Energy Efficiency in Existing Buildings

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ECM categories

- Controls
  - Occupancy/Demand Based Control
  - Discharge Air Temperature Resets
  - Static/Differential Setpoint Reset
- Retrocommissioning
  - Schedules/Night Setbacks
  - Test and Balance

ECM categories

- Lighting
  - Exploit Daylighting
  - Control (occupancy, daylighting, scheduling)
  - High Performance Fixtures
- Operation and Maintenance
  - Water Treatment
  - Calibration
  - Faulty Steam Trap Repair

ECM categories

- HVAC
  - Variable Speed Systems
  - Heat recovery
  - High performance equipment
  - Turn it off.
- Envelope
  - Improve space utilization
  - Address Infiltration/Exfiltration

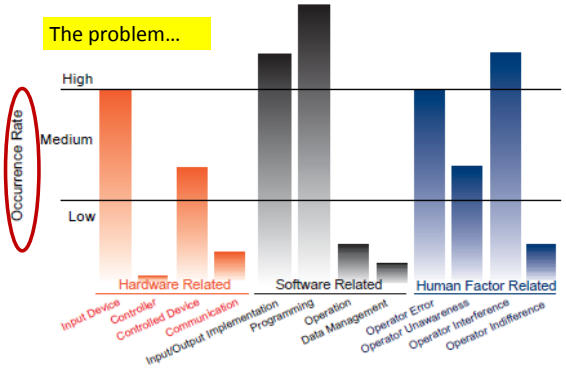


Figure 1. Qualitative Representation of the Occurrence Rate of Control Problems.

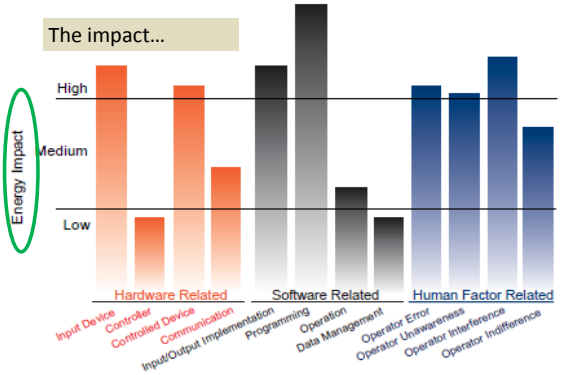
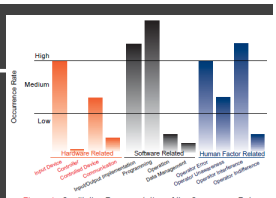


Figure 2. Qualitative Representation of the Energy Impact of Control Problems.

Controls

- Key issues:
  - Input device
  - Control device
  - I/O in software
  - Programming
  - Operator error
  - Operator interference

SOURCE: http://www.energy.iastate.edu/Efficiency/Commercial/download_nbcip/NBCIP_02_03.pdf



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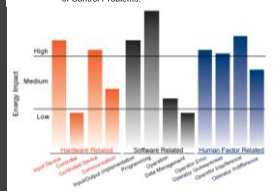


Figure 2. Qualitative Representation of the Energy Impact of Control Problems.

Low-cost solutions

- Economizer Operation
  - Lock-out and setpoints
- Building Pressurization
  - Test and Balance
- Temperature Control
  - Review setpoints, deadbands
- Humidity Control
  - Calibrate sensors
- Operating Schedule
  - Review exceptions

Capital Cost Solutions

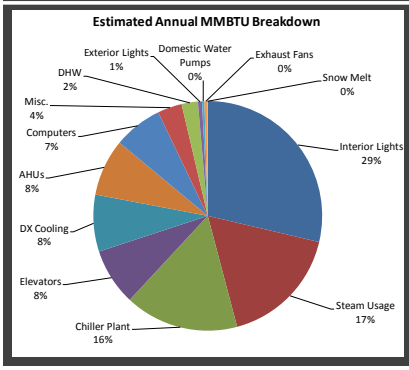
- Relocate thermostats
- VFD installation
- Equipment replacement
- New controls
- Building envelope

- Recommendations to replace at end of life

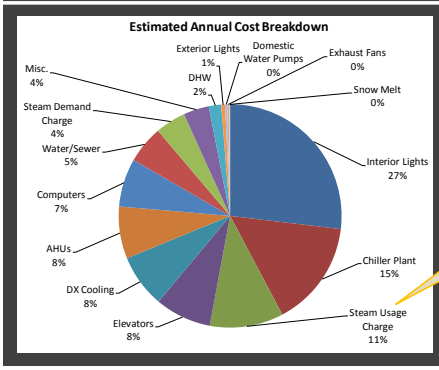
Energy Metrics

Emissions	Energy (Source)	Energy (Site)	Energy Cost
CO2e	BTU	BTU	dollars
CO2e	BTU	kWh	$/kWh, $/kW
CO2e	BTU	therm	$/therm

Energy Site BTUs



Energy Cost $$$s



Energy — Site vs. Source

- A building in Minneapolis:
  - Site EUI = 61 kBTU/SF in 2009
  - Source EUI = 184 kBTU/SF in 2009
  - Emissions = 31 lbs CO2e/SF in 2009
- *National average:*
  - *Site EUI = 129 kBTU/SF*
  - *Source EUI = 387 kBTU/SF*

Energy — Emissions

- A building in NE with electric heat:
  - 88 kBTU/SF Site vs. 291 kBTU/SF Source
    - Emissions = 34 lbs per SF
- Same building with Natural Gas:
  - 92 kBTU/SF Site vs. 243 kBTU/SF Source
    - Emissions = 28 lbs per SF

Other challenges

- Comfort is King
  - Need adequate ventilation
- Maintenance backlog
  - The squeaky wheels get the grease
- Operations staff training
- Building Turnover from NC to EB