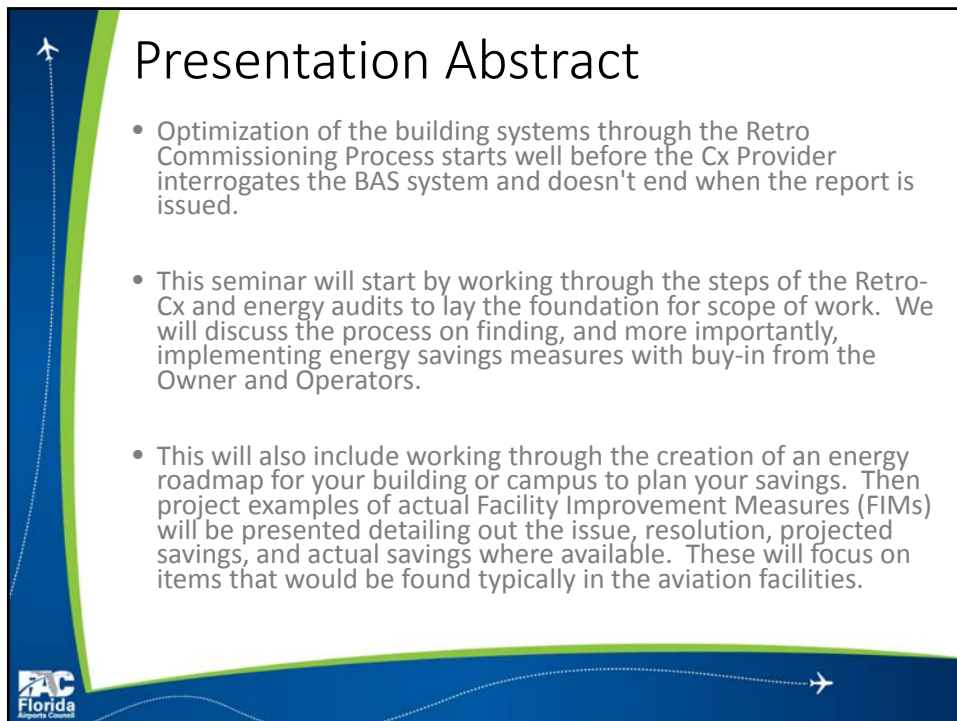


The slide features a blue background with a green curved line on the left side. A white dotted line with an arrow at the top left and bottom right curves around the green line. The title 'Retro-Commissioning' is centered in a large black font. Below it, the subtitle 'The Process and Optimization Implementation Case Studies' is centered in a smaller black font. The FAC Florida Airports Council logo is in the bottom left corner.

Retro-Commissioning

The Process and Optimization Implementation Case Studies

FAC
Florida
Airports Council



The slide features a blue background with a green curved line on the left side. A white dotted line with an arrow at the top left and bottom right curves around the green line. The title 'Presentation Abstract' is centered in a large black font. Below it, three bullet points are listed. The FAC Florida Airports Council logo is in the bottom left corner.

Presentation Abstract

- Optimization of the building systems through the Retro Commissioning Process starts well before the Cx Provider interrogates the BAS system and doesn't end when the report is issued.
- This seminar will start by working through the steps of the Retro-Cx and energy audits to lay the foundation for scope of work. We will discuss the process on finding, and more importantly, implementing energy savings measures with buy-in from the Owner and Operators.
- This will also include working through the creation of an energy roadmap for your building or campus to plan your savings. Then project examples of actual Facility Improvement Measures (FIMs) will be presented detailing out the issue, resolution, projected savings, and actual savings where available. These will focus on items that would be found typically in the aviation facilities.

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Learning Objectives

At the end of the this course, participants will be able to:

- Learn the essential steps of an Energy Audit and Retro Commissioning (RCx)
- Learn the difference between RCx and energy audits
- Learn how to use the investigation results to create an energy roadmap for Capex budget planning
- Learn about real world examples of implemented Facility Improvement Measures (FIMs)



Energy Audits

The primary functions of energy audits are:

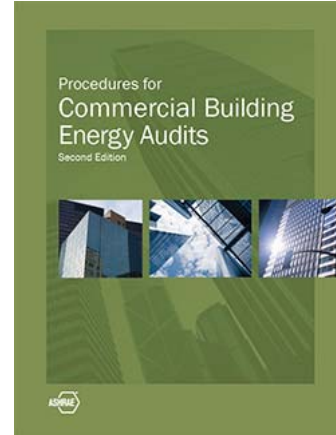
- Benchmark the performance of your building(s)
- Identify the electrical and thermal load drivers and end-use breakdown of energy by system
- Capture and describe the characteristics and operations of the building(s) and systems
- Identify a prioritization sequence of capital asset replacements and upgrades (lighting, chillers, etc.)
- Identify if RCx or other O&M improvements are warranted



