



Make Good Buildings Even Better - RCx

GSCC - September 24, 2013

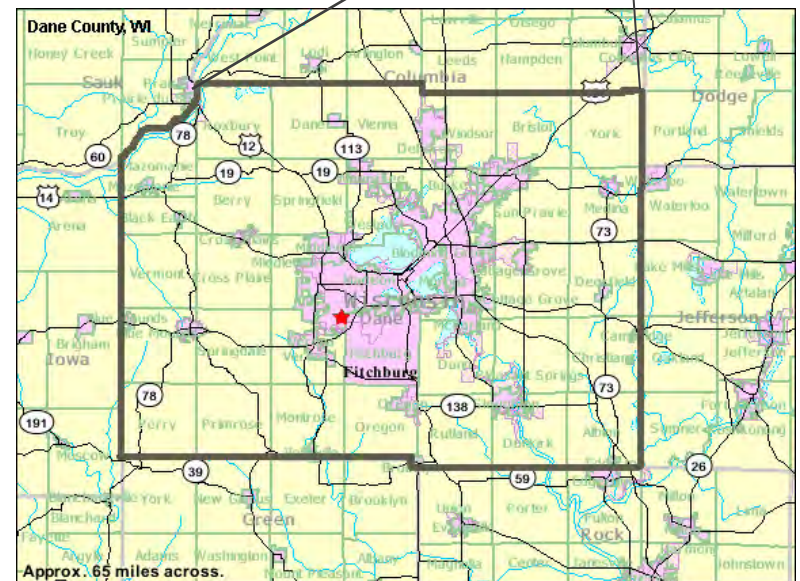
Sam Cooke, PE, CEM

John Crook, Manager Facilities/BI



City of Fitchburg

- Population (2012): 25,895
- Tree City (Arbor Day)
- Cool City (Sierra Club)
- Bike Friendly Community Award
- USMCPA



City of Fitchburg Campus

City Hall



Library



Community Center

City of Fitchburg Campus



City Hall

Community Center

Library

City of Fitchburg Campus

CITY HALL

- Built in 1999
- 56,300 square feet
- 4 floors
- Uses: City Staff Offices, Meeting Rooms, Police Department, FACTv Studio, Storage



City of Fitchburg Campus

COMMUNITY CENTER

- Built in 1988
- 20,200 square feet
- 2 floors
- Uses: Senior Center, Meeting Rooms, Food Prep, SC Staff Offices, FACTv, Gym Space



City of Fitchburg Campus

LIBRARY

- Built in 2010
- 56,400 square feet
- 3 floors
- LEED Gold (60 – 79 LEED points)
- Uses: Book/Media Access, Meeting/Study Rooms, Children Areas, Staff Offices, Underground Parking



Make Good Buildings Even Better - RCx

Retro-commissioning (RCx) is:

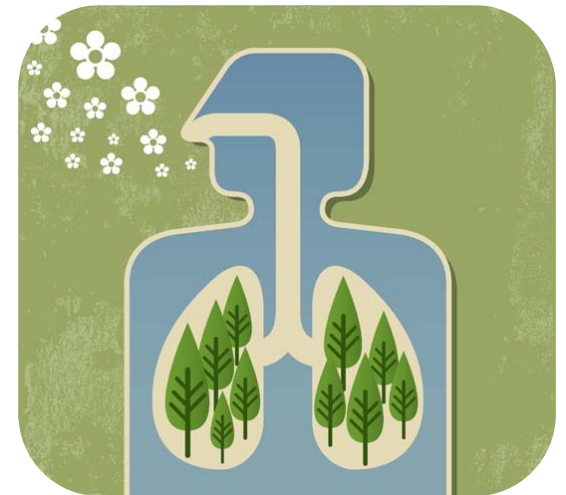
- Following a systematic process
- Optimizing buildings and systems
- Changing systems to perform interactively
- Meeting the current operational needs



Adapted from ASHRAE Guideline 0-2005

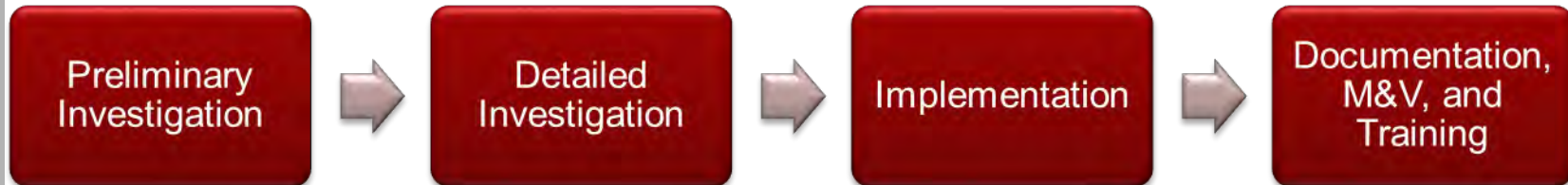
Proven Benefits of RCx

- Reduced energy consumption
- Improved indoor air quality
- Improved worker productivity
- Lower environmental impact
- Retention of staff
- Good PR



