



# 18<sup>th</sup> National Conference on Building Commissioning

A PECI EVENT

## Is my BMS ready for this? How it can help achieve LEED-EBOM Certification

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# AIA Quality Assurance



## Learning Objectives

1. Understand the benefits of a properly working Building Management System
2. How the Building Management System interacts with the LEED EB-O&M Process
3. How the Building Management System can be used in Commissioning
4. How a BMS can be upgraded to support these efforts.

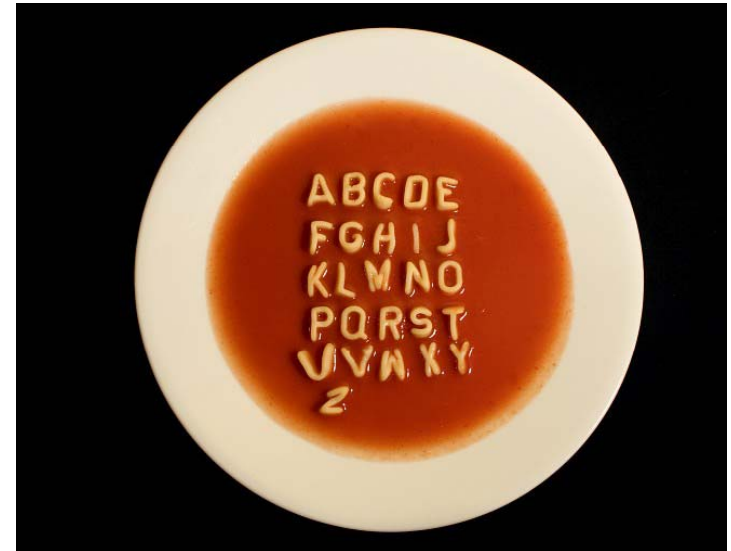
# Introduction

## Alphabet Stew

- BMS, BAS, EMS, EMCS

## Working Definition:

- Coordinating Controller
- Equipment Controllers
- End devices (Input/output)
- Networked communication
- Operator interface (PC)



# Introduction

## **BMS as a Building System**

- Was designed and installed uniquely for your particular building (HVAC, Elec, LS, Comm)
- Can be operated optimally...or not.
- Benchmarking can record the best operational parameters...or not.
- Maintenance can ensure optimum operation...or not
- Entropy and obsolescence...no choice on this one.

# Introduction

## **BMS as a Tool**

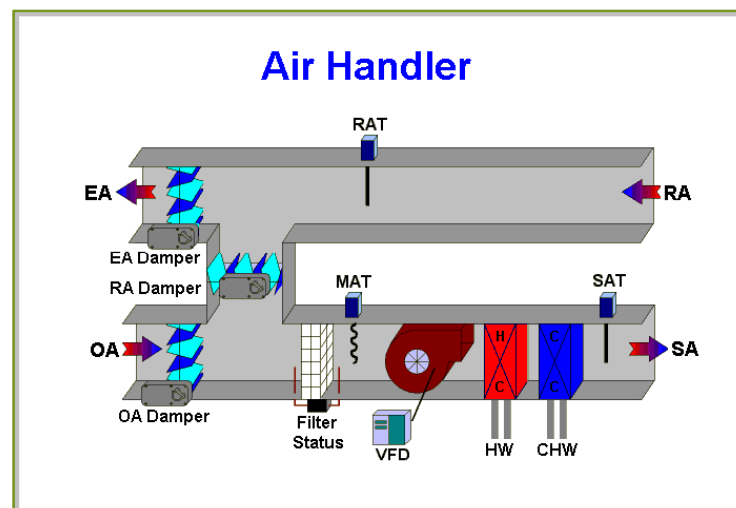
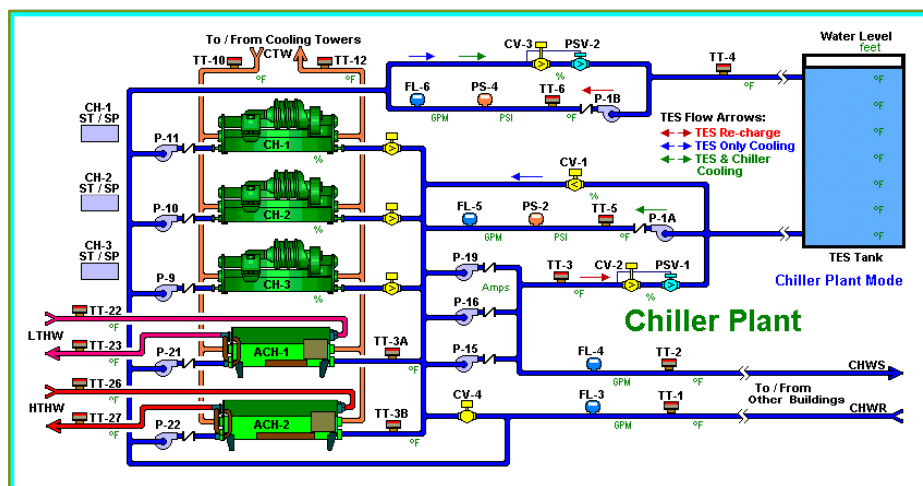
- Must be maintained properly
- Must be used properly – training and skill are necessary
- Always active, gathering data and monitoring operation.
- Can provide advanced communication capabilities
- Can save time, effort, and money...or not.

