

# SUSTAINABILITY TRACK

## Session 8



Phoenix, AZ  
August 3-6, 2008



# Greening your Operations

## *Implementing LEED-EB*

Tia Heneghan  
CTG Energetics



# Today's Goals

- LEED-EB
  - Basics
  - Breaking it down
- High Performance Operations
  - On-going Commissioning Program
  - Metering



# The LEED EB Difference

- LEED for Existing Buildings
  - Focuses on building performance
  - Helps building owners reduce the environmental impacts of their facilities
- LEED for New Construction
  - Focuses on building design and construction



# Why LEED EB?

- LEED EB Helps:
  - Solve building-operation problems
  - Reduce building-operation costs
  - Improve indoor environmental quality
  - Communicate the need for good O&M practices
  - **Provide a framework for sustainability**
  - Report environmental stewardship efforts
- LEED EB is Flexible and Non-Prescriptive



# LEED EB Program Basics

- Must Meet All 9 Prerequisites
- 92 Points Organized as Credits
- Credits Divided Into Five Categories
  - Sustainable Sites (SS)
  - Water Efficiency (WE)
  - Energy and Atmosphere (EA)
  - Materials and Resources (MR)
  - Indoor Environmental Quality (EQ)



# LEED EB Program Basics

- Performance Period
  - 3 months of data
- Certification Levels:
  - **Certified**                      **34 to 42 Points**
  - **Silver**                              **43 to 50 Points**
  - **Gold**                                 **51 to 67 Points**
  - **Platinum**                         **68 +**

# Sustainable Facilities Program Development



Discovery

Assessment



Goal setting

Action

# LEED EB Audit



- “Gut Check” Against LEED-EB Checklist
  - Review current FM practices
  - Do they align with LEED EB
- EPA ENERGY STAR Score
  - Minimum of 2 points - 69





# FM Best Practices

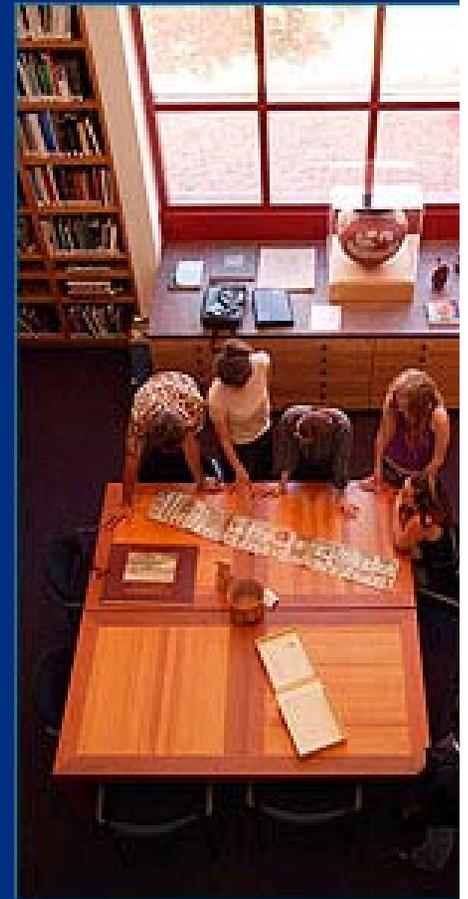
- Custodial (Green Cleaning)
- Occupant Recycling
- Materials Purchasing
- Site Management Practices
- Tenant Comfort
- Energy Management





# Starting Steps

- Team Kick-off
- Define Goals
- Establish Milestones
- Identify Metrics
- Document Processes
- Track Progress





# A Different Perspective

- 5 Rating System Categories
  - Sustainable Sites (SS)
  - Water Efficiency (WE)
  - Energy and Atmosphere (EA)
  - Materials and Resources (MR)
  - Indoor Environmental Quality (EQ)

- 
- Reconfigured for Alignment With FM
    1. High Performance Operations
    2. Green Cleaning
    3. Site Management
    4. Materials Accounting
    5. LEED Program Administration



# Categories to Functional Areas

Sustainable Sites

Water Efficiency

Energy & Atmosphere

Materials & Resources

Indoor Environmental Quality

High Performance Operations

Green Cleaning

Site Management

Materials Accounting

LEED EB Administration

## Materials In: Sustainable Purchasing

<b>MRC1</b> Ongoing Consumables 40%/60%/80% Of Purchases <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 3 pts Champ___	<b>MRC2.1</b> Durable Goods, Electric <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___
<b>MRp1</b> Sustainable Purchasing Policy <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N Required Champ___	<b>MRC2.2</b> Durable Goods, Furniture <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___
	<b>MRC3</b> Facility Alterations and Additions <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___
<b>Mrc5</b> Food <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>MRC4.1-4.2</b> Reduced Mercury in Lamps 90/70 pg/lum-hr <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 2 pts Champ___

