RETRO-COMMISSIONING CAN BRING BIG SAVINGS

MSBO CONFERENCE
OCTOBER 7, 2019

OVERVIEW

• EXECUTIVE SUMMARY
• STANDARD RCx PROCESS (ASHRAE/BCA)
• RCx PROJECT FINDINGS
• DTE RCx PROGRAM
• QUESTIONS
EXECUTIVE SUMMARY

WHAT IS RETRO-COMMISSIONING (RCx)
WHEN TO USE THE RCx PROCESS
THE COST-BENEFIT POTENTIAL OF RCx

DEFINITION OF COMMISSIONING

ASHRAE Guideline 0 defines commissioning as “a quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner’s Project Requirements.”
LEED INTENT OF COMMISSIONING

The intent of fundamental commissioning under LEED V4 is “to support the design, construction, and eventual operation of a project that meets the owner’s project requirements for energy, water, indoor environmental quality, and durability.”

DEFINITION OF SAVINGS

ENERGY BENEFITS
- Energy or utility usage improvements
  - Electrical
  - Gas
  - Water / sewerage
  - Other resources
- Optimize system performance
DEFINITION OF SAVINGS

NON-ENERGY BENEFITS
• Improve thermal comfort
• Verify indoor air quality
• Train operators or occupants
• Extend equipment life
• Increase occupant learning and productivity

TYPES OF COMMISSIONING

New Building Commissioning (Cx)

Existing Building Commissioning (EBCx)
TYPES OF COMMISSIONING

EXISTING BLDG Cx

RETRO-COMMISSIONING

ONGOING Cx

MONITORING-BASED Cx

RE-COMMISSIONING

WHAT IT ISN’T

RCx is not:

• Energy Auditing
• Any Level of ASHRAE Auditing
• Building Assessment
• Building Tune-up
WHAT IT IS

WHEN TO USE THE RCx PROCESS

• Prior to building renovations or upgrades

• High energy usage for building type

• Increasing energy usage over time

• Chronic system problems (operational, comfort, airflow, system reliability)

• Participate in utility or finance program

• Comply with rating system or org. policy
Cost-Benefit Potential of RCx

- National studies on the value of Cx and EBCx performed by LBNL (2009) and updated with assistance from the BCA (2018)


POTENTIAL COST OF RCx

Updated Study Simple Payback

Median 2.2 years.
Range generally 1 and 4 years payback

Median $0.26 project cost per sq.ft.
Typical range $0.15 to $0.56
POTENTIAL COST OF RCx
Can vary significantly based on scope of project
- Size
- Equipment Types
- Number of Units
- Controls
- Depth of Effort Desired

POTENTIAL BENEFITS OF RCx
Updated Study Energy Savings
- Median 6% - Typical range 3% to 11% (combined utility/non-utility programs)
- EBCx outside utility programs could hit 10% to 25% range
POTENTIAL BENEFITS OF RCx

• Significant non-energy benefits
• Resolve root cause of chronic issues
• Preventative measures for future
• Master planning and capital planning
• Get the most out of what you have

RCx PROVIDER DESIRED KNOWLEDGE, SKILLS, & ABILITIES

• MEP practical field experience
• MEP systems/equipment knowledge
• Working knowledge of temperature controls systems
• Measurement & Verification understanding
• Communications skills, written and verbal
RCx PROVIDER DESIRED KNOWLEDGE, SKILLS, & ABILITIES

• Ability to interact well with all types of people - team builder - “interpreter”
• Patience, persistence and resourcefulness always helpful
• Resource that has building envelope knowledge and knows how to test components within the envelope systems
• Match time and talent to project needs.

EXECUTIVE SUMMARY RECAP

• RCx is a technical process used to help improve current systems operations and inform infrastructure planning
• RCx can provide guidance prior to renovations and upgrades, help solve chronic problems, and save energy
• RCx typically has favorable paybacks and can be scaled to your specific needs and budget
• Utilities have RCx incentive programs that may help with cost for eligible customers
RETRO-COMMISSIONING

STANDARD RETRO-COMMISSIONING PROCESS

ASHRAE GUIDELINES & STANDARDS
BUILDING COMMISSIONING ASSOCIATION (BCA)
ESSENTIAL ELEMENTS & BEST PRACTICES

Investigation Phase
Field inspections, data gathering, testing and analysis to accurately assess system performance and identify improvement opportunities.

Implementation Phase
Desired facility improvements are completed and the results and performance are verified.

Hand-Off
Systematic transition from a commissioning activity and the commissioning team to standard operating practice and the operations and maintenance team.

Ongoing Cx (aka Persistence)
Implementation of systems and tools to support persistence benefits and continuous performance improvement over time.