# Use the Tool the Right Way!



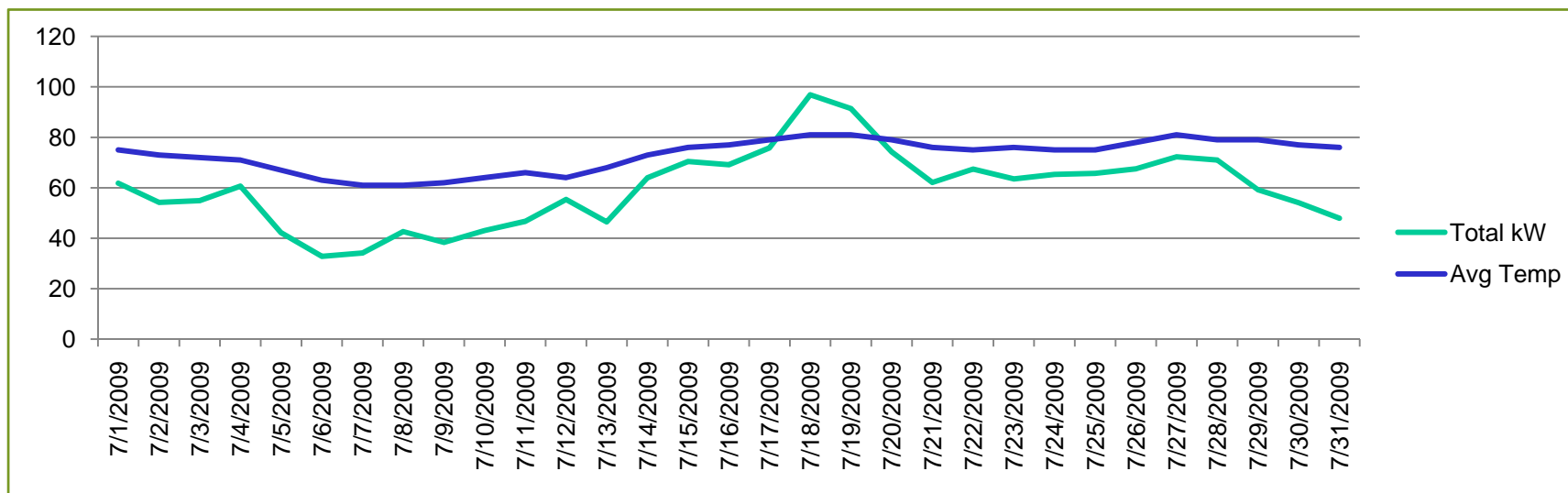
# Overview: A State of the Art BMS

- Interactive, animated, full color graphical interface
- Open Protocol – BACNet or LONworks
- IT-compatible: Uses industry standard networking hardware & computers
- Data collection and archive capabilities – Trending.



