# Five Building Energy Improvements to Help the Utility Plant

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# AGENDA

- Background
- Define the Goal
- Five Building Strategies
- Discussion

# BACKGROUND

- District Energy System Benefits (partial list)
  - Aesthetics (elimination of cooling towers & stacks)
  - Increased Redundancy & Reliability
  - Ease of using multiple fuels & technologies
  - Ease of changing systems

- Can naturally create a rift between Production (Provider) and Demand (User)
  - Users question reliability, system efficiency, metering accuracy…
  - Providers are handcuffed by how Users operate buildings
  - Goals are not aligned, and the transparency to do so does not always exist

# BACKGROUND

- Users and Providers individually optimize
  - Plants install more efficient equipment, integrate the system more efficiently, implement heat recovery, etc…
  - Users decrease building energy use with HVAC and process optimization
- Results in Sub-Optimization of the District Energy System
- Must start thinking about maximum combined efficiency
  - But this is **not easy**, can be **iterative**, and is constantly **evolving**,

# DEFINE THE GOAL

- One size does not fit all
- Takes total participation (All DES stakeholders)
  - What's to Gain?
    - Efficiency
    - Fuel Cost Savings
    - Sustainability Goals
    - Capital Cost Deferral
    - Emission Reductions
    - Improved Building Occupancy
    - Air Permitting
    - Maintenance
    - Publicity

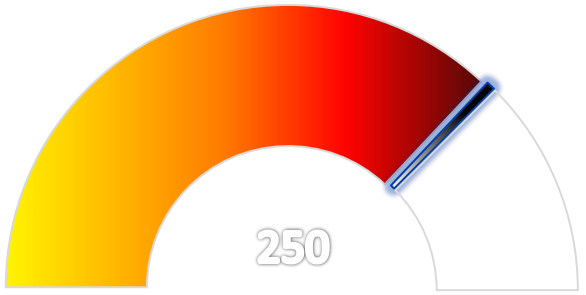
# DEFINE THE GOAL

- No matter the goal, energy efficiency is a focal point
- First **reduce** the load, then **optimally** serve that load


**So how do we make our systems more efficient?**

# FIVE BUILDING STRATEGIES TO OPTIMIZE THE CAMPUS SYSTEM

1. Ghost Load Elimination
2. Hydronic Flow Control
3. Peak Driver Reduction or Offset
4. Heat Exchanger Sizing
5. Enhanced HVAC Controls




**Baseline EUI**
**vs. Benchmark Building**

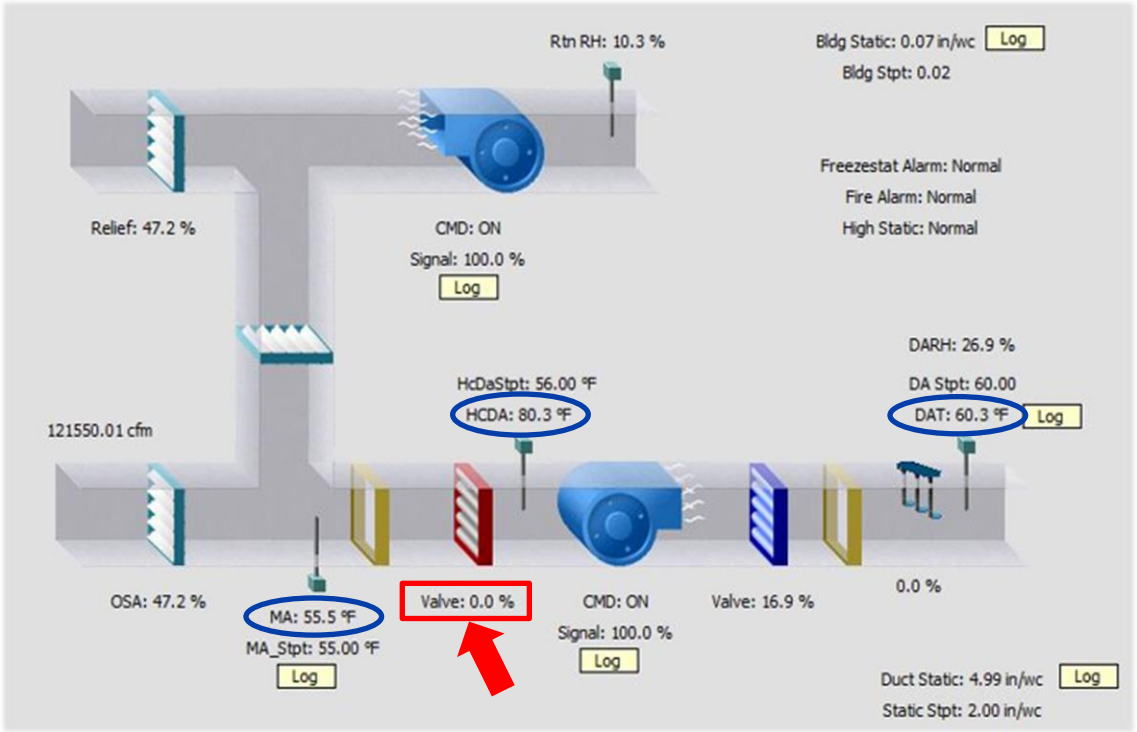
# GHOST LOAD ELIMINATION (#1)