## Materials Out: Waste Management

<b>MRC7</b> Waste Diversion: Ongoing Consumables 50%/70% <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 2 pts Champ___	<b>MRC8</b> Waste Stream Audit <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___
<b>MRp2</b> Waste Management Policy <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N Required Champ___	<b>MRC8</b> Durable Goods <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___
	<b>MRC9</b> Facility Alterations and Additions <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___

## Green Cleaning

<b>EQc3.4-6</b> Purchase of Sustainable Cleaning Products 30%/60%/90% <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 3 pts Champ___	<b>EQc3.7</b> Sustainable Cleaning Equipment <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>EQc3.8</b> Indoor Chemical and Pollutant Source Control <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>EQc3.2-3</b> Custodial Effectiveness Assessment Score <3/<2 <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 2 pts Champ___
<b>EQc3.1</b> High Performance Cleaning System <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___			
<b>EQp3</b> Green Cleaning Policy <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N Required Champ___			

## Site Management

<b>SSc2</b> Building Exterior & Hardscape Management <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>SSc3</b> IPM, Erosion Control, and Landscape Mgmt Plan <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>EQc3.9</b> Indoor Integrated Pest Management (IPM) <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>WEC3</b> Water Efficient Landscaping 50%/75%/100% <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 3 pts Champ___
<b>SSc5</b> Protect or Restore Open Space <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>SSc6</b> Stormwater Quantity Control <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>SSc7.1</b> Heat Island Reduction, Non-Roof <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>SSc8</b> Light Pollution Reduction <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___

## Site Development

## Administration

<b>EQp2</b> Environmental Tobacco Smoke Control <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N Required Champ___	<b>SSc1</b> LEED Certified Building And Construction <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>EQc1.5</b> IAQ Management Program, During Construction <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>EQc2.1</b> Occupant Comfort, Occupant Survey <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>SSc4.1-4</b> Alternative Commuting Transportation 10%/25%/50%/75% <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 4 pts Champ___	<b>EAc4.1-4</b> Renewable Energy <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 4 pts Champ___
<b>EQc2.4-5</b> Daylight and Views, Daylight 50%/75%, Views 45%/90% <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 2 pts Champ___	<b>SSc7.2</b> Heat Island Reduction, Roof <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>IOc3</b> Documenting Sustainable Building Cost Impacts <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 2 pts Champ___	<b>IOc2</b> LEED Accredited Professional <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>IOc1.1-4</b> Innovation in Design, Upgrades, Operations and Maintenance <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 4 pts Champ___	

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# EPP – Federal Requirement

## Materials In: Sustainable Purchasing

<p><b>MRc1</b> Ongoing Consumables 40%/60%/80% Of Purchases</p> <p><input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N</p> <p>3 pts Champ ____</p>	<p><b>MRc2.1</b> Durable Goods, Electric</p> <p><input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N</p> <p>1 pt Champ ____</p>
<p><b>MRp1</b> Sustainable Purchasing Policy</p> <p><input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N</p> <p>Required Champ ____</p>	<p><b>MRc2.2</b> Durable Goods, Furniture</p> <p><input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N</p> <p>1 pt Champ ____</p>
<p><b>MRc5</b> Food</p> <p><input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N</p> <p>1 pt Champ ____</p>	<p><b>MRc3</b> Facility Alterations and Additions</p> <p><input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N</p> <p>1 pt Champ ____</p>
	<p><b>MRc4.1-4.2</b> Reduced Mercury in Lamps 90/70 pg/lum-hr</p> <p><input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N</p> <p>2 pts Champ ____</p>



## Green Cleaning

<p><b>EQc3.4-8</b> Purchase of Sustainable Cleaning Products 30%/80%/90%</p> <p><input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N</p> <p>3 pts Champ ____</p>	<p><b>EQc3.7</b> Sustainable Cleaning Equipment</p> <p><input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N</p> <p>1 pt Champ ____</p>	<p><b>EQc3.8</b> Indoor Chemical and Pollutant Source Control</p> <p><input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N</p> <p>1 pt Champ ____</p>	<p><b>EQc3.2-3</b> Custodial Effectiveness Assessment Score &lt;3/&lt;2</p> <p><input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N</p> <p>2 pts Champ ____</p>
<p><b>EQc3.1</b> High Performance Cleaning System</p> <p><input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N</p> <p>1 pt Champ ____</p>			
<p><b>EQp3</b> Green Cleaning Policy</p> <p><input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N</p> <p>Required Champ ____</p>			