BCA EBCx (RCx) BEST PRACTICES
WHAT RCx STRIVES TO ACHIEVE

- Resolve O&M Issues
- Improve IAQ
- Identify Staff Training Needs

Facility Improvement

- Reduce Utility Bills
- Reduce Overall Operating Costs

Energy Savings

- Reduce Carbon Footprint
- Improve Energy Star Rating Or Other Benchmarks

Sustainability

EBCx vs. AUDIT per the BCA

<table>
<thead>
<tr>
<th>Activity</th>
<th>EBCx</th>
<th>Audit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walkthrough</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Document Review (As built, Tenant Interviews, TAB reports, CFR, Submittals, Previous System Manuals, review O&amp;M work request, Energy Audits/Facility Assessment documents, etc.)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Utility Bill Analysis</td>
<td>X</td>
<td>X*</td>
</tr>
<tr>
<td>O&amp;M Practices: Interviews &amp; Reviews</td>
<td>X</td>
<td>X*</td>
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<tr>
<td>Facility Improvement Measurements (FIM) Identified</td>
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<td>X*</td>
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<tr>
<td>Identifying Capital Improvement Opportunities</td>
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<tr>
<td>System Sequence Testing</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>System Functional Testing</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Data &amp; Trend Logging &amp; Analysis</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

* ASHRAE Level II or Higher
MEASUREMENT & VERIFICATION (M&V)

M&V NOT OFTEN REQUIRED IN PAST BUT GAINING MOMENTUM TO PROVE OUT MEASURE SUCCESS

TYPICAL RCx PROCESS TOOLS

- RCx Plan
- Current Facility Requirements (CFR)
- Master List of Findings
- Facility Improvement Measures (FIMs) Log
- RCx Final Report
TYPICAL RCx PERSISTANCE DOCS

• Systems Manual (living doc)
• O&M Staff Training Manual
• Ongoing Cx Plan (or Re-Cx Plan)

“Energy and persistence conquer all things”
- Benjamin Franklin

RETRO-COMMISSIONING PROJECT FINDINGS

EXAMPLES OF FINDINGS FROM ACTUAL PROJECT WORK
FACILITY IMPROVEMENT MEASURE CLASSIFICATIONS

- Low Cost / No Cost Measure
- Operational & Maintenance Measure
- Energy Conservation Measure
- Non-Energy Benefit
- Investigation Required

GOOD MEASURES TO LOOK FOR

1. If it doesn’t need to run, turn it off.
2. If you can’t turn it off, turn it down.
3. Only run to the level needed.
4. Reduce, reuse, recycle.
5. Don’t believe everything you hear; trust but verify.
MOST COMMON MEASURES

<table>
<thead>
<tr>
<th>Electric ECMs and Energy Savings</th>
<th>% Program Savings (kWh)</th>
<th>% Program Savings (Cumulative kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule HVAC Space</td>
<td>26%</td>
<td>24%</td>
</tr>
<tr>
<td>Decentralized Outdoor Air Control</td>
<td>14%</td>
<td>8%</td>
</tr>
<tr>
<td>parking lot, pressure relief, reset</td>
<td>13%</td>
<td>5%</td>
</tr>
<tr>
<td>Other</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td>Chilled Water Temperature Reset</td>
<td>7%</td>
<td>6%</td>
</tr>
<tr>
<td>Supply air to intermediate</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>Other</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Schedule Air Compressors</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Schedule Fans Reduced</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>Reduce ventilation</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Condenser water temperature</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Optimize supply air performance</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Schedule lighting</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Reduce VAV Maximum Position</td>
<td>3%</td>
<td>1%</td>
</tr>
<tr>
<td>Software Space Temperature</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Optimize Daylight</td>
<td>2%</td>
<td>1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Natural Gas ECMs and Energy Savings</th>
<th>% Program Savings (Ccf)</th>
<th>% Program Savings (Cumulative Ccf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule Heaters</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>Schedule HVAC for office</td>
<td>15%</td>
<td>28%</td>
</tr>
<tr>
<td>Chilled Water Temperature Reset</td>
<td>13%</td>
<td>31%</td>
</tr>
<tr>
<td>Supply air to intermediate</td>
<td>11%</td>
<td>14%</td>
</tr>
<tr>
<td>Heat recovery</td>
<td>8%</td>
<td>60%</td>
</tr>
<tr>
<td>Setback temperature regulation</td>
<td>7%</td>
<td>60%</td>
</tr>
<tr>
<td>Schedule HVAC for office</td>
<td>7%</td>
<td>24%</td>
</tr>
<tr>
<td>Process water and chilled</td>
<td>7%</td>
<td>81%</td>
</tr>
<tr>
<td>Option 2: 60%</td>
<td>7%</td>
<td>85%</td>
</tr>
<tr>
<td>Regain/replace/upgrade</td>
<td>3%</td>
<td>88%</td>
</tr>
<tr>
<td>Observe ventilation control</td>
<td>2%</td>
<td>50%</td>
</tr>
<tr>
<td>Optimize supply air performance</td>
<td>2%</td>
<td>92%</td>
</tr>
<tr>
<td>Schedule HVAC for office</td>
<td>2%</td>
<td>94%</td>
</tr>
<tr>
<td>Reduce ventilation</td>
<td>2%</td>
<td>96%</td>
</tr>
<tr>
<td>Prevent air leakage</td>
<td>2%</td>
<td>98%</td>
</tr>
<tr>
<td>Demand control ventilation</td>
<td>2%</td>
<td>100%</td>
</tr>
</tbody>
</table>