# Overview: A State of the Art BMS

- Basic graphing and data display capabilities.
- Remote Access via the internet – Webserver
- Mobile/wireless PDA interface
- Mobile/Email/Text Msg/Pager Alarm routing for critical systems



# What can a BMS do for Me?

## Energy Savings

- Responsive control Strategies
  - Resets on external loads
  - Resets on internal loads
  - Demand-Control Ventilation
  - Optimum Start-Stop
  - Demand-Response – “Smart Grid initiatives”
  - Occupancy – interface to lighting controls
  - Tenant Overrides (and Billing \$!)

# What can a BMS do for Me?

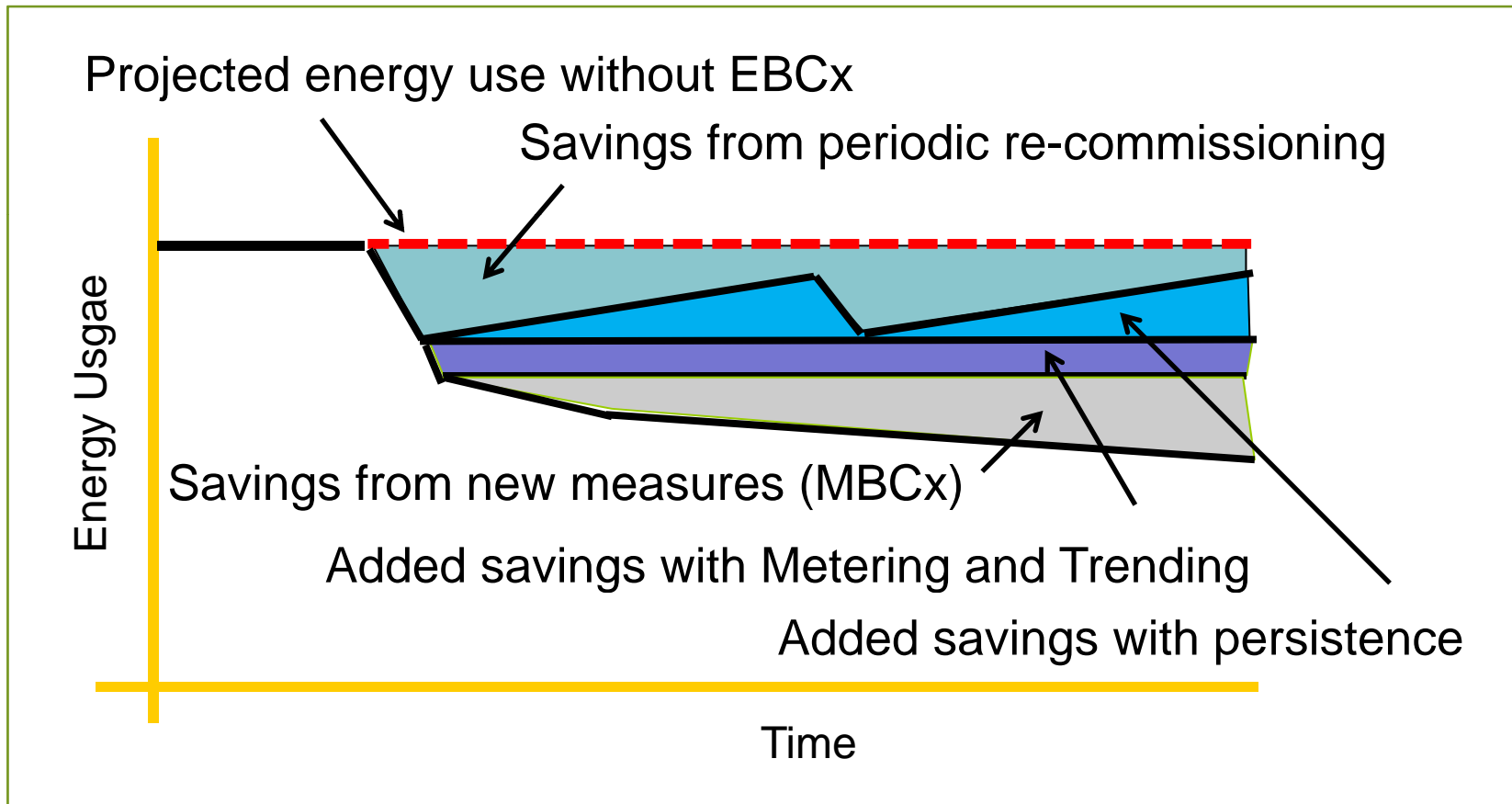
## Energy Savings

- Existing Building Commissioning
  - Investigation and Analysis - Traditional
  - Monitoring Based Commissioning
  - Continuous Implementation