- What Is It?
  - Artificial Loads on the System
- Why Fix It?
  - These usually add to system peak demand
- Examples

  Simultaneous Heating & Cooling | Other Loads

# GHOST LOAD ELIMINATION (#1)

Simultaneous Heating & Cooling




Example
Two Air Handlers
110,000 cfm total

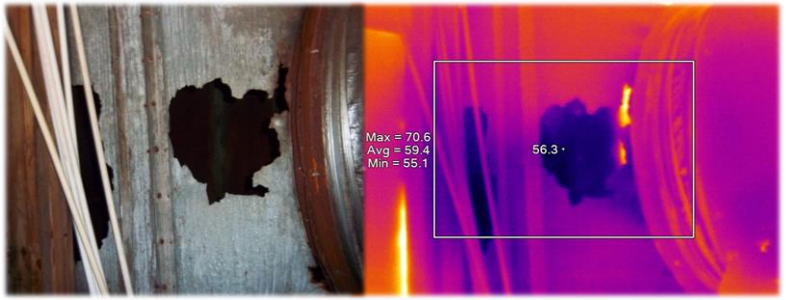
Peak Savings
3 MMBtu/hr Heating
200 tons Cooling

Annual Energy Savings
$250,000

# GHOST LOAD ELIMINATION (#1)

## Other Loads

- DHW Heating
- Ice Melt
- Duct Leakage, Missing Pipe Insulation
- Process Cooling
- Failed Economizers
- Failed Steam Traps

# HYDRONIC FLOW CONTROL (#2)

- What Is It?
  - Never heard of this???


- Why Fix It?
  - Pumping Energy can account for as much as 30% of total DES energy !!!
  - Low ΔT causes strains on distribution and overrun production assets
- Examples

  Control valves | Coil Cleaning | Heat Exchanger Sizing | Controls Optimization

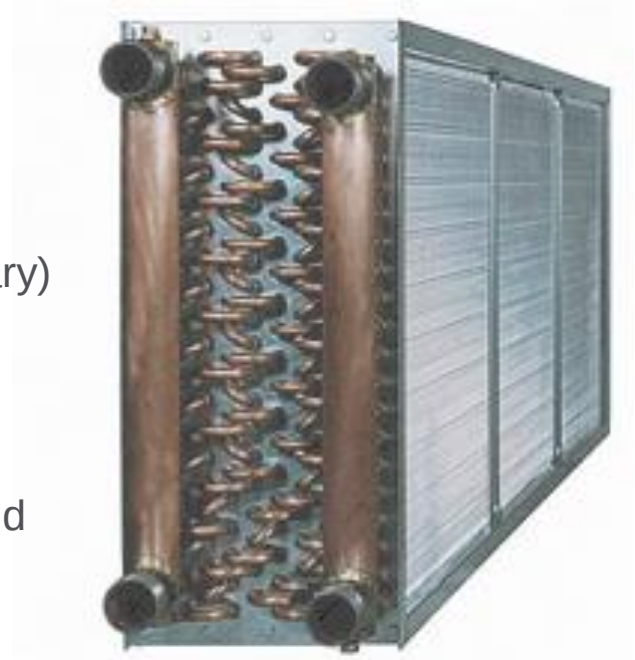
# HYDRONIC FLOW CONTROL (#2)

- Control Valves
  - Pressure Independent Control Valves
- Coil Cleaning

- Air and Fluid Side Cleaning
- Put space between coils in Air Handlers!

