Federal Energy Management 101

Track 7, Session 1

Moderated by Sheila Hayter

Session Learning Outcomes

- Identify common building systems that use energy, including HVAC, lighting, and building envelope.
- Recognize the facets of energy consumption within the common building systems, both actual and targets.
- Identify energy conservation measures (ECMs) and understand what the common ECMs are.
- Recognize how ECMs are funded, implemented, and savings verified.

Obtaining FEMP IACET CEUs

The Federal Energy Management Program (FEMP) is an Accredited Provider of International Association for Continuing Education and Training (IACET) CEUs under the ANSI/IACET 1-2018 Standard. FEMP established the WBDG–Whole Building Design Guide (www.wbdg.org) – a federally supported portal providing guidance, criteria and technology from a 'whole buildings' perspective and managed by the National Institute of Building Sciences (NIBS) – as the official Learning Management System to host FEMP's continuing education.

To receive FEMP IACET Accredited Continuing Education Units (CEUs):

- Create a free WBDG account or log in to an existing account using the same email registered for EEx24.
- Visit www.wbdg.org/energy-exchange to view sessions attended and accredited for IACET CEU credits.
- Complete the assessment demonstrating learned knowledge from the session with a passing score of 80 or above then the following session evaluation.
- Meet the deadline for earning EEx24 session IACET CEUs through the WBDG by **May 10, 2024.**

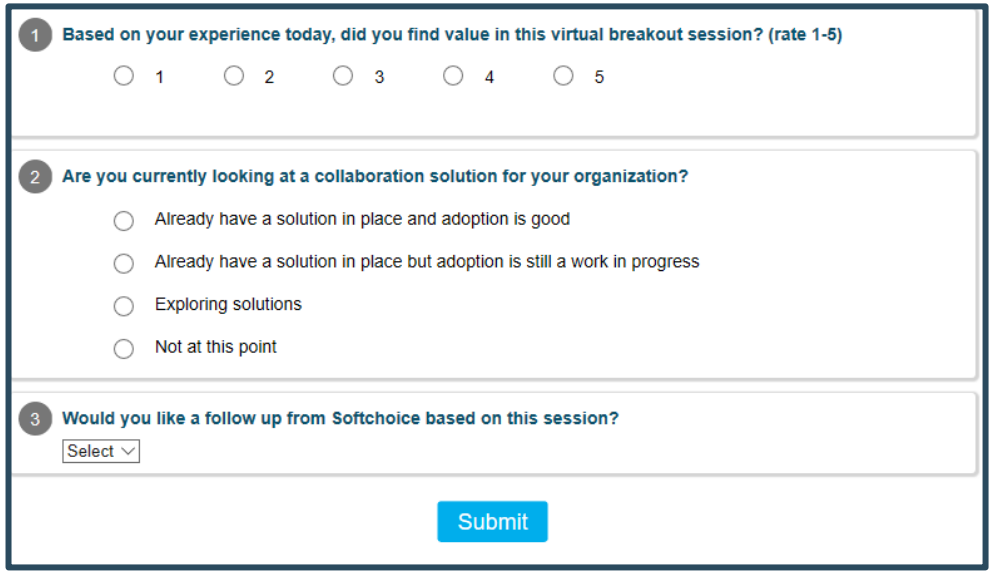
For questions related to the accreditation, email support for Energy Exchange at FEMP_Training@hq.doe.gov.

FBPTA Aligned Course

- This session has been aligned with at least one Federal Buildings Personnel Training Act (FBPTA) performance
- This session will be uploaded to AccelerateFM, the FBPTA compliance reporting tool, for all attendees with an account who complete the session assessment and evaluation.
- If you don't have an account in AccelerateFM and you create one within 30 days of this session and complete the session assessment and evaluation, this session will be uploaded for you
- If you want to learn more about FBPTA, visit www.fmi.gov or https://afm.fmi.gov/account/login
- Sessions that have been archived will be available for future viewing and can be added to your profile in Accelerate FM for FBPTA credit

Session Rating: Provide Feedback

We aim to improve our technical program every year, so please let us know how this session met (or did not meet) your expectations by taking the Session Rating Survey.



Agenda

- Introduction
- HVAC Systems
  - Systems, energy consumption, and ECMs
- Lighting Systems
  - Systems, energy consumption, and ECMs
- Building Envelope
  - Systems, energy consumption, and ECMs
- Process Energy
  - Systems, energy consumption, and how to manage
- Funding
  - Common federal funding opportunities
- Questions

Sheila Hayter, PE

Moderator

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Heating, Ventilation, & Air Conditioning (HVAC)