RCx Scope of Work

- Preliminary Investigation
- Detailed Investigation
- Implementation
- Measurement and Verification
- WI Utility Incentive (Focus on Energy - RCx Incentives: \$0.08/kWh and \$0.50/therm)



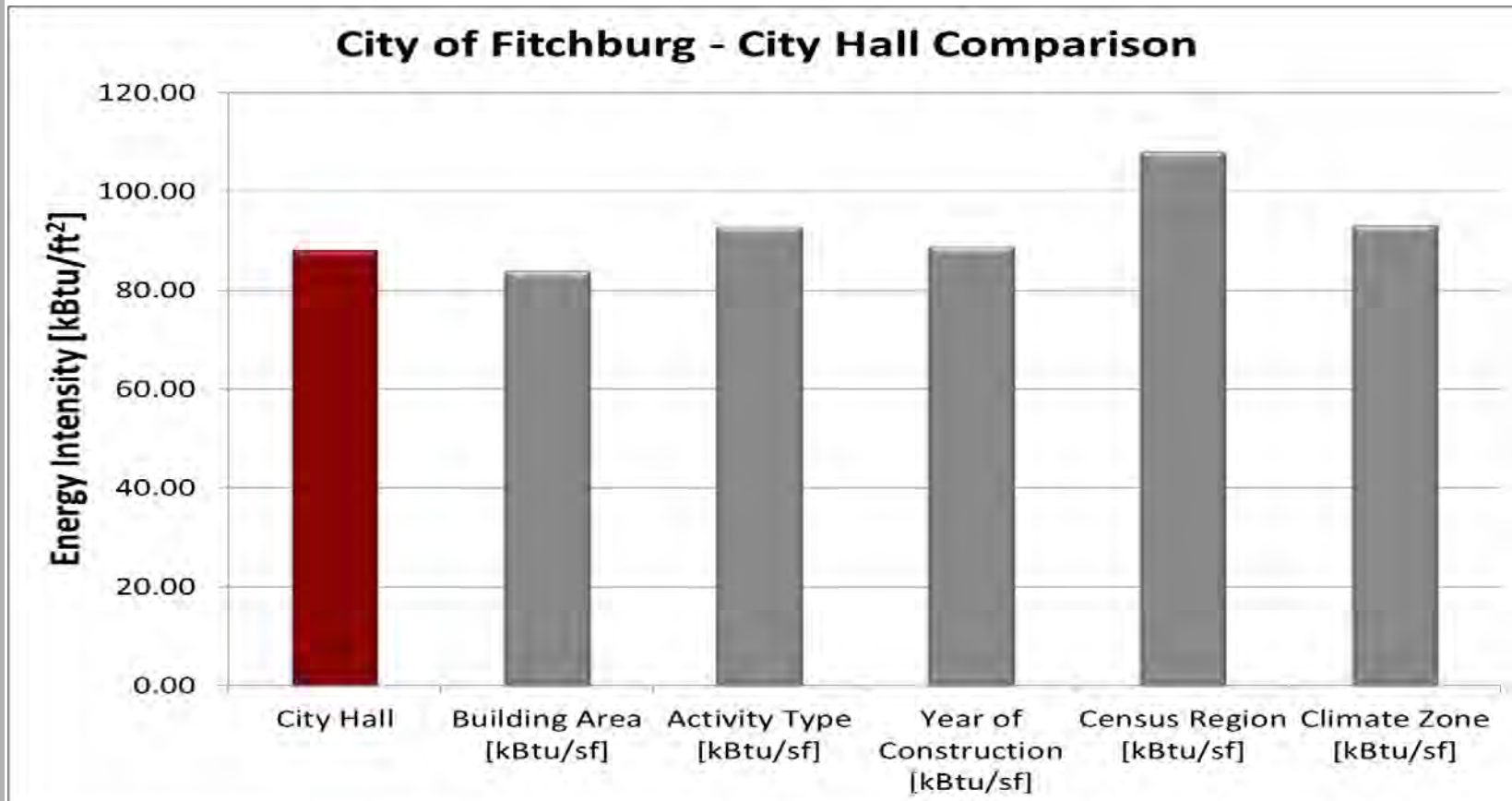
RCx – City Hall



Solar photovoltaic and solar thermal panels on City Hall roof top

RCx – City Hall

- Energy Use Intensity
 - 88,000 BTU/ft²/year
 - Energy Star PM Score: 71
- Mechanical Systems:
 - (3) VAV AHUs
 - HW Nat Gas Boilers
 - Water-cooled Chillers



RCx – City Hall

Energy Conservation Measures (examples):

- **Change 24-hour operation of AHUs**
- **Separate FACTv IT from AHU system**
- **Lower HVAC static pressure set point**
- Reduce simultaneous heating and cooling (leaking AHU hot water valve)
- Lower heating outside air lockout temperature
- Implement standby CFM setpoints in less frequently used areas
- Install VFD controls on cooling tower fans