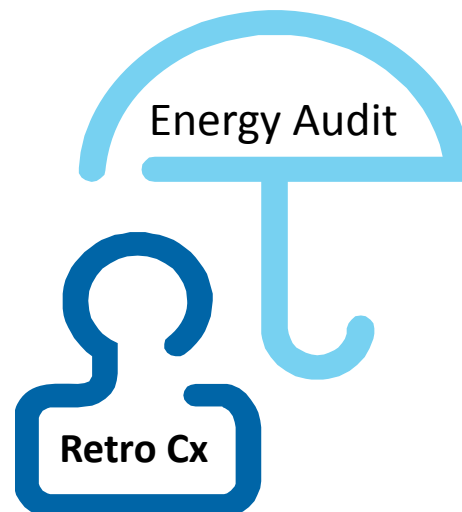
Energy Audits: Level of Rigor

Audits are generally classified into 3 levels of rigor:

- Cursory walkthrough; identify low hanging fruit and determine if a deeper dive is warranted
- Intermediate investigation; compile in greater detail exact counts and types of end use systems and operational characteristics
- Investment Grade; calibrated energy modeling, contractor quotes for measures



Comparison



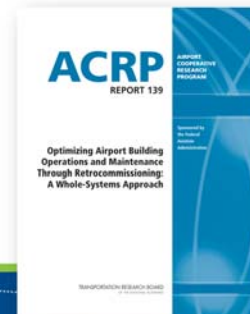
What is Retro-Cx

- **PROCESS:** An experienced commissioning team investigates the existing systems operation looking for equipment and systems that are not operating “properly”.
- **RESULT:** The most common HVAC discovery is even though the space temperatures are comfortable, the systems are consuming much more energy than necessary due to over-cooling, over-heating, over-ventilating.
- **COST:** Retro-commissioning’s cost is a few weeks of time for the commissioning team. The cost savings discovered usually pay back the retro-commissioning cost in months.



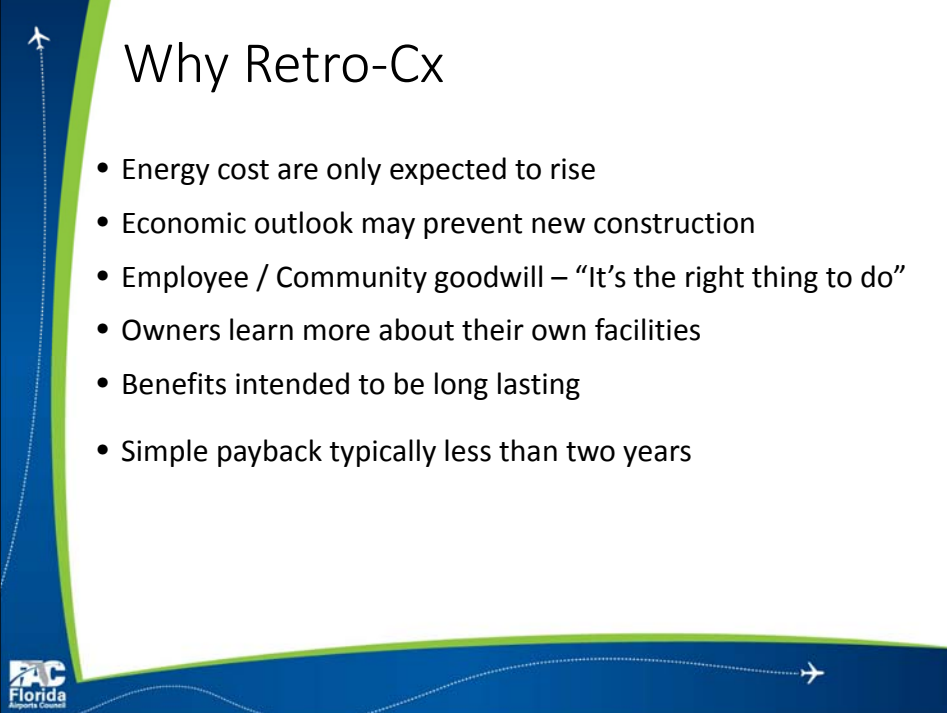

Why Retro-Cx

- Older bldgs. (Pre 1990) on average consume more energy
- Antiquated control systems that don’t work
- Energy saving control strategies missed in design
- Neglected maintenance wasting energy and/or causing IAQ problems
- System upgrades that miss the mark
- Building usage / floor plans changed



