2015.pdf](https://www.purdue.edu/oirae/documents/OIRAE_Briefings/Space_Utilization_October_2015.pdf)
- Facilities Inventory and Utilization Study 2016 (North Carolina Universities and Community Colleges):  
[https://www.northcarolina.edu/sites/default/files/2016\\_facilities\\_inventory\\_and\\_utilization\\_study\\_final.pdf](https://www.northcarolina.edu/sites/default/files/2016_facilities_inventory_and_utilization_study_final.pdf)

## Energy Savings Estimates

- Tips and Tricks for Estimating Energy Savings:  
[https://www.bcx.org/ncbc/2009/docs/Cizik\\_NCBC09.pdf](https://www.bcx.org/ncbc/2009/docs/Cizik_NCBC09.pdf)
- Adjustable Speed Drive Part-Load Efficiency, US Dept of Energy:  
[https://www.energy.gov/sites/prod/files/2014/04/f15/motor\\_tip\\_sheet11.pdf](https://www.energy.gov/sites/prod/files/2014/04/f15/motor_tip_sheet11.pdf)
- CBE Setpoint Savings Calculator: <http://comfort.cbe.berkeley.edu/energycalc/>

# Integrating Room Schedules to HVAC Unique Aspects and Results



September 25 & 26<sup>th</sup>, 2018



University of Colorado **Denver | Anschutz Medical Campus**

# The Challenges we faced daily.

- Events were put together on the fly, sometimes by scheduling the appropriate support resources, sometime not.
- Because we didn't know what events were happening when, most heating and air conditioning ran virtually 24/7/365.
- Considerable energy was being used to maintain empty rooms. One employee was dedicated to scheduling the HVAC occupancy for the Classrooms based on the weekly classroom schedules.

# Ideas that Converge

- In 2011, a small group of resource managers formed a committee to review events on the Anschutz campus; tasked with finding a better way to schedule support resources. EMS was being used for classrooms only.
- Facilities Engineers were also researching a piece of software (EMS Plug-in) that would reduce energy consumption by automating the HVAC scheduling operations with EMS.
- Facilities Engineering team performed energy savings and simple payback estimates.

# The Committee's Results

- By expanding EMS to all rooms and adding Features, Event Scheduling for all support service teams could be streamlined.
- This would provide enhanced the customer experience with room scheduling and events.
- By automating the HVAC equipment to EMS, the energy savings are considerable.

# Estimates for Justification (2012)

- Initial estimates for the hardware & software installation was \$368k, with projected annual savings of \$151k.
- 2.4 years simple payback.
- 585,097 kWh
  - Equivalent to 78 homes.
- 1027 Tons CO<sub>2</sub>e.
  - » Equivalent to 180 car emissions.

# Turning the Dream into Reality

- Facilities Engineering team Identified the specific sensors needs and programming for each room type. This provided the plan on how to integrate all of the pieces between the HVAC system, the EMS plug-in and the EMS System.
- Our BAS Contractor installed the required sensors and programming. The EMS gateway was programmed by our Engineers.
- Working together, our Engineers and BAS Contractor commissioned the system.

# Lessons Learned

- Justifying the project was difficult as management required an independent payback justification.
- Buy-in from all campus constituencies was critical for success since both public and private rooms were involved. EMS training was key to success.
- Projects always take more time than anyone thinks. We learned to be patient.
- Third party commissioning would have been helpful since our resources were limited.

# Efficiencies and Successes

- Programming has been completed for approximately three years.
- We no longer have heating and cooling taking place in areas that once ran 24/7/365.
- The project payed itself back in energy savings in just under 3 years.
- Xcel rebate approved and received - \$39,458 (11.3%).
- The Project has been expanded to also include all CU managed buildings on the Denver Campus.

# Benefits of an Integrated HVAC System

- We now have “real” utilization data instead of “scheduled” data.
- Energy savings annually of \$145,000.
- Employee no longer has to schedule the classroom HVAC occupancy based on the EMS schedule.

# Integrating Room Schedules to HVAC Unique Aspects and Results



Networking. Mentorship.  
Professional Development.

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