# Monitoring-Based Commissioning

## Updated Paper – LBNL, June 2009



# What can a BMS do for Me?

## **Reduced Downtime**

- Remote Access
  - Dial-up, Webserver, etc.
- 24-Hour Alarming

## **Preventative / Anticipatory Maintenance**

- Continuous Implementation
  - Runtime Logging Vs Sensor Limits
  - Fault Detection Diagnostics (PIER – CEC Studies)
  - Automated Functional Testing

# Automated Functional Testing

## Brian Welsh (WCxG) – 2009 NCBC

- Ongoing Commissioning with BAS and Dataloggers
  - Using the capabilities of the BMS to exercise the equipment as it would be during functional testing to point out problems.

Valve Leakage Test					
	VAV-1	VAV-2	VAV-3	VAV-4	VAV-5
Supply Air Temp	55	55	55	55	55
Damper Position	10%	12%	10%	11%	30%
Valve Position	0%	0%	0%	0%	0%
Discharge Air Temp	55	56	55	76	55

# What can a BMS do for Me?

## Reduced complaints

- Data vs. “perception” ASHRAE 55-2004
  - Trend Logs
- Sensor costs have been coming down
  - Affordable to add points to the system
- Wireless sensor technology – ZIG-B, etc
  - Overcome the design vs. use issue - Furniture
  - Overcome the remodeling issue

# What If I Don't Have a System?

## **Now is the best time ever**

- Costs are lower per point than ever
- Systems are more open than ever
- Systems are more flexible than ever
- Consultants and Contractors can have robust training programs
- Information on how your building operates is GOLD

## **Installation can be Phased!**

# Problems With The Existing BMS

## **Old Software/Hardware**

- Lack of manufacturer support for old system.
- Can't support new controllers
- Proprietary – “locked” into one vendor

## **Bad or useless information/Bad operation**

- Sensors out of calibration
- Sensors in a bad location
- User Overrides – Setpoints and Sequence.

# Problems With The Existing BMS

## **Ineffective alarms**

- Too many/nuisance
- Non-functional – overridden or disabled.

## **Building upgrades/Use**

- Architectural changes – moving walls but not sensors
- Use changes – server room/conference room
- People – what the occupants do can affect the system

## **Lack of Training**

- Original staff that was trained no longer there
- No interest or support for training.

# BMS Remediation 101

## **Old Hardware/Software**

- Maintain or Upgrade
- Vendor/Contractor Support & Relationship

## **Bad or useless information/ Bad Operation**

- BMS must be maintained just like other systems
- Systems manual – How should the building operate?
- Benchmarking and Trend logs

# BMS Remediation 101

## **Ineffective Alarms**

- Priority Assessment – Filtering Exercise
- Alarm testing – Routine Functional testing

## **Building Upgrades/Use**

- Mechanical systems and controls must be considered in architectural renovations and major use changes.
- Occupant education & facility surveys.

## **Training**

- Must be supported from Management – Budget!
- Vendor/Contractor Support & Relationship
- Train Smart – Video Recording, Internal training for staff turnover.

# LEED EB-O&M

## EA Prerequisite 1

- Energy Efficiency Best Management Practices: Planning, Documentation, Opportunity Assessment
  - Document Current Sequence of Operation
    - Verify record documents or start from scratch.
  - Building Operations Plan
    - Normal Hours of operation, HVAC setpoints, lighting level setpoints, how the operation changes for off-hours, special days, etc.