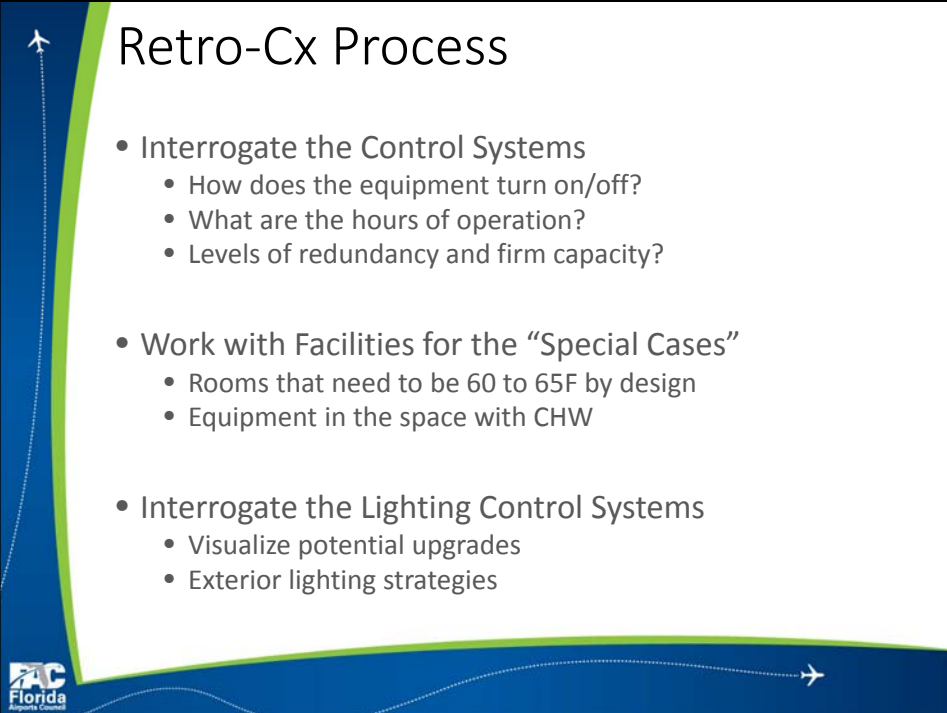

Why Retro-Cx

- Energy cost are only expected to rise
- Economic outlook may prevent new construction
- Employee / Community goodwill – “It’s the right thing to do”
- Owners learn more about their own facilities
- Benefits intended to be long lasting
- Simple payback typically less than two years



Retro-Cx Process

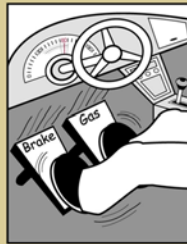
- Interrogate the Control Systems
 - How does the equipment turn on/off?
 - What are the hours of operation?
 - Levels of redundancy and firm capacity?
- Work with Facilities for the “Special Cases”
 - Rooms that need to be 60 to 65F by design
 - Equipment in the space with CHW
- Interrogate the Lighting Control Systems
 - Visualize potential upgrades
 - Exterior lighting strategies



Retro-Commissioned Defined

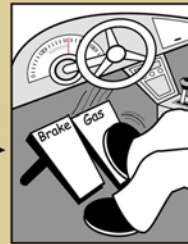
LOWER OPERATING COSTS: Optimize Performance

Commissioning of building systems is a process which reveals situations where both the gas and brake pedals of the buildings systems are being used simultaneously. Fine-tuning the operation of these systems through commissioning by releasing the brakes and using only the gas pedal can result in significant energy cost savings.