RCx – City Hall

ECM – Change 24-hour Operation of AHUs

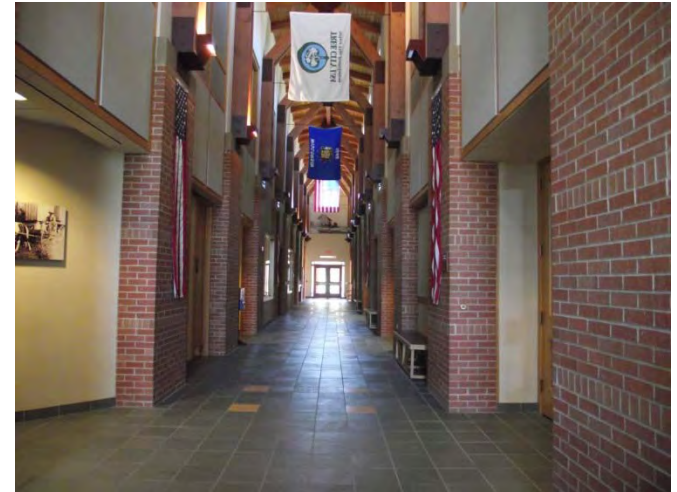
Police Department operation is 24/7, but not all areas served by the AHU are occupied during second and third shift. Areas with reduced, short term, or no occupancy include: prefunction hall (pictured), multipurpose room, conference rooms, fitness center/ locker rooms, and briefing room.

ECM would be combination of CO₂ sensors in intermittent use rooms and scheduled OA reduction for others.

OA savings: \$3,990/year

CO₂ sensors install and programming cost: \$3,150

Simple Payback: < 1 year



RCx – City Hall

ECM – Separate FACTv IT from AHU system

Currently one of the three large AHUs serving the City Hall Building is left on 24/7 to condition the office space housing the FACTv servers.

ECM examines installing a split system AC unit for servers after hours and running the AHU on a schedule.

AHU savings: \$2,760/yr

Split system cost to run: ~\$1,000/yr

Split system install cost: \$2,800

Simple Payback: 1.6 years



RCx – City Hall

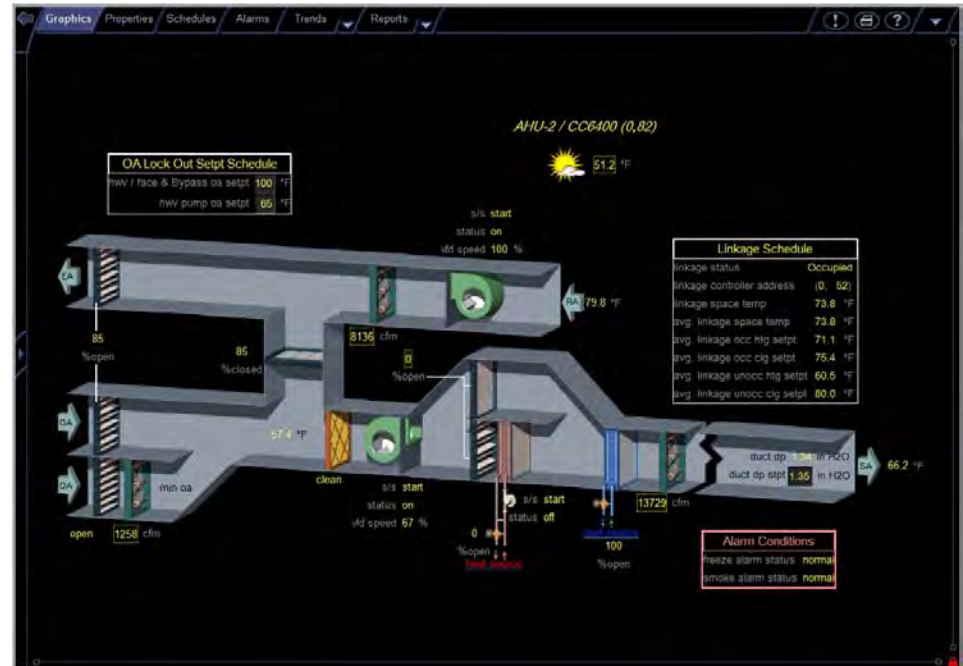
ECM – Lower HVAC static pressure set point

Trending was performed on both the AHU supply fan speed and the VAV box damper positions. With the exception of known 'trouble' areas such as the FACTv server room, VAV dampers averaged just 56-70% open, indicating supply static could be reset down.