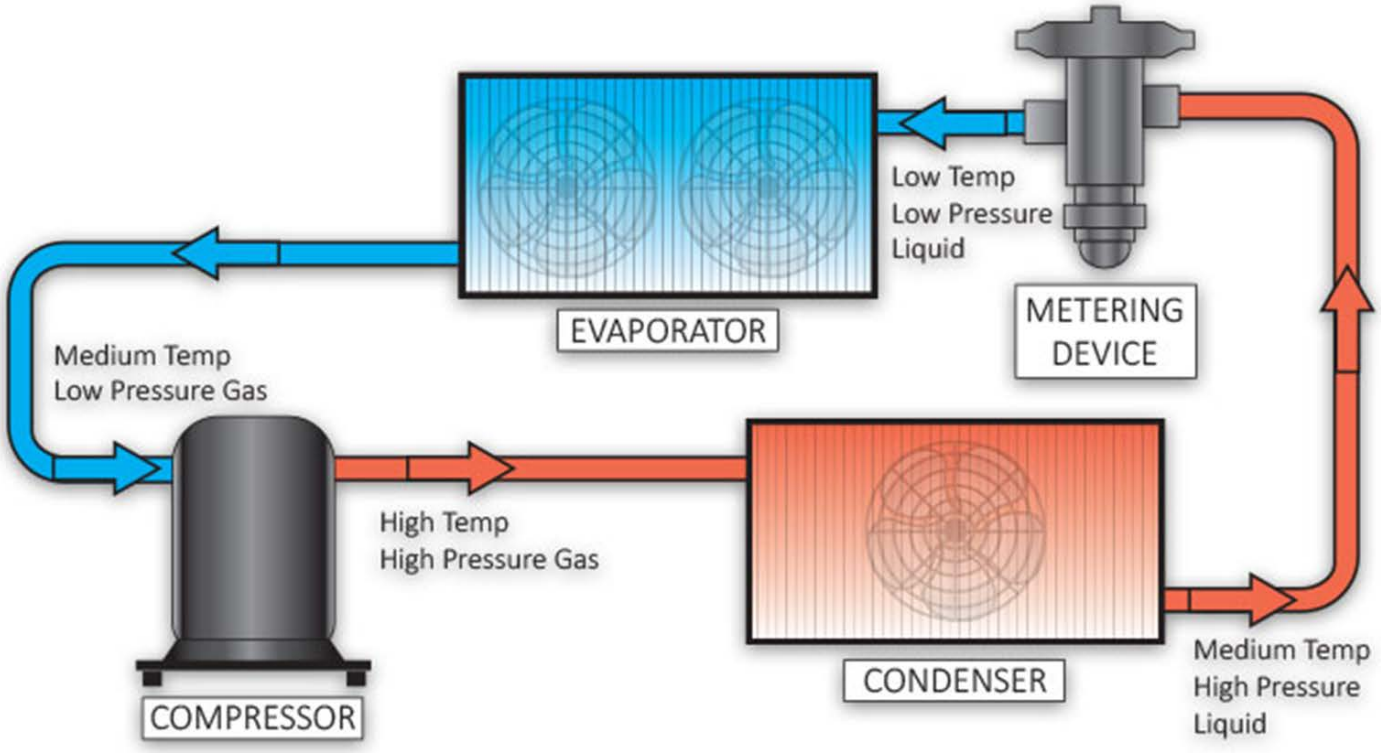
Heating Ventilation and Air Conditioning (HVAC)

- Historically 40-60% energy consumption
- Most energy conservation measure (ECM) savings
- Turn it off/ Turn it down concept

Cooling Systems

- Typical energy loads
- Compressor
- Condenser
- Evaporator
- Metering devices

Basic Refrigeration Cycle



Compressors

The heart of the system

- Intakes low temp/ low pressure vapor
- Discharges high temp/ high pressure vapor
  - Motor driven
  - Drive shaft
  - Pistons
  - Valves
  - Crankcase heaters
- Reduce runtimes

ECM Likelihood	
High	⚡⚡⚡
Medium	⚡⚡
Low	⚡

Condensers

- Changes state of refrigerant
  - Desuperheats
  - Condenses
  - Subcools

- ECM opportunity
  - Maintenance ϟϟϟ
    - Improper
    - Inadequate
  - Fan cycling ϟϟϟ
    - Load
    - Temperature

ECM Likelihood

High ϟϟϟ

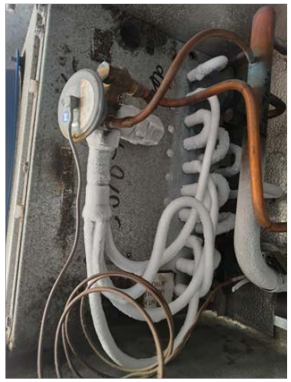
Medium ϟϟ

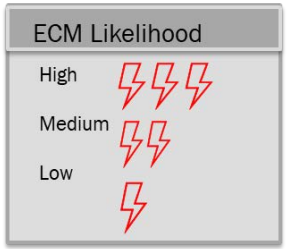
Low ϟ

Metering Devices

- Changes state of refrigerant
  - High pressure/ high temp liquid
  - Low pressure/ low temp vapor

- ECM opportunity
  - Maintenance
    - Improper
    - Loose sensing bulb





Evaporator

- Air handler
- Removes (Returns) air
- Processes air
- Supplies air

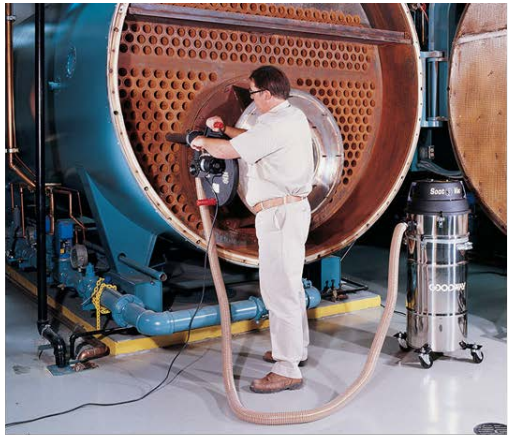
- ECM opportunity
  - Maintenance
    - Improper
    - Inadequate

ECM Likelihood	
High	
Medium	
Low	

Boilers

- Boilers
- Gas fired RTU
- Furnaces
- ECM opportunity
  - Maintenance
    - Improper
    - Inadequate
    - Combustion Analysis
  - Reduce runtimes

ECM Likelihood	
High	
Medium	
Low	



Controls Systems

- Include three types of devices:
- Sensors detect and measure a controlled variable
- Controllers - manual or automatic, the "mini brain" that initiates action
- Controlled Devices – respond to the controller to adjust the sensed condition

Setpoint is the desired condition.
No adjustment of the controlled device is required when setpoint is reached.