WITHOUT COMMISSIONING

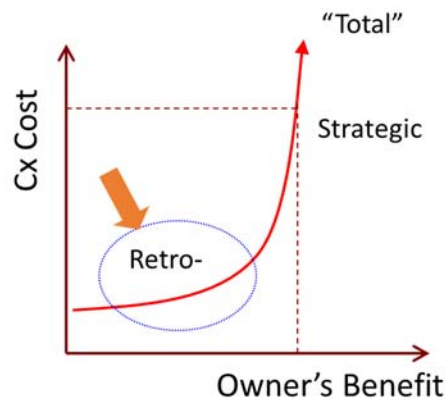
COMMISSIONING PROCESS



WITH COMMISSIONING



Retro-Commissioning Defined



Commissioning Value Curve



What is Retro-Cx

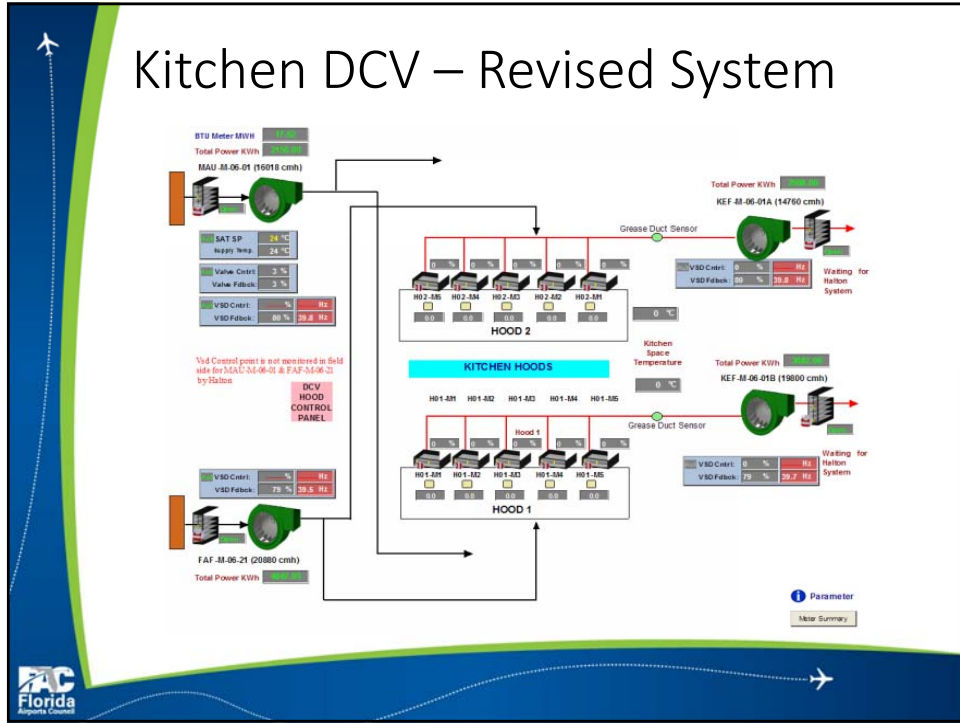
- Retro-Cx is **NOT** an energy study!
 - Energy studies leave the Owner with proof of what they already suspect: something is wrong
 - It provides no answers as to what to do or where to start
 - Skip all the paperwork and go find the **MONEY**

Kitchen Demand Controlled Ventilation (DCV)

- Proof of Concept Approach
- Existing Constant Volume Kitchen
 - Scheduled per Chefs but seemed 24/7 at times
 - Chilled Water Cooling make-up air to space
 - Multiple Hoods
 - Multiple Fans



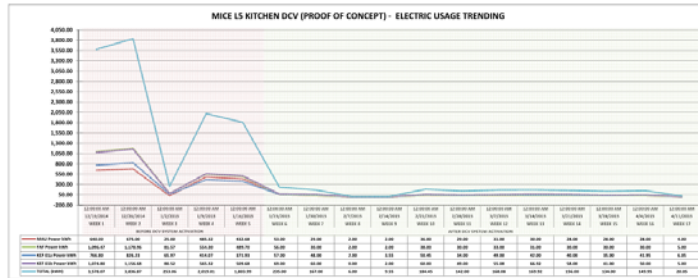
Kitchen DCV – Revised System



Kitchen DCV - Results

	Average Weekly Electricity	Average Weekly Chilled Water
Before DCV	3,707.47 kWh	5,190 KwR/H
After DCV	167.38 kWh	1,577.35 KwR/H
Savings in percentage	95.5%	69.4%
Annualized saving	184,084.68 kWh	187,857.8 KwR/H
Utility Tariff	\$0.15143 per kWh	\$0.0536 per KwR/H
Annual cost saving	\$27,875.9	\$10,069.2

Table 1: Summary of DCV system performance



Example measure: Occupancy-sensed zone conditioning reset

Issue reported: Hot perimeter zones, cold internal zones (hot & humid climate). High energy \$/SF

What was happening:

- Perimeter VAV's starved of air.
- High solar heat gain from windows.
- VAV minimum CFM setpoints totaled 16,000 CFM.
- Interior scheduled but unoccupied zones subcooling and reheating.

Measure: Wire existing lighting occupancy sensors to BAS, reset VAV minimum flow to 0 if sensed unoccupied and relax temperature deadband.