Fan Savings (All AHUs):
\$480/year

Setpoint Programming
cost: \$1,440

Simple Payback: 3 years



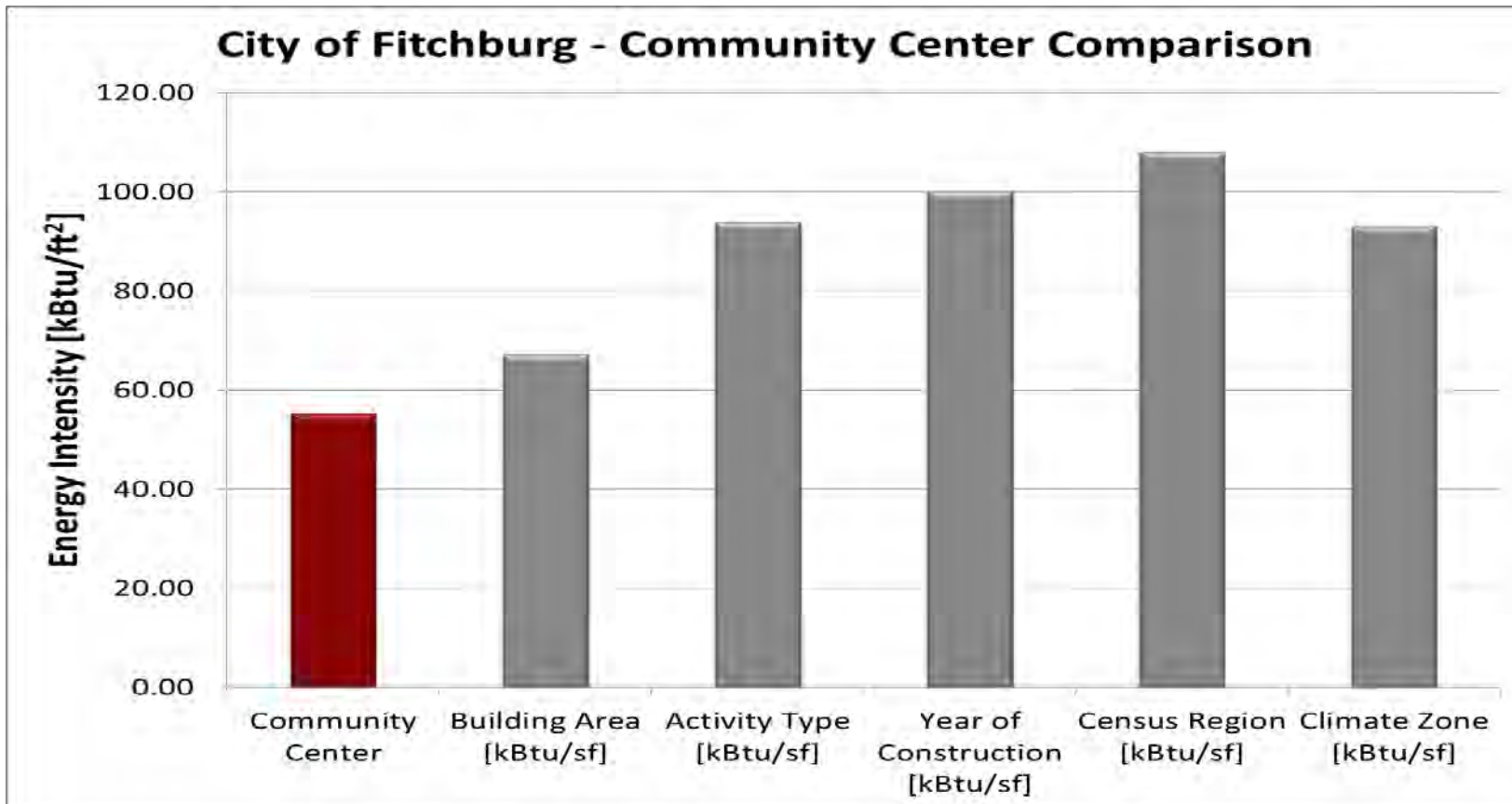
RCx – Community Center



Senior Center dining/meeting area

RCx – Community Center

- Energy Use Intensity
 - 55,000 BTU/ft²/year
- Energy Star PM Score
 - N/A
- Mechanical Systems
 - (5) MZU CV AHUs
 - HW Nat Gas Boilers
 - DX Cooling



RCx – Community Center

Energy Conservation Measures (examples):

- **Upgrade multi-zone unit to VAV system**
- Fix leaking outside air damper on FCU
- **Upgrade three existing low EER condensers**
- Separate IT servers from AHU load
- **Fix hot/cold deck zone damper leaks**
- Make Lighting sensors adjust for daylight
- Replace hot/cold deck discharge T-sensors
- Repair torn MZU isolation boot

RCx – Community Center

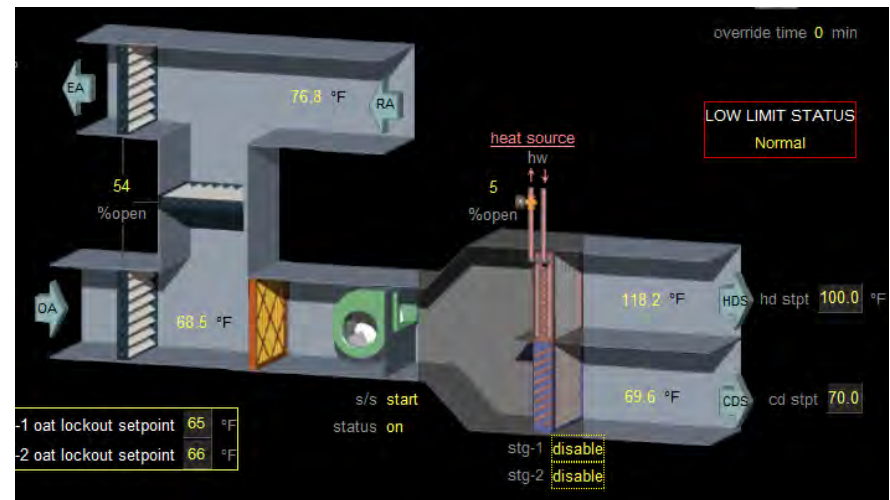
ECM – Upgrade multi-zone unit to a VAV system