# Build your program

## Materials In: Sustainable Purchasing

<b>MRc1</b> Ongoing Consumables 40%/60%/80% Of Purchases <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 3 pts Champ___	<b>MRc2.1</b> Durable Goods, Electric <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___
<b>MRp1</b> Sustainable Purchasing Policy <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N Required Champ___	<b>MRc2.2</b> Durable Goods, Furniture <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___
	<b>MRc3</b> Facility Alterations and Additions <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___
<b>MRc5</b> Food <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>MRc4.1-4.2</b> Reduced Mercury in Lamps 90/70 pg/lum-hr <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 2 pts Champ___

## Site Management

<b>SSc2</b> Building Exterior & Hardscape Management <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>SSc3</b> IPM, Erosion Control, and Landscape Mgmt Plan <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>EQc3.9</b> Indoor Integrated Pest Management (IPM) <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>WEc3</b> Water Efficient Landscaping 50%/75%/100% <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 3 pts Champ___
<b>SSc5</b> Protect or Restore Open Space <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>SSc6</b> Stormwater Quantity Control <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>SSc7.1</b> Heat Island Reduction, Non-Roof <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>SSc8</b> Light Pollution Reduction <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___

## Site Development

## Green Cleaning

<b>EQc3.4-6</b> Purchase of Sustainable Cleaning Products 30%/60%/90% <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 3 pts Champ___	<b>EQc3.7</b> Sustainable Cleaning Equipment <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>EQc3.8</b> Indoor Chemical and Pollutant Source Control <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___	<b>EQc3.2-3</b> Custodial Effectiveness Assessment Score <3/<2 <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 2 pts Champ___
<b>EQc3.1</b> High Performance Cleaning System <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt Champ___			
<b>EQp3</b> Green Cleaning Policy <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N Required Champ___			

Tia Heneghan



# Set Goals

- Occupant Recycling
  - Increase by 10%
- Green Housekeeping
  - Implement program in 6 months
- Environmental Preferred Products (EPP)
- ENERGY STAR Rating
- Water Reduction