# LEED EB-O&M

## **EA Prerequisite 2 and Credit 1**

- Minimum Energy Efficiency Performance and Optimize Energy Efficiency Performance
  - Control running time of equipment
  - Temperature setpoints out of range
  - System Overrides not released
  - Repair/ verify economizer operation
  - Fully use system capabilities

# LEED EB-O&M

## **EA Credit 2.1 (2 points)**

- Existing Building Commissioning – Investigation and Analysis
  - Document the breakdown of energy usage in the building
  - Diagnostic Monitoring and Functional Testing

# LEED EB-O&M

## **EA Credit 2.2 (2 points)**

- Existing Building Commissioning – Implementation
  - Implement low-cost/no-cost improvements
  - Train Facilities staff in modified operation
  - Update the Building Operating Plan (From PR1)

# LEED EB-O&M

## **EA Credit 2.3 (2 points)**

- Existing Building Commissioning – Ongoing Commissioning
  - Planning, System testing, performance verification, corrective action response, ongoing measurement and documentation.
  - Cx cycle not to exceed 24 months
  - Update the Building Operations Plan as necessary.

# LEED EB-O&M

## EA Credit 3.1

- Have a Building Management System in place
  - Controls major building systems including
    - Heating
    - Cooling
    - Ventilation
    - Lighting
  - Have a BMS Preventative Maintenance Program in Place
  - Demonstrate that the BMS is being used to inform decisions about energy conservation.

# LEED EB-O&M

## EA Credit 3.2

- Performance Measurement – System Level Metering
  - Energy sub-metering covering at least 40% (1point) or 80% (2 points) of the total expected annual energy usage of the building.
  - Permanent installation is required
  - Metering must be continuous and data logged for analysis.
  - Monthly and Annual reports are required.

# LEED EB-O&M

## IEQ Prerequisite 1

- Minimum Indoor Air Quality Performance
  - Meet ASHRAE 62.1-2007
    - Economizer dampers
    - Supply Fans
    - Exhaust Fans,
    - Sensor CO<sub>2</sub>/VOC calibration
  - Can't meet ASHRAE 62.1-2007
    - Provide at least 10 cfm per person OA

# LEED EB-O&M

## IEQ Prerequisite 2

- Environmental Tobacco Smoke (ETS) Control
  - Case 1- Non-residential Buildings
    - Option 1
      - » Prohibit Smoking in or around the building (The California Solution)
    - Option 2
      - » Smoking only in designated Smoking rooms – Must maintain 0.02 negative pressure relative to the surrounding rooms.
  - Case 2 – Residential and Hospitality Buildings
    - Reduce leakage

# LEED EB-O&M

## **IEQ Credit 1.2**

- Indoor Air Quality Management Best Practices
  - Outdoor Air Delivery Monitoring
    - Outdoor Airflow Measurement Device
    - CO2 Sensors in densely occupied areas

# LEED EB-O&M

## **IEQ Credit 1.3**

- Indoor Air Quality Management Best Practices
  - Increased ventilation
    - 30% increase over minimum required by ASHRAE 62.1-2007
      - Senior Center – Optional free cooling/ventilation

# LEED EB-O&M

## **IEQ Credit 2.3**

- Occupant Comfort – Thermal Comfort Monitoring
- Ensure Comfort Criteria of ASHRAE 55-2004
  - Continuous Monitoring of Space Temperature and Humidity – 15 min Sampling
  - Alarms for conditions that would require adjustment or repair

# LEED EB-O&M

## **WE Credit 1 (1 or 2 points)**

- Water Performance Measurement
  - Whole Building Metering
  - Submetering
    - Irrigation
    - Indoor Plumbing
    - Cooling Towers
    - Domestic Hot Water
    - 80% of other process water – Humidification, Laundry, Pools, Dishwashing
  - Can be manual logging, but....

# LEED EB-O&M

## **WE Credit 3 (1-5 points)**

- Water Efficient Landscaping
  - Goal is to reduce potable water usage for irrigation
  - Alternate water sources
    - Rainwater
    - Greywater
    - AC Condensate
  - Controls for filtration, pumping/valves

# LEED EB-O&M

## **WE Credit 4 (1-2 points)**

- Cooling Tower Water Management
  - Goal is to reduce potable water usage for Towers
  - Option 1 – improve water treatment/reduce blowdown
  - Option 2 - Alternate water sources
    - Rainwater
    - Greywater
    - AC Condensate
    - Pool filter backwash
  - Controls for filtration, pumping/valves