This ECM includes adding a retrofit variable volume terminal unit with an airflow monitoring station and associated volume damper to each zone discharge ductwork associated with the MZU. The airflow will be measured and the volume adjusted based on space conditions.

Fan and OA Savings:
\$2,940/year

VAV installation and
programming costs:
\$12,000

Simple Payback:
3.5 years



RCx – Community Center

ECM – Replace existing condenser unit(s)

Some of the existing condenser units are past or near their life expectancy. When replacing existing equipment, equipment Energy Efficiency Rating (EER) should be considered to balance upfront cost with annual operating costs (existing units EER = 8).

Base Case EER: 13

Premium Efficiency EER: 16

AHU-1,2,3 CU Replacement

Base costs: \$17,250

Premium: \$22,970

Annual Electric Savings: 12,960 kWh

Annual \$ Savings: \$1,940

Simple Payback: 11.8 years



RCx – Community Center

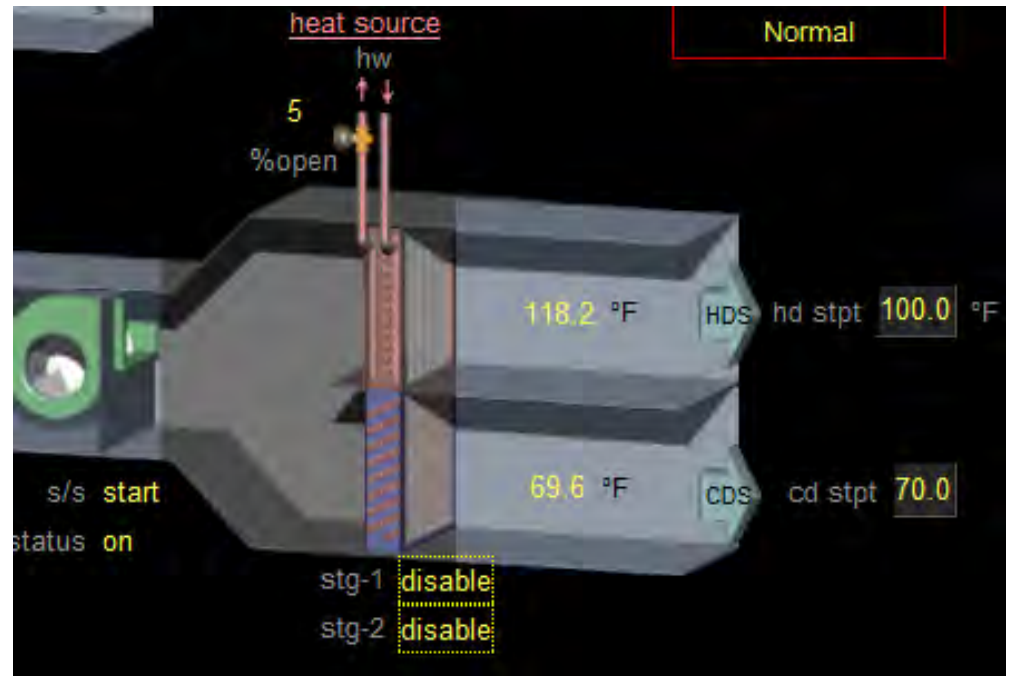
ECM - Fix hot/cold deck zone damper leaks

During functional performance testing (FPT) the zones were commanded 100% open to the cold deck and temperature measurements taken at the zone discharge. Zones 4 and 5 discharge temperatures were found to be ~5 degrees F warmer than the cold deck temperature.