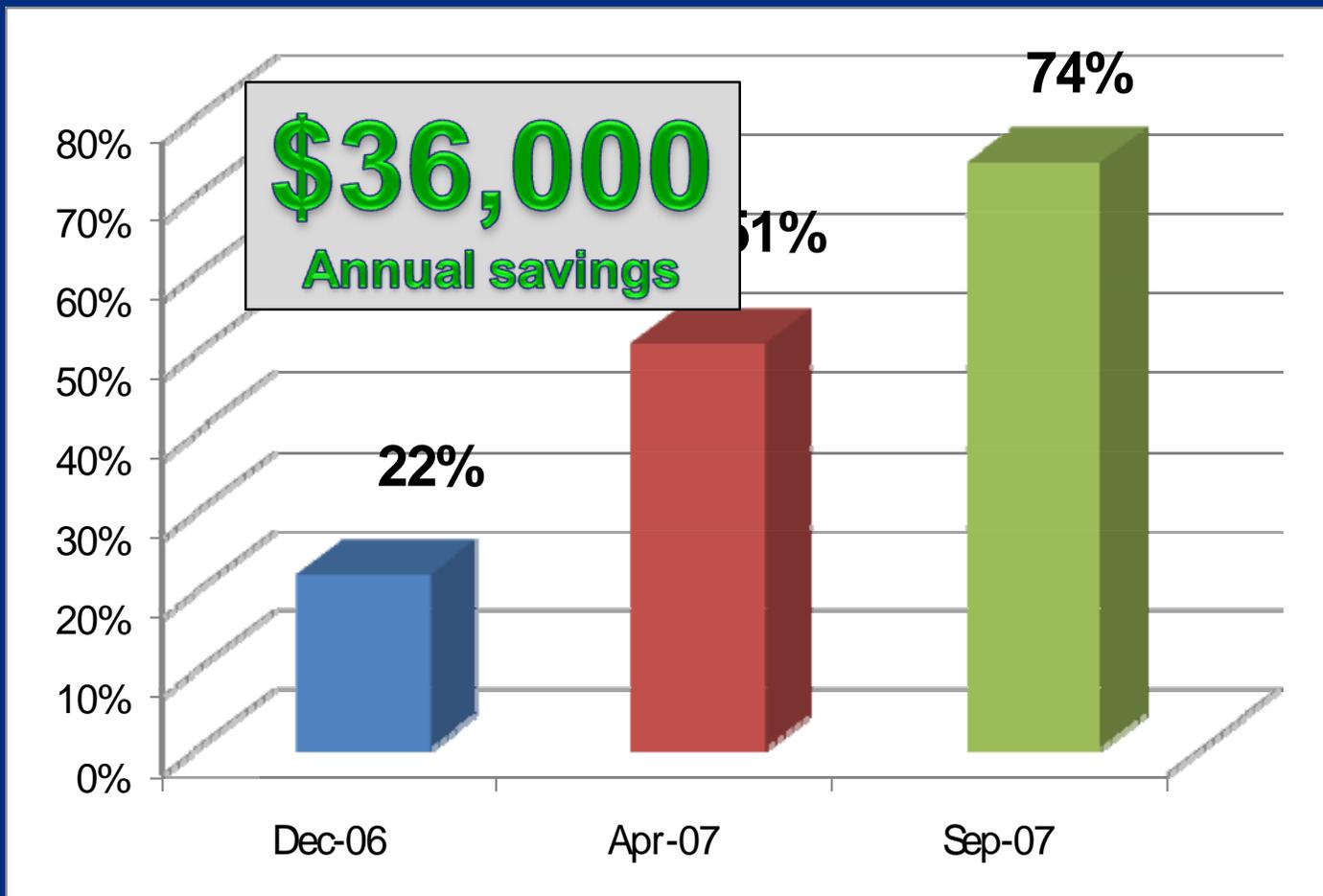
# Team Synergies

- Improving Occupant Recycling\*
  - Property Manager
    - Regional and Site Specific
  - Custodial Team
    - Regional and Site Specific
  - Cleaning Supply Firm
    - Regional and Site Specific
  - Café Manager
  - Waste Hauler (City)





# The Results



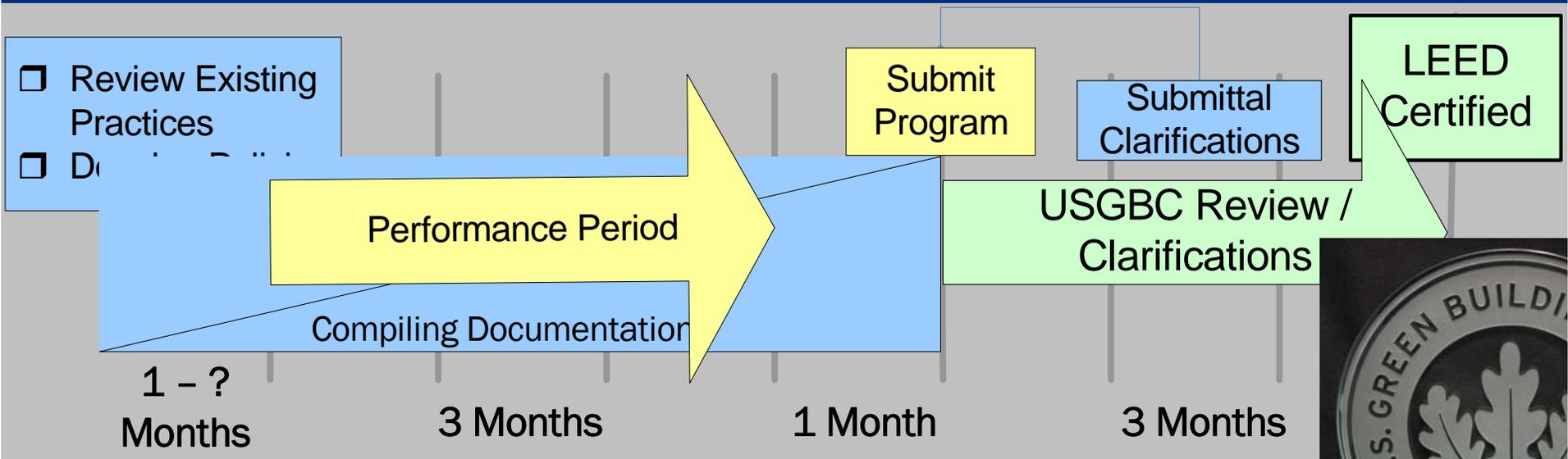
# Cost Effective Implementation Strategies



- Use your vendors (reports)
  - Office products
  - Cleaning supplies
  - Landscape contractor
  - Waste Hauler
- RFP for services
  - Differentiator
  - LEED EB reports



# Milestones





# Key Success Strategies

- High level champion
- Set realistic goals
- Establish milestones
- Use existing infrastructure
  - Use your vendors
  - Team strengths
- Institutionalize practices
- Regular team communication





# What does Green look like?



*State Services Building, Denver*



*Getty Center, Los Angeles*



*Adobe Towers, San Jose*



# High Performance Operations

## Occupant Health and Productivity

**EQc1.3**  
Increased Ventilation

Y  M  N

1 pt

**EQp1**  
Outside Air and Exhaust

Y  M  N

Required

**EQc1.2**  
Outside Air Delivery Monitoring

Y  M  N

1 pt

**EQc1.4**  
Reduce Particulates in Air Distribution

Y  M  N

1 pt

**EQc2.3**  
Thermal Comfort Monitoring

Y  M  N

1 pt

**EQc2.2**  
Occupant Controlled Lighting

Y  M  N