# HYDRONIC FLOW CONTROL (#2)

- Heat Exchanger Sizing
  - Marginal Upfront Cost for Long Term Savings
  - Size Air Handler coils for maximum reasonable ΔT
    - Chilled Water (12-18°F) | Heating Water (40-80°F)
  - Size building decoupling heat exchangers (if necessary) for low approach and high delta-T
- Poor Controls
  - Use existing Building Automation System (BAS) to find set points causing poor coil performance



# PEAK REDUCTION / OFFSET (#3)

- What Is It?
  - Strategically reducing or shifting peak load energy uses
- Why Fix It?
  - Sometimes very low cost options to manage peak load
- Examples

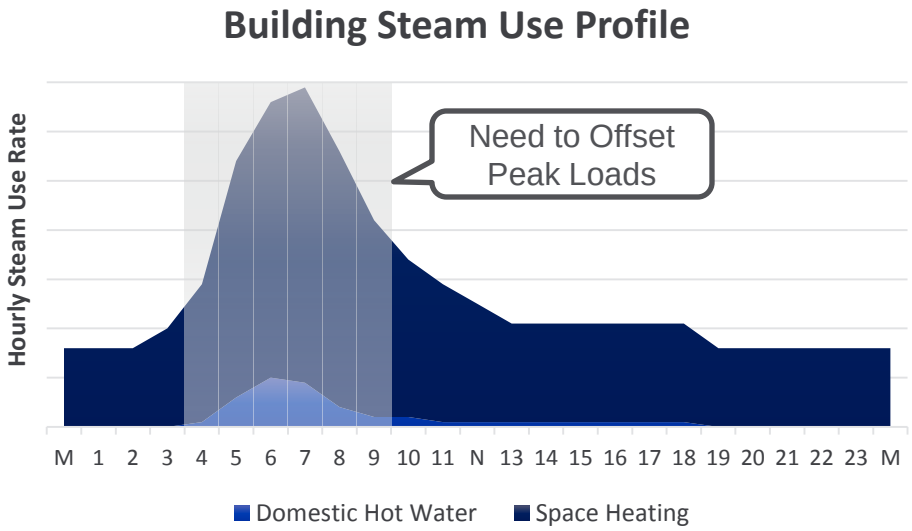
  Thermal Storage | Optimizing Night Setback and Warmup Modes

  Pipe Loads in Series | Heat Recovery

# PEAK REDUCTION / OFFSET (#3)

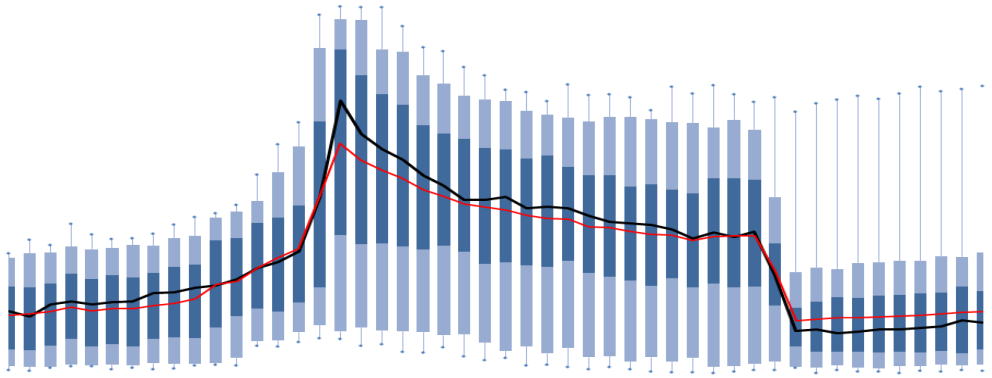
## Thermal Storage

- Domestic Hot Water Storage
- Reduce unoccupied outside air ventilation rates



# PEAK REDUCTION / OFFSET (#3)

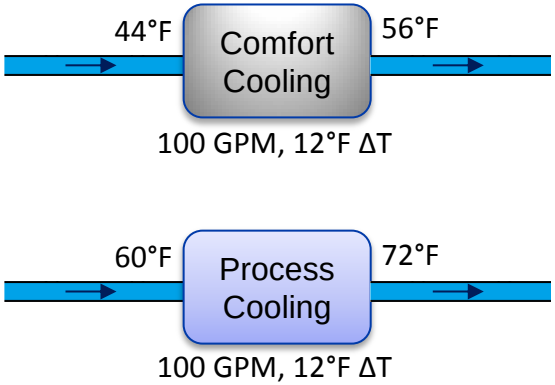
- Optimizing Night Setback and Warmup Modes
  - Building efficiency measures often result in night setback modes
  - Can realize energy savings (reduced fan power, building shell heat loss)
  - Can significantly add to peak heating demand in the morning