Fan and OA Savings:
\$1,050/year

Damper Replacement
costs: \$ 925

Simple Payback:
< 1 year



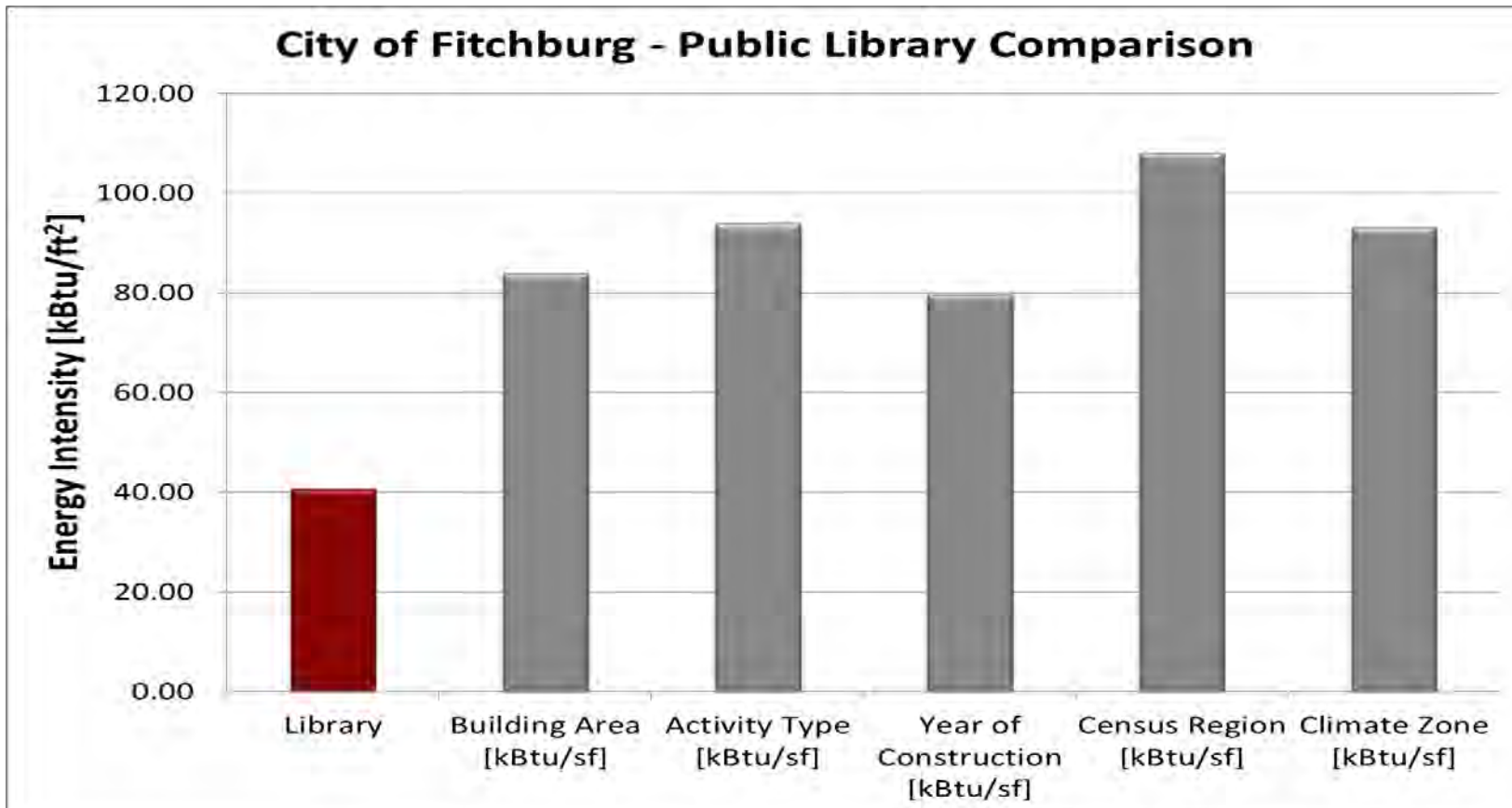
RCx – Library



Entrance lobby and Children's Library area

RCx – Library

- Energy Use Intensity
 - 41,000 BTU/ft²/year
- Energy Star PM Score
 - N/A
- Mechanical Systems:
 - (1) VAV AHU + other AHUs
 - Centralized Geo Heat/Cool Heat Pumps



RCx – Library

Energy Conservation Measures (examples):

- Purchase and install Honeywell interface
- **Use Lighting controls (use daylight)**
- **Stop radiant floor heat, while cooling**
- **Address ground source heat pump issues**
- **Program advanced VAV controls**
- Add temperature reset to AHU
- Reduce VFD minimum setting
- Repair entryway snow melt indicator