Sensor/Controller
Photo: FEA

Controlled Device
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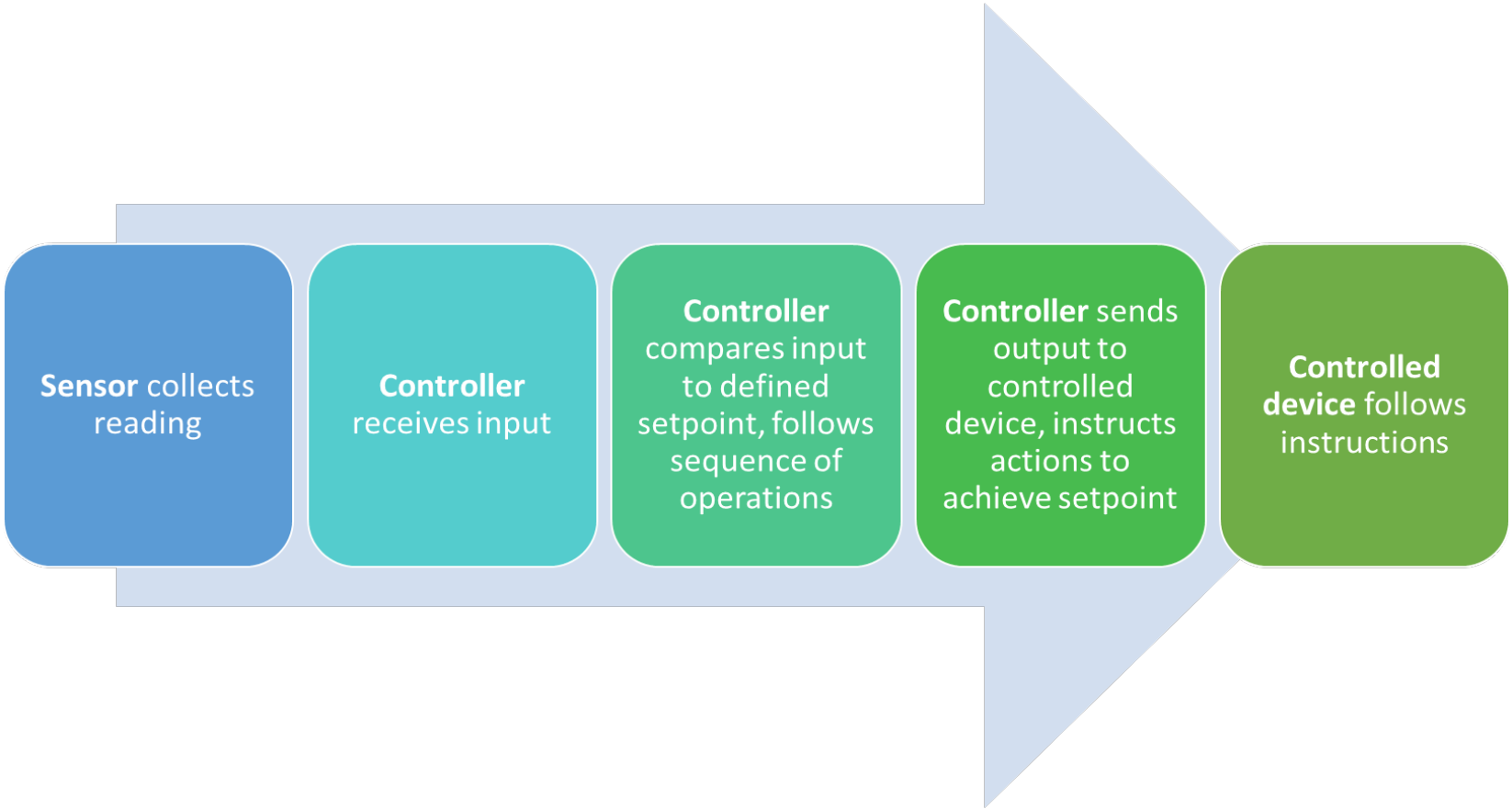
Basic Controls Sequence Example



Controls & Building Automation Systems Benefits

- How do we use controls to save energy?
- Schedule control
- Optimal start/stop
- Setbacks – nights, weekends, holidays
- Demand controlled ventilation
- Outside air reset
- Economizers (chiller bypass, outside air economizing)
- Night cooling/purging
- AHU supply duct static pressure reset

Lighting

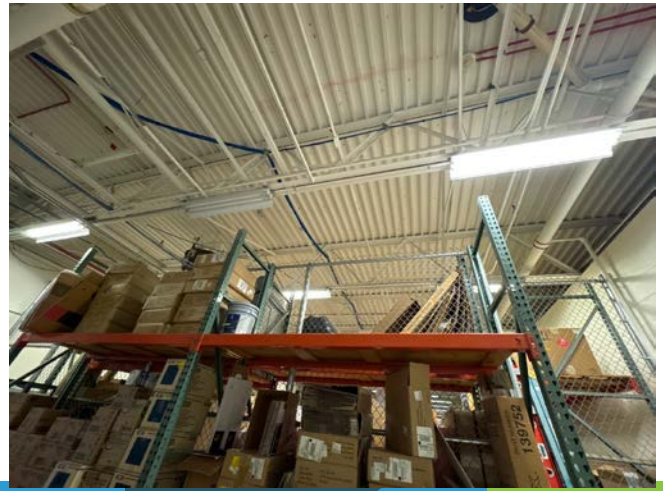
Energy Intensive Exterior Lighting Practices

- Common challenges for exterior lighting:
  - Lack of integrated controls
  - No dimming capability, no occupancy sensors, no daylight sensors
  - Typically, metal halide or high-pressure sodium (HID)
  - Low light levels
    - Safety can be a concern as well

Energy Intensive Interior Lighting Practices

- Can be difficult to replace if in high bay area
- T8 and T12 lighting will no longer be available

- Common challenges for interior lighting issues:
  - 24/7 office areas with no occupancy or vacancy sensors, no integrated controls
  - High bay lighting HID or fluorescent
  - Fluorescent lighting with no dimming capability