# PEAK REDUCTION / OFFSET (#3)

- Pipe Loads in Series
  - Get double the heat for the same flow

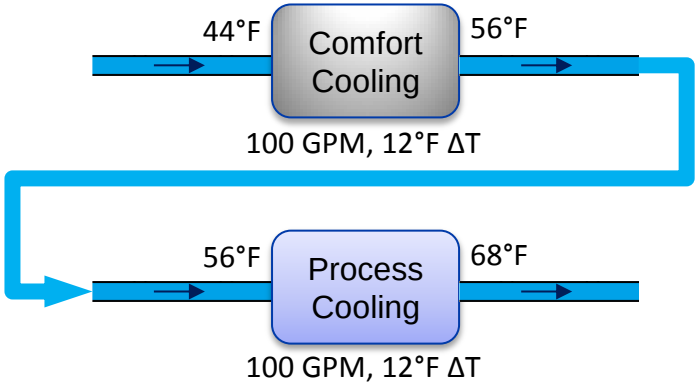
CASE 1: PARALLEL LOADS




RESULT: 200 GPM, 100 tons

ΔT = 12°F

CASE 2: SERIES LOADS




RESULT: 100 GPM, 100 tons

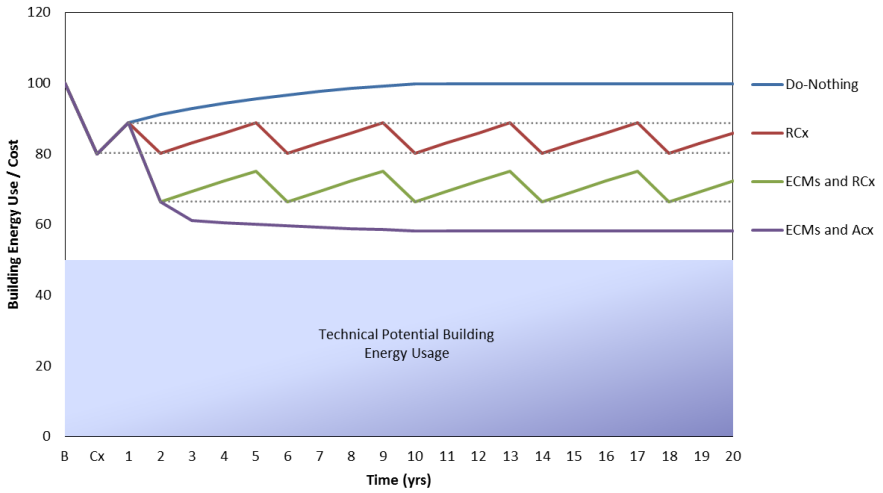
ΔT = 24°F

# PEAK REDUCTION / OFFSET (#3)

- Heat Recovery
  - Examples: Run Around Coils, Enthalpy Wheels, Heat Pipes, Heat Recovery Chiller
  - Retro-Commissioning Failed Systems
  - Installing New Systems
  - Bottom Line is to Move Heat Around the Building, then Add or Subtract

# ENHANCED HVAC CONTROLS (#4)

- What Is It?
  - Two Step Process: Make what you have work, then **Enhance** it…
- Why Fix It?
  - Building controls are the most under-utilized asset in buildings
  - The Sawtooth Effect
- Examples
  - ASHRAE Sequences
  - Design Standards
  - Fault Detection & Diagnostics (FDD)



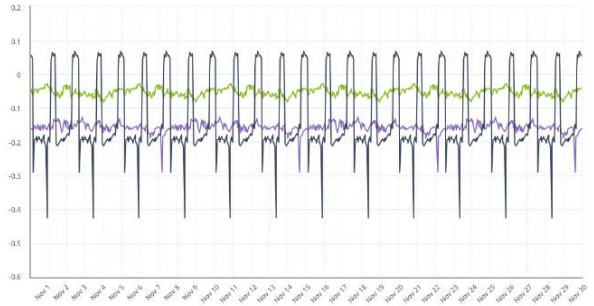
# ENHANCED HVAC CONTROLS (#4)

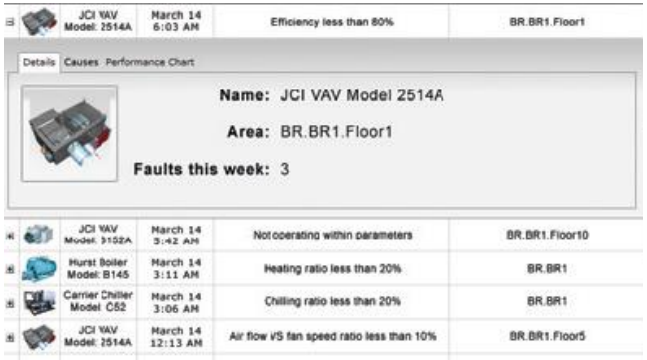
- ASHRAE “Best of Class” Sequences
  - Guideline 36 – provides program language for BAS use
- Design Standards
  - Create and maintain building HVAC and controls design standards
  - Minimal investment to maximize building efficiency
  - Include standard sequences to cover 90% of installations and retrofits
    - AHU, VAVs, Unitary Equipment Chilled Water Systems, Hot Water Systems
  - Include controls points lists, feedback requirements
  - Develop a strategy to deal with “Big Data”