RCx – Library

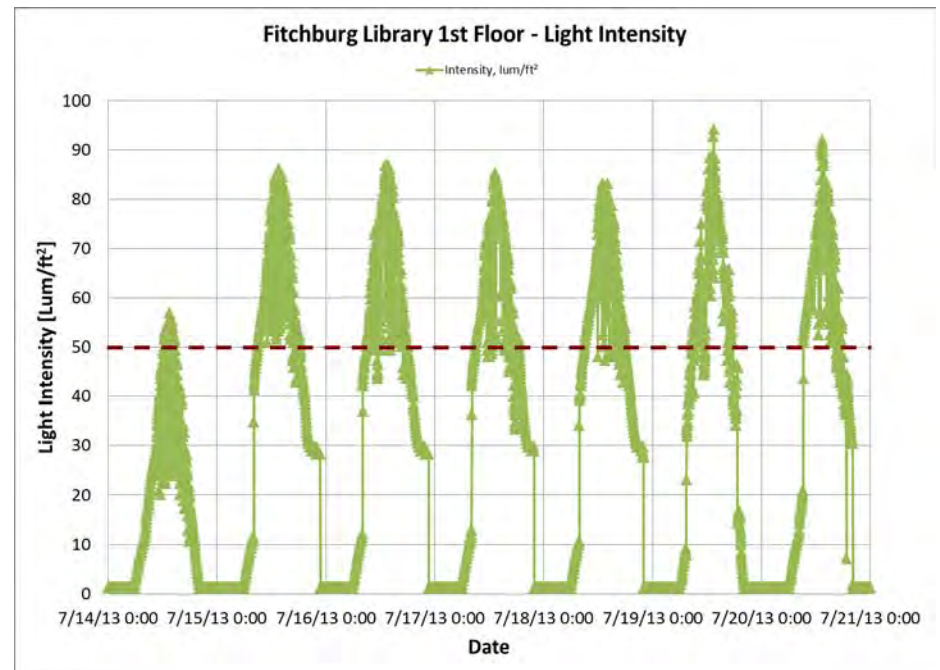
ECM – Use Lighting Controls

The library is equipped with day lighting controls which appear to be operating incorrectly. The chart shows the light intensity for a single zone over the course of a week. When the intensity is above 50 Lum/ft² the fixtures on the day lighting circuits can be turned off.

Electrical Savings:
\$1,160/year

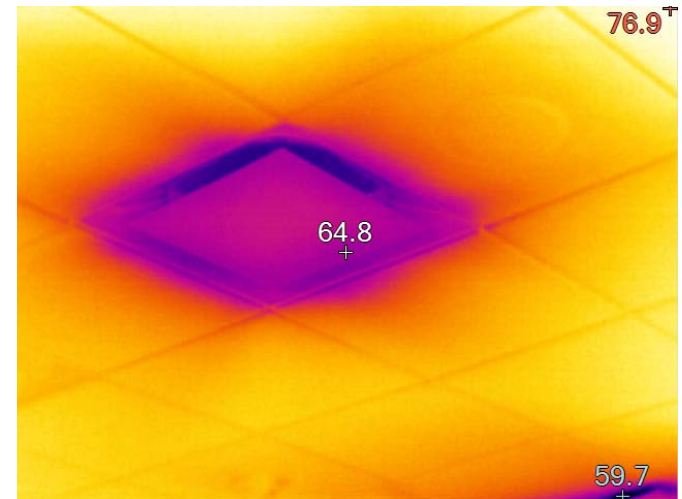
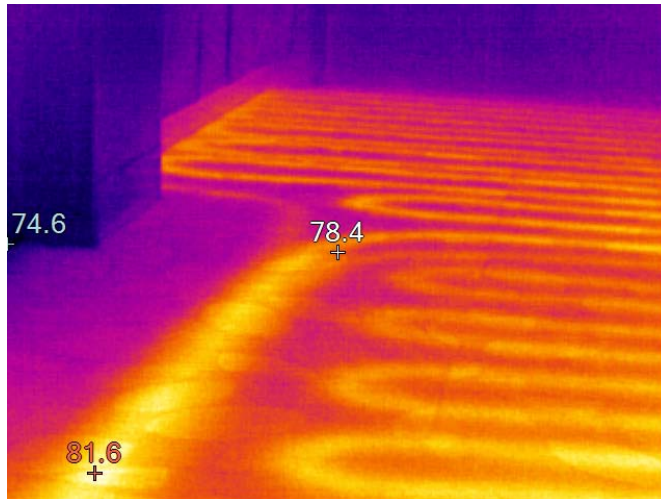
Programming cost: \$400

Simple Payback:< 1 year



RCx – Library

ECM – Radiant floor heat, while cooling space



RCx – Library

ECM – Radiant floor heat, while cooling space

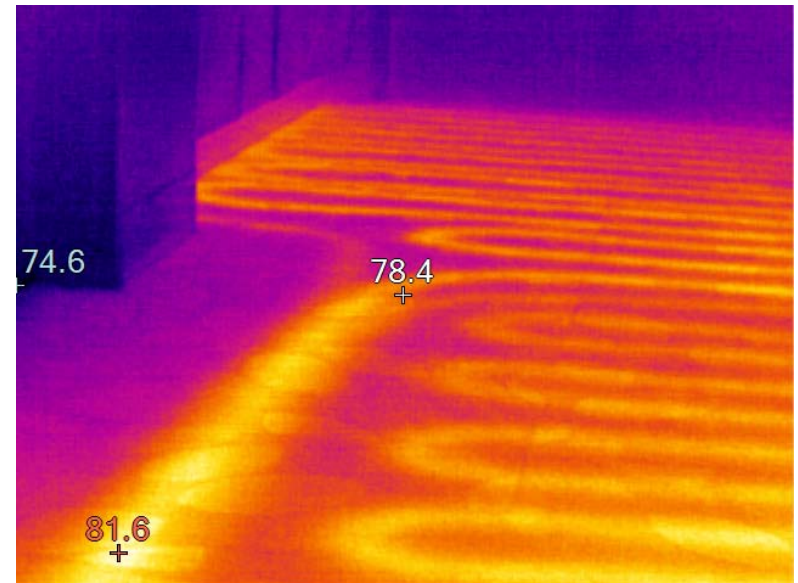
When the radiant floor is running simultaneously, energy is being used both by the hot water system to warm the floor and the chilled water system through the air handling unit (AHU).