LED Office Lighting Examples

Lens Troffers

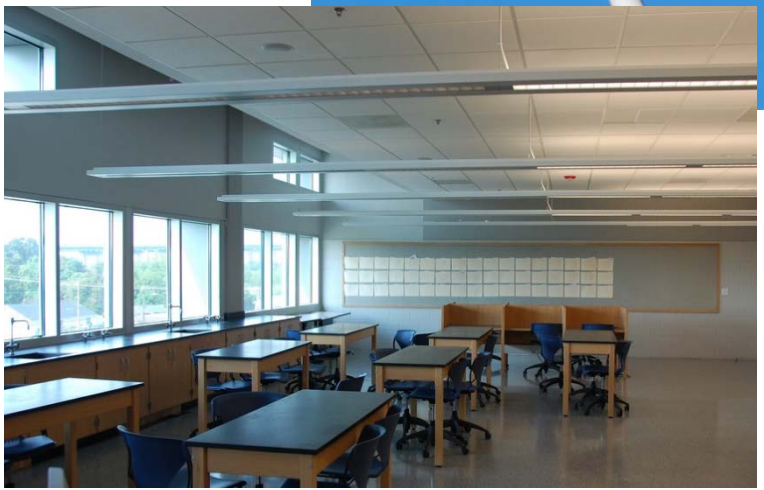
High Performance Troffer

Parabolic Troffers

Basket Troffers

Lighting Best Practices

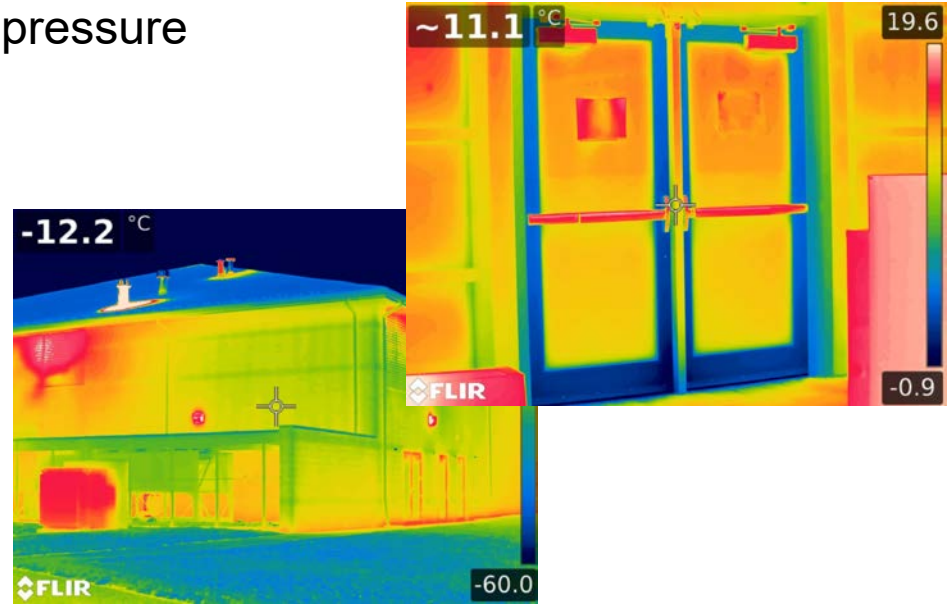
- Occupancy sensors
- LED fixtures and exit signs offering lower wattage and increased lifespans
- PV/BESS powered lighting
- Advanced lighting controls
  - Can include many features (daylight sensors, dimming control, and more)
  - Energy Management Information System (EMIS) integration is recommended
    - Can be integrated to interact with HVAC



Building Envelope

Building Envelope Principles

- Walls, windows, doors and roofs
- Avoid encroachment of unwanted heating or cooling
  - Maintain positive building air pressure
  - Inspect/ insulate walls
  - Inspect/ maintain windows
  - Replace door seals/ closures
  - Inspect roofing systems
    - Cool roofs



Building Envelope

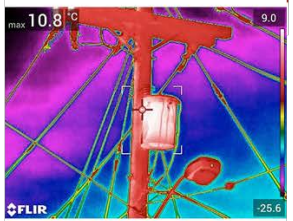
Listen to your buildings!

- Establish a baseline
- What is normal?
- Compare performance over time

Building Envelope: Analysis

Temp Range: -40F- 3632F
Pixels: 1024 x 768 [768,432]
Price: $50,940

Temp Range: -10F- 1000F
Pixels: 464 x 348 [161,472]
Price: $25,200



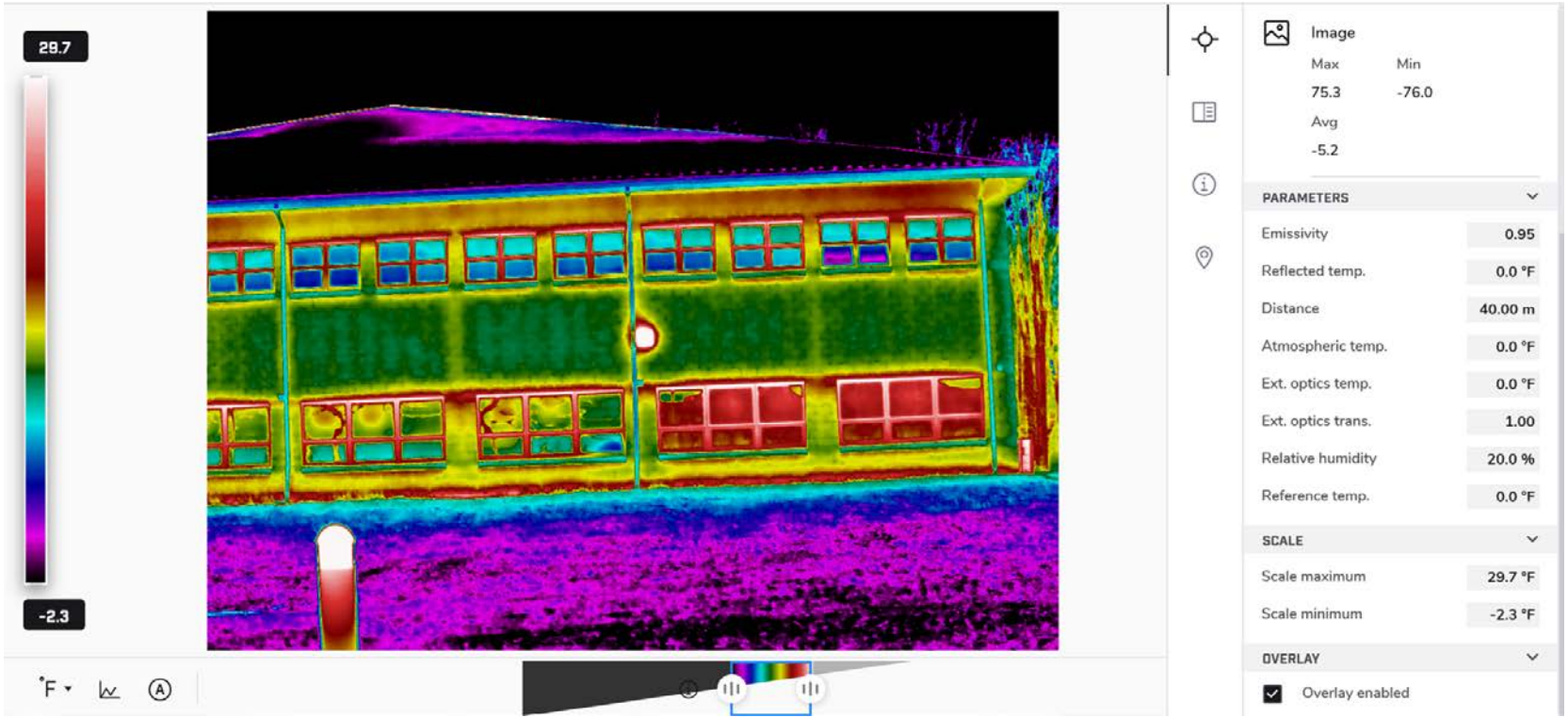
Temp Range: -4F- 1202F
Pixels: 320 x 240 [76,800]
Price: $14,334