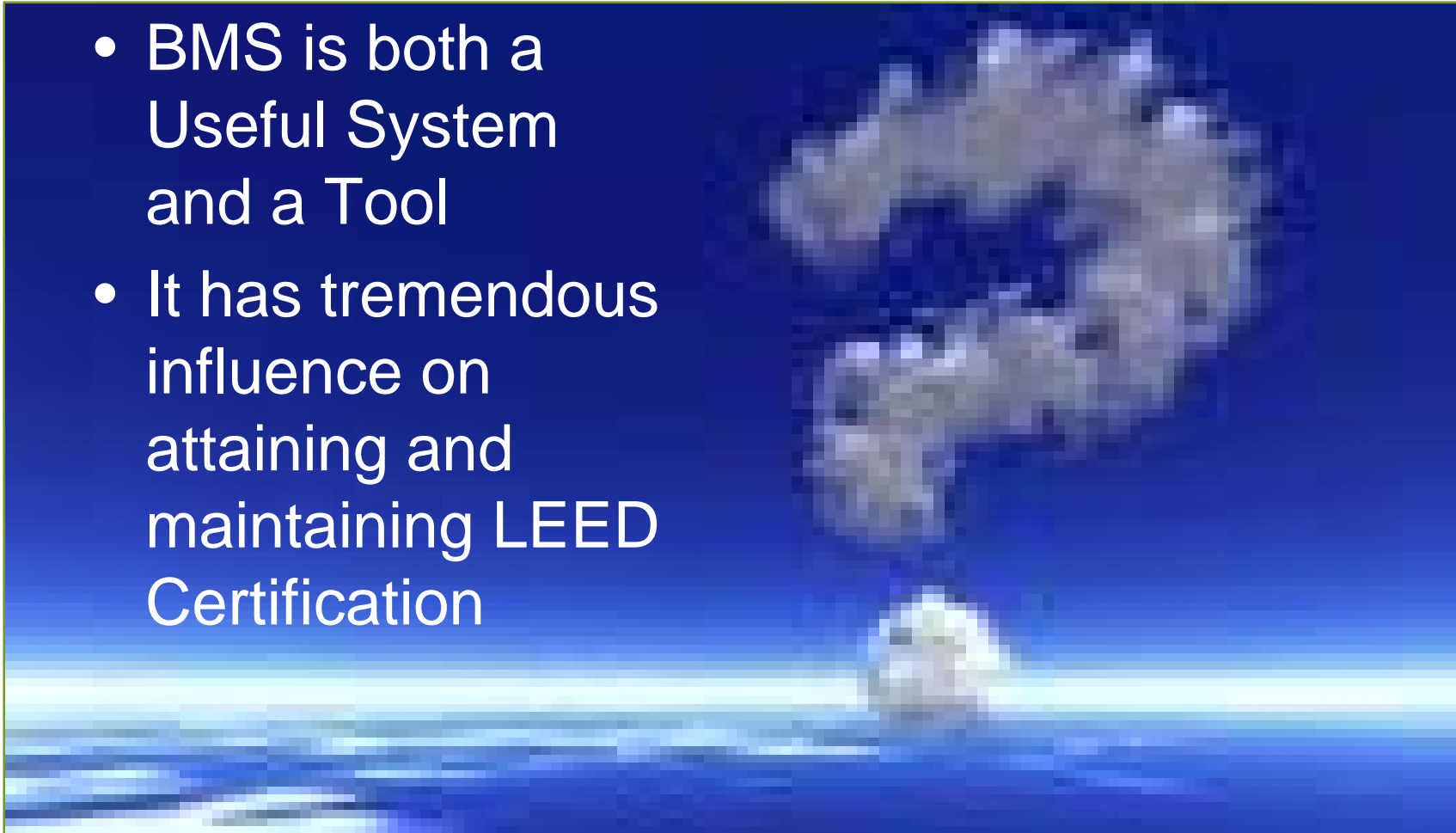
# LEED EB-O&M

## **SS Credit 8 (1 points)**

- Light Pollution Reduction
  - Interior Lighting
    - Time-Controlled Lighting
    - Vacancy Sensors
    - Drop Shades after nighfall
  - Exterior Lighting
    - Photocells
    - Time-Controlled Display/Accent Lighting

# Summary

- BMS is both a Useful System and a Tool
- It has tremendous influence on attaining and maintaining LEED Certification



# AIA Quality Assurance



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Thank you for your time!

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