With both systems already on the BAS, interlocks can be added to disable the radiant heat when the space is calling for cooling.

Electrical Savings from
heat pump and AHU:
\$2,820/year

Programming cost: \$400

Simple Payback: < 1 year



RCx – Library

ECM – Program advanced VAV controls

Newer VAV control strategies include “Dual Maximum” CFM setpoints which reset the airflow for both heating and cooling strategies. Typical VAV control has a single heating CFM setpoint and modulate the hot water reheat valve. Savings result from lower fan energy as well as lower reheat energy use.

Electrical Savings
from heat pump and
AHU: \$6,760/year

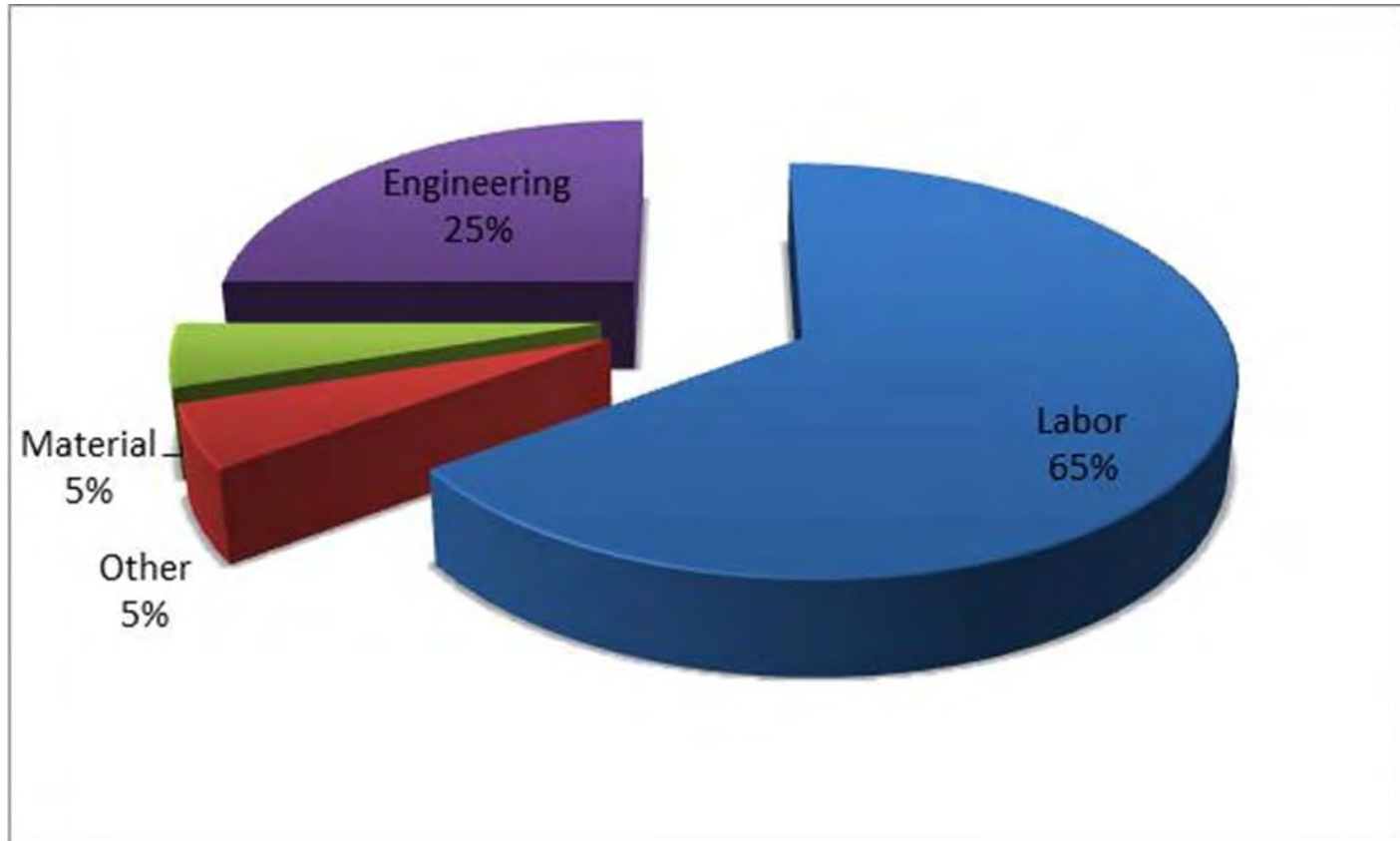
Programming cost:
\$400

Simple Payback:
< 1 year



RCx Costs

Cost ranges between \$0.20/SF and \$3.00/SF



Source: NEMI Retro-commissioning Existing System Inventory

SCS ENGINEERS



Sam Cooke: scooke@scsengineers.com

John Crook: john.crook@fitchburg.wi.us

Thank You!