Temp Range: -4F- 482F
Pixels: 80 X 60 [4,800]
Thermal Sensitivity: 150mK
Focus: Auto
Wireless: Yes
Emissivity: 0.10 to 1.00
Price: $1,237

Temp Range: -4F- 572F
Pixels: 128 x 96 [12,288]
Price: $624

Building Envelope: Exterior Analysis

Building Envelope: Exterior Analysis



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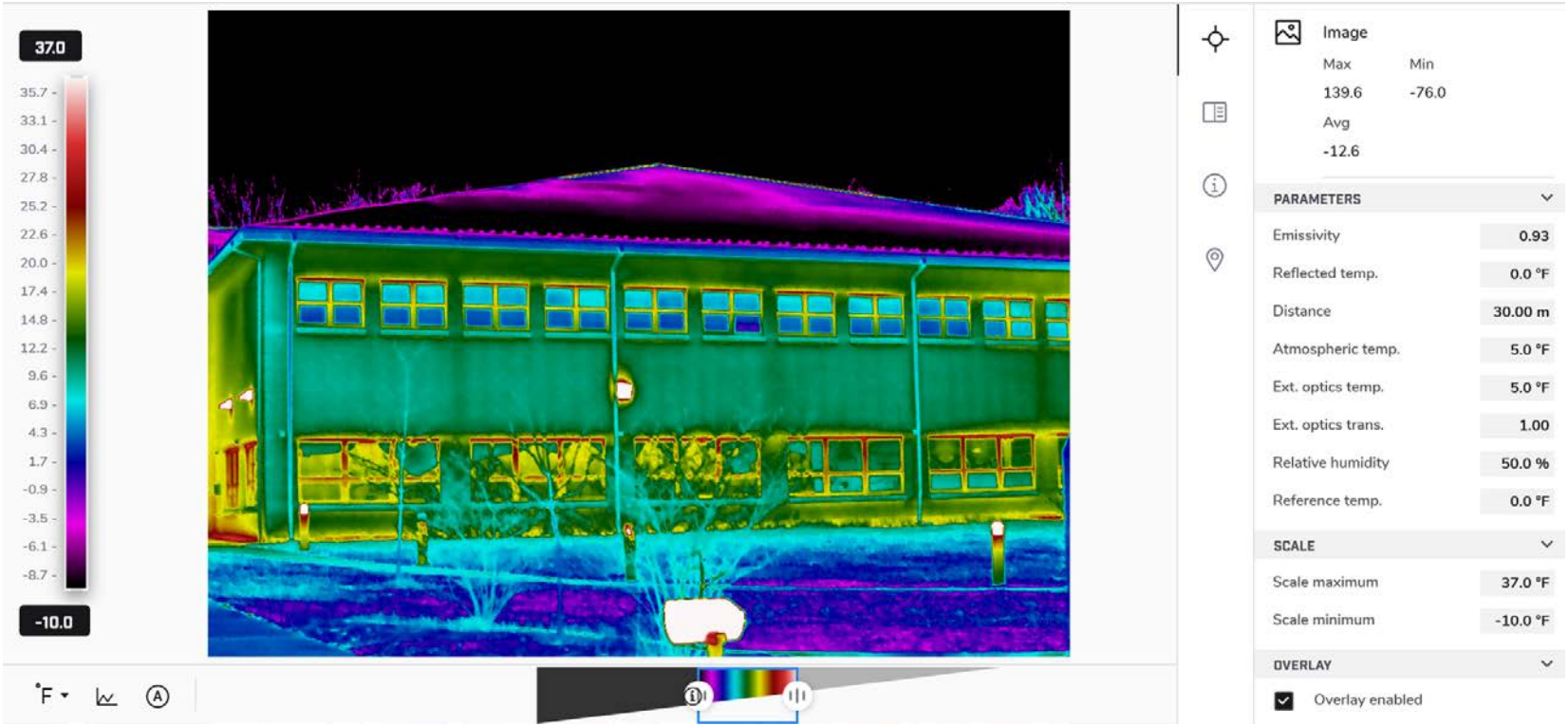

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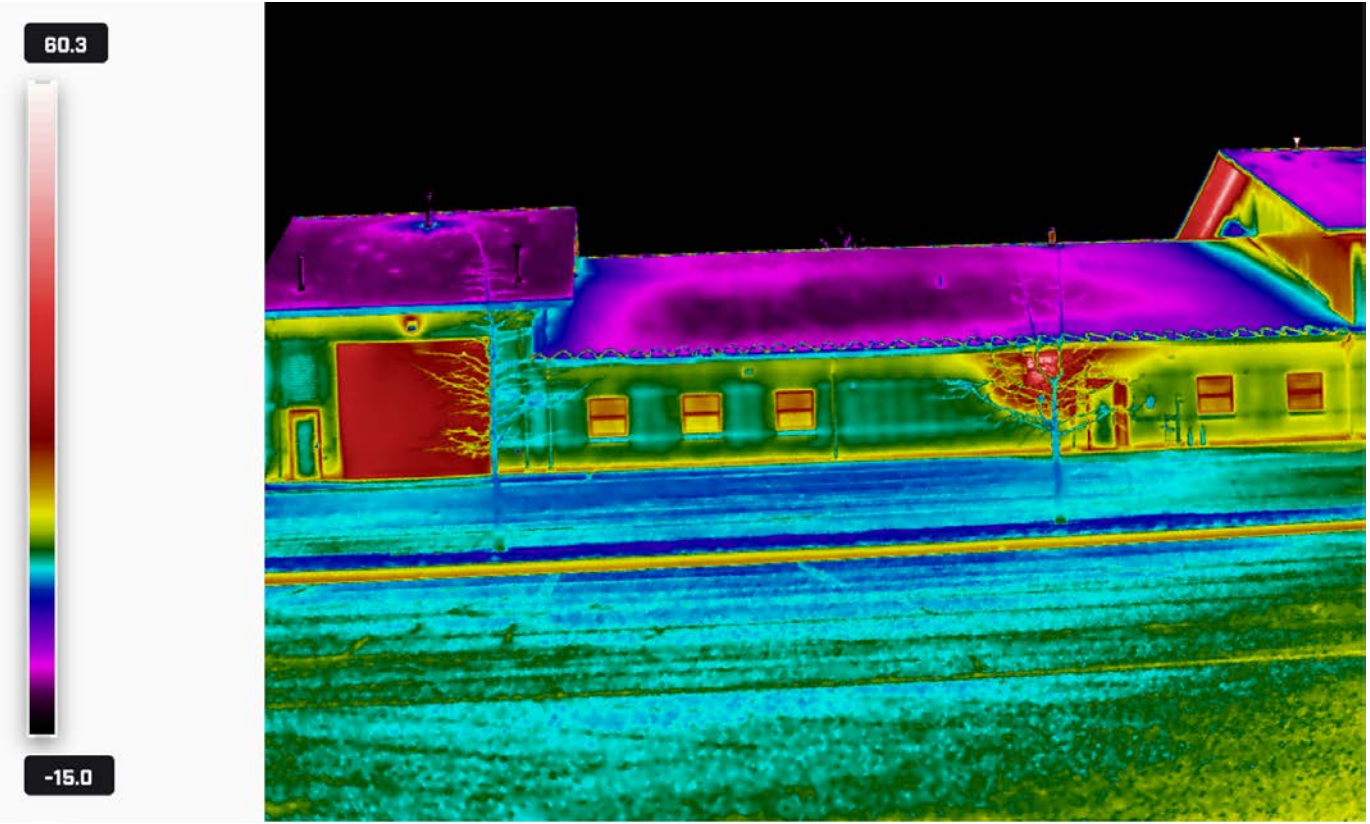
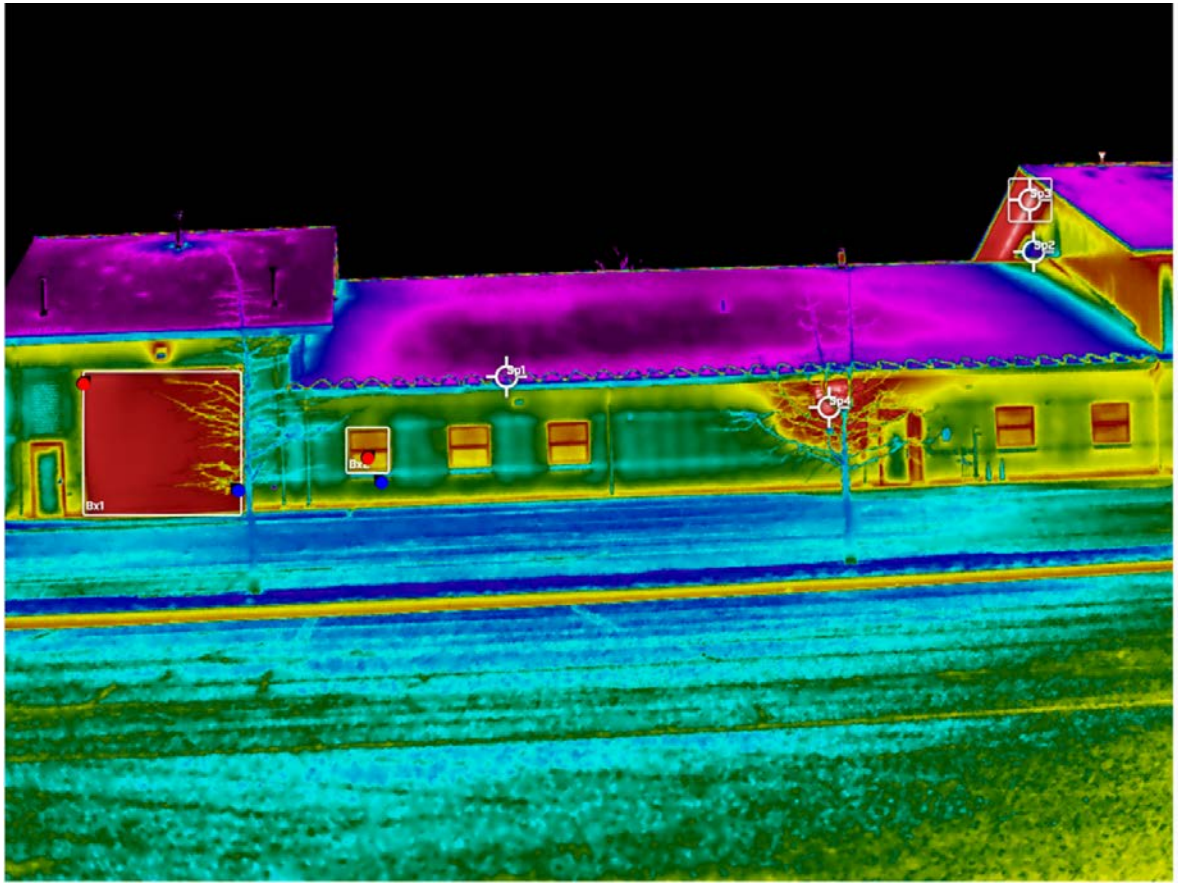


Building Envelope: Exterior Analysis



Spot temperatures

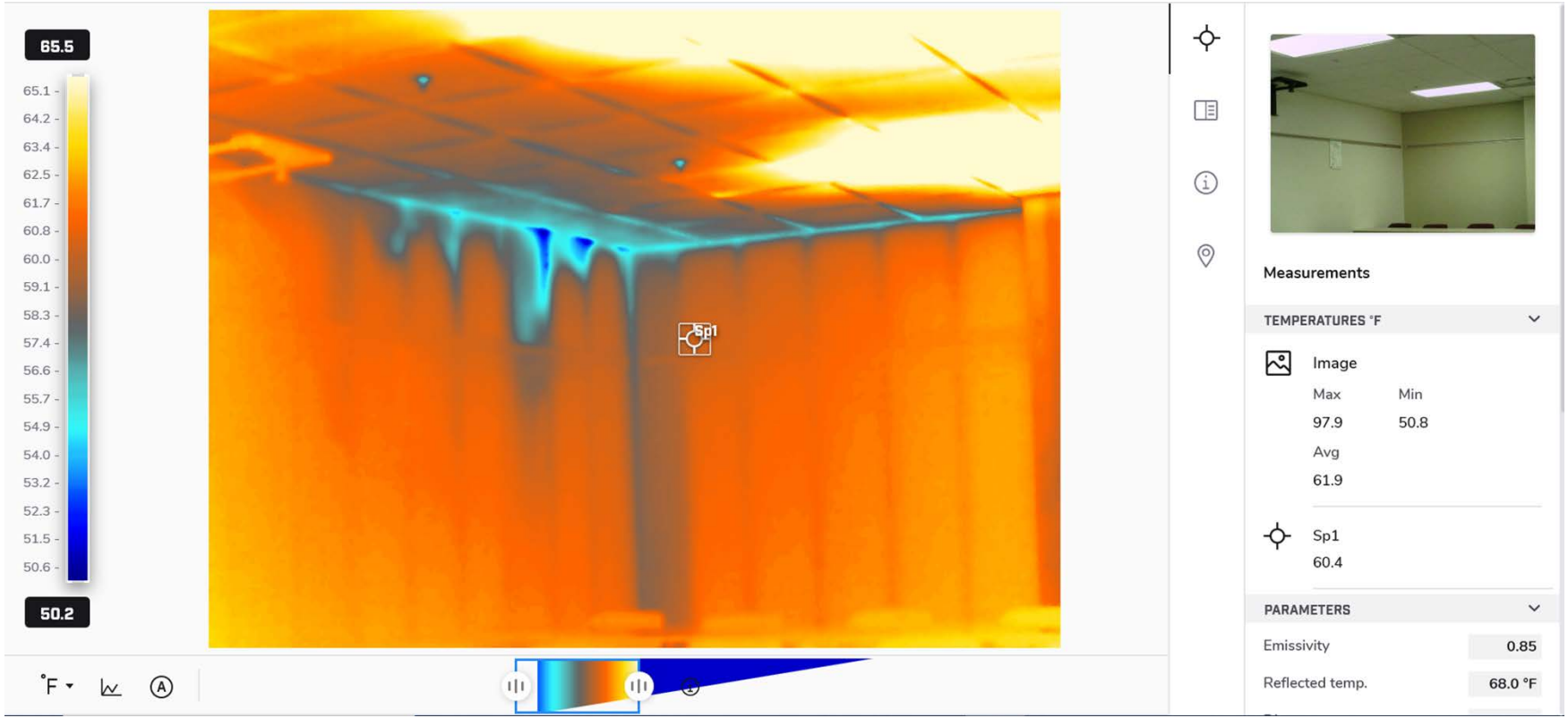
- SP1: 4.1F
- SP2: 1.7F
- SP3: 51.3F
- SP4: 43.6F

Box temperatures

- BX1
  - Max: 33.4F
  - Min: 8.4F
  - Avg: 26.1F
- BX2
  - Max: 26.3F
  - Min: 7.7F
  - Avg: 17.4

Building Envelope: Interior Analysis

Building Envelope: Interior Water Leaks

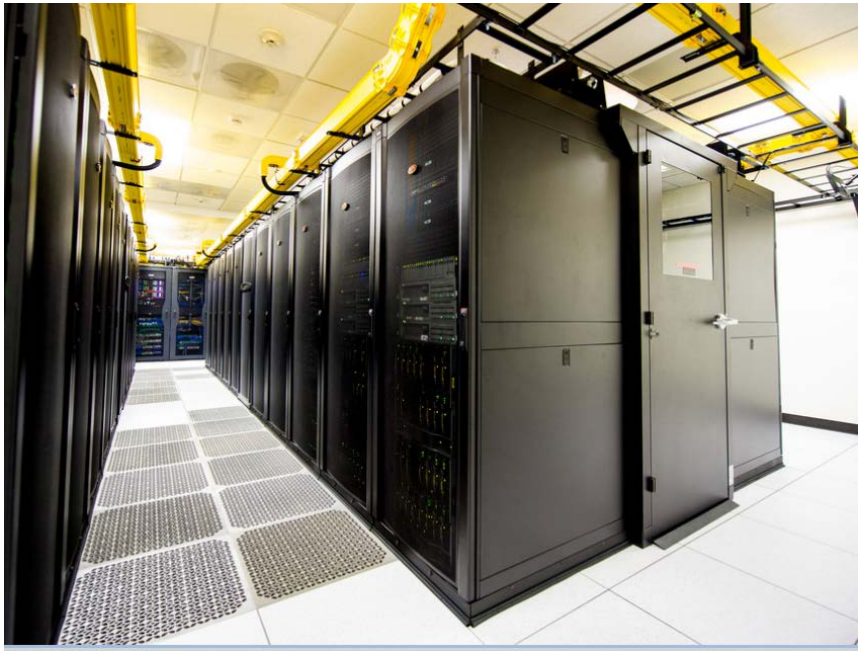


Process Energy

Process Energy

- Process energy can be difficult to reduce yet can use a significant amount of energy
- ECMs can be very similar to other non-process energy loads
- Making operational improvements can be impactful
- Properly maintaining equipment, preventative maintenance, and adding fault detection software

Data Centers



- Make sure VFD/VSD are installed where applicable
- Typically, temperature can be lifted in data centers to save energy
- Hot deck / cold deck configuration is important to avoid waste, seen in the photo
- Economizing when possible

Process Boilers, Chillers, and Compressors

- Very similar to HVAC ECMs discussed above
- Variable speed chillers, heat recovery chillers, VFDs on cooling tower fans
- Heat exchangers for free heating / cooling
- Condensing boilers, modulating, smaller sized boilers to enable shutting down when load is lower
- Variable speed compressors, storage tanks, can you lower the pressure?

Operations & Maintenance (O&M)

O&M: Getting the Best Performance Out of Buildings

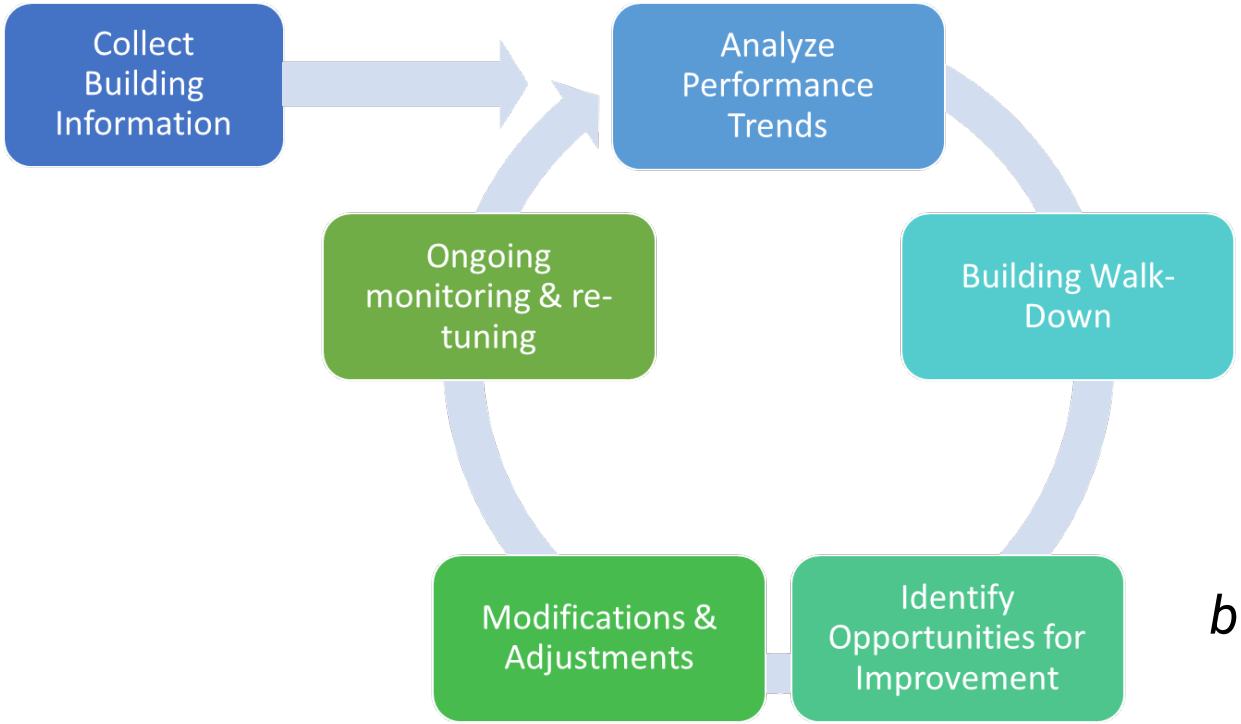
- Three persistent myths:
  1. Newer facilities are more efficient than older facilities
  2. Facilities need complex controls systems to be efficient
  3. Training facilities staff has a minimal impact on building performance

Operations & Maintenance: New vs. Old Buildings

- Myth #1: Facility age is not an accurate predictor of efficiency.
- According to EPA:
  - 39% of buildings with a rating of 75 or better were less than 25 years old
  - 42% of buildings with a rating between 25 and 74 were less than 25 years old
  - 35% of buildings with a rating between 0 and 24 were less than 25 years old

Operations & Maintenance

Myth #2: *Complex controls won't get you there...*



...but a good building re-tuning process will.

Operations & Maintenance: Training

Myth #3:

Training facilities staff has a minimal impact on building performance

O&M Training: Why?

The Federal Buildings Personnel Training Act (FBPTA) of 2010 requires all federal personnel providing building operations & maintenance services to demonstrate competencies necessary to effectively operate government facilities.

Targets for New Buildings
Strong Federal mandates

Water Efficiency
Water reduction each year from 2007 levels

Optimize Energy Efficiency
Reduce Energy Use Intensity each year from 2015 levels

Protect Efficiency Investments
Savings don't persist without trained operators (PNNL)

Training saves money & achieves organizational goals

Trained Professionals Save Money

Facility Managers

Ongoing Commissioning
cut energy costs ~15%/Year

Building Operators

BOC Certified Operators
save $11K / Year

Energy Managers

50% of CEM energy
programs save >$250K/Year

Operations & Maintenance: Other Benefits of Training

Investing in training yields a **knowledgeable, efficient, and adaptable** workforce capable of maintaining high-quality facilities

- Enhanced Skills and Knowledge
- Improved Efficiency
- Risk Mitigation
- Effective Communication Skills
- Strategic Thinking
- Adaptability
- Professional Recognition & Career Advancement

Related Sessions

- Track 7
  - Session 2 – Federal Water Management 101
  - Session 3 – Operations and Maintenance for Federal Agencies
  - Session 4 – Metrics Matter
  - Session 5 – Commissioning Controls for Energy and Water Efficiency
  - Session 7 – Energy Audit 101: Ideas to Execution
- Track 10
  - Session 2 – Performance Contracting , Procurement Authorities, and Best Practices for Implementing EISA 4132 Energy & Water Measures
  - Session 3 – Contracting Officer Roundtable from Multiple Federal Agencies
  - Session 5 – Performance Contracting for Maintenance and Operations
  - Session 6 – Inflation Reduction Act Funding Uses Within the Federal Government

Thank You

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