# ENHANCED HVAC CONTROLS (#4)

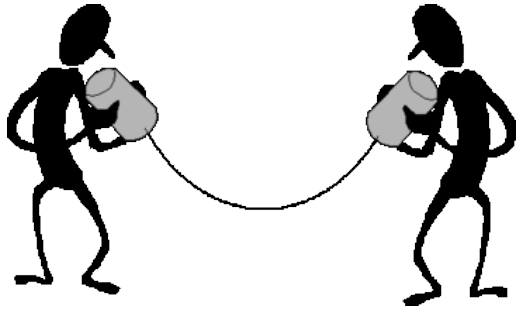
## Fault Detection & Diagnostics (FDD) Keys to Success

1. Understand the building use
2. Rectify the building systems
3. Perform a **Data Integrity** test
4. Quantify the building's **FDD Readiness**
5. Develop the **Building Baseline**
6. Use ROI to develop the case for FDD
7. Select a partner and implement the software





# COMMUNICATION (#5)



- What Is It?
  - “the imparting or exchanging of information or news”
- Why Fix It?
  - “If it ain’t broke…” vs. Continuous Improvement
- Examples

  Metering | Energy Dashboards and Reporting | Automation

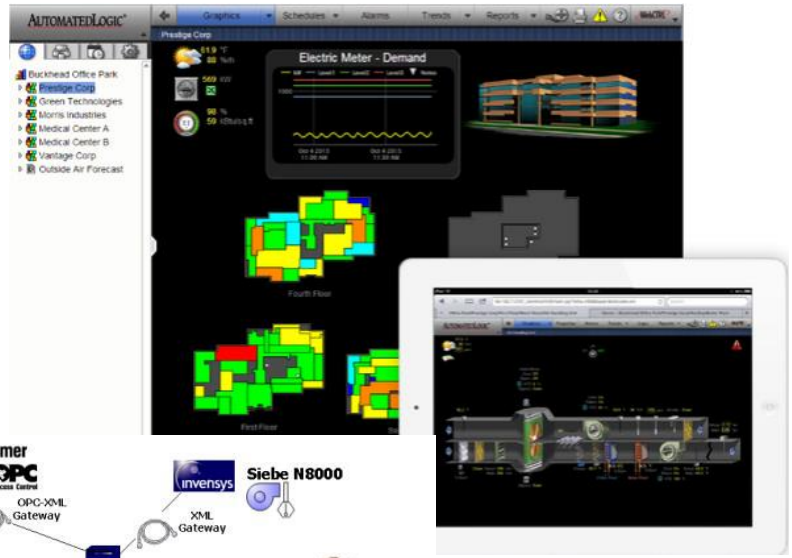
# COMMUNICATION (#5)

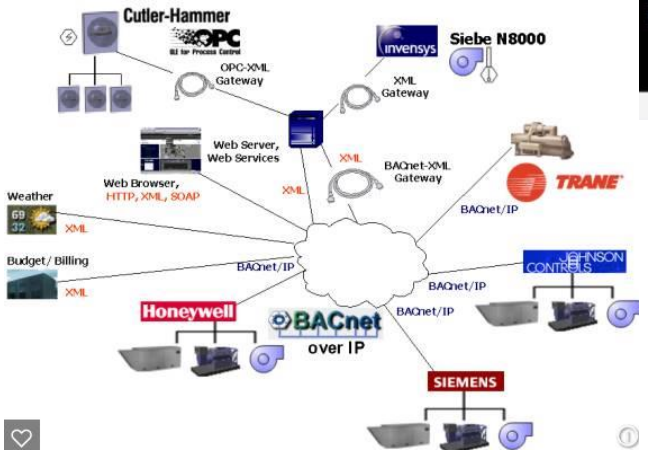
Metering & Energy Dashboards


# COMMUNICATION (#5)

## Automation

- Building Automation Systems (BAS)
- Plant Programmable Logic Controllers (PLC)
- Open Protocol Communication e.g. - BACNet
- Sophisticated User Interfaces
- Data Archiving



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# - Questions and Discussion -

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