FROM DTE RCx TRAINING

AIR HANDLING UNITS

Air Leakage
AIR HANDLING UNITS

Dirty Filters & Air Bypassing

AIR HANDLING UNITS

Rooftop Unit Airside Economizer “Free Cooling” not activated properly
AIR HANDLING UNITS

Temp Sensor out of air

Outside Air Temp Sensor close to roof
TEMPERATURE CONTROLS

Temperature Controls graphics screen with incorrect and missing information

EXHAUST FANS

Exhaust Fans on roof left running 24/7 year round
HVAC ZONE CONTROLS

Clean heater & stat to extend life, even if old

Classroom Thermostat behind a storage unit
HVAC ZONE CONTROLS

Thermostat in small storage room found to control the large group room

HEATING SYSTEMS

Boiler system heating controls not optimized
HEATING SYSTEMS

Missing insulation

COOLING SYSTEMS

Cooling tower nozzles clogged
**PLUMBING**

Two separate domestic hot water systems cross connected

**BUILDING ENVELOPE**

Opening to Outside
LIGHTING CONTROLS SYSTEMS

Exterior Lighting Controls programmed incorrectly & missing life safety separation

RETRO-COMMISSIONING

RESOURCES TO LEARN MORE
COMMISSIONING RESOURCES

• The Building Commissioning Association
  http://www.bcxa.org/

• California Commissioning Collaborative
  http://www.cacx.org/

Both groups have resource/link pages with fairly comprehensive “other resources” for further information.

DTE Energy
Retro-Commissioning Program

MSBO 2019 Facilities Conference

October 7, 2019
Objective:
Reduce energy waste & improve customer satisfaction

Commercial and industrial programs:
- Prescriptive & Custom Incentive programs
- Thermostat
- Building Operator Certification
- Multifamily Program
- Business Energy Consultation
- Lighting Instant Discount Program
- Retro-Commissioning Program
- Food Service Instant Rebate Program
- HVAC Instant Rebate Program

Retro-Commissioning

- RCx program offers a systematic process for identifying and implementing operational and maintenance improvements in a building
- Intent of the program is to capture energy savings by optimizing existing equipment (rather than replacing inefficient equipment)
- Two tracks-Standard and Express depending on size and electric consumption
Standard vs. Express

• Standard - fully funded RCx services, provided by a qualified service provider, valued at up to $80,000
• Express - find & fix program that does not require a Service Provider
  • Controls contractor finds & implements agreed upon measures

Customer Benefits

- Reduction in maintenance and operating costs
- Increased property value
- More comfortable indoor environment
- Improved occupant productivity
- Assurance that operations meet owners needs
- Extended equipment service life
- Improved integration of building systems
Key Program Details - Standard Program

- Customers: Large DTE customers (Commercial buildings)
- Measures: control, operational, & maintenance type EE opportunities
- Process: application -> investigation -> implementation -> verification

Ideal Candidate - Large Buildings

- Commercial & Industrial
- Functional DDC controls system
- >250,000ft²
- No major mechanical issues
- DTE customer
- No major planned renovations
RCx Program Phases

Eligible Measures

<table>
<thead>
<tr>
<th>Timers &amp; Schedules</th>
<th>Setpoints</th>
<th>Controls</th>
<th>Adjustment &amp; Repairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add or adjust schedule timer for equipment*</td>
<td>Add or adjust pressure reset (air/water)</td>
<td>Adjust or repair economizer control*</td>
<td>Repair compressed air leaks</td>
</tr>
<tr>
<td>Add timer switches to equipment</td>
<td>Add or adjust pressure reset (air/water)</td>
<td>Adjust or repair outside air ventilation control*</td>
<td>Adjust or repair VFDs for fans/pumps</td>
</tr>
<tr>
<td></td>
<td>Add or adjust temperature reset (air/water)*</td>
<td>Adjust or repair airflow control</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Add or adjust temperature setpoint and setbacks/setups</td>
<td>Adjust or repair heating or cooling water flow controls</td>
<td></td>
</tr>
</tbody>
</table>

* highest gas-saving measures
Express Track

Find & Fix Program (smaller buildings)

• No Service Provider is required
• Controls contractors get paid by DTE to perform study
• Controls contractor evaluates ways to optimize controls; then implements the measures

Express Track

• Targets buildings that use 1 million kWh-5 million kWh annual electric energy consumption
• Requires pre & post implementation screenshots of the BMS is acceptable documentation
• Examples are:
  • Scheduling
  • Set point changes
    – Chilled water resets
    – Static pressure resets
    – Discharge (or supply air) temperature resets
• Physical repairs
Controls Contractor Role

**Controls contractor scope; smaller buildings program**

- Complete BMS review utilizing trending/reporting data to analyze building operation & energy performance
  - Schedule reviews looking for energy reduction options
  - Temperature reset capabilities & settings
  - Economizer & outdoor air control to minimize outdoor needs
  - Operational parameters, sensor & output performance
- Provide reports verifying above items
- Provide customer training based on findings & adjustments made

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**Resources**

- RCx program staff
- Program collateral
- Service Provider network
THANKS!!