Result: 30% annual power reduction.

\$30,000 avoided in the first year.

Immediate payback.

Eliminated simultaneous heating and cooling in interior zones.

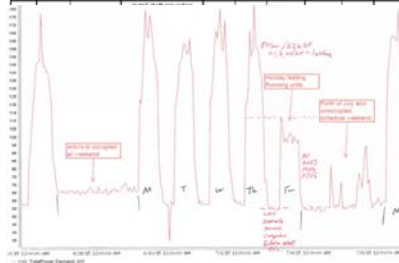
Exterior zones maintain temperature setpoints.



O&M Measures

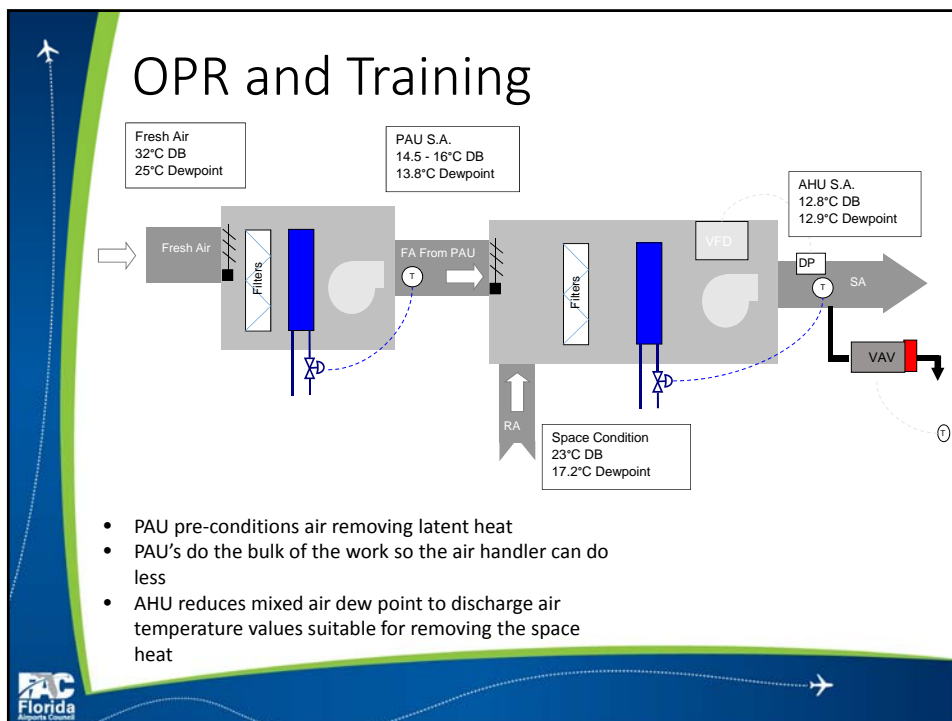
- Dozens of "little" issues can add up
- Work orders issued as if the list of measures were a "punch list"
- Result: 10% campus savings target achieved a year ahead of schedule!

Item #	Energy System Type	Recommended Change	Description	Cost	Priority	Estimated Savings by System	Estimated Savings by Building	Risk	R/O Impact
5	HVAC	Replace Duct	The service air ducting units are self-discharge and the current fan duct makes an immediate 90° bend at the point of connection, resulting in reduced duct and excessive restricting air flow. Install a smooth transition 90° collar on the discharge of the duct.	Low	High	High	Low	Fast	N/A
6	HVAC	Replace Duct	An existing air ductwork requires to be replaced to correct conditions on the ramp level (AS) Area 200	Low	High	Low	Low	Fast	Large
7	HVAC	Preventative Maintenance	Implement preventive tips, shaft & motor vibration inspection routine. Repair or replace worn shaft and motor bearings on ACS AHU's, AS2 AHU's 41 & 42 and motor bearings on ACS AHU's 38, 39, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29	Medium	High	High	Low	Fast	Medium
8	HVAC	Replace Duct	Replace ductwork from kitchen areas, remove to eliminate air vapor deposition onto AHU filters and coils.	Medium	Medium	Medium	Low	Medium	Large
9	HVAC	SDC Controls	Replace all "non static" dry contact I/O with 4-20mA current transducers to detect motor/compressor amps of HVAC equipment.	Medium	Medium	Medium	Low	Medium	Medium



Owner's Project Requirements and Training

- Created an OPR for ECM that was implemented
- Design group did a renovation and allowed non-optimized strategies
- Created document and trained staff



Questions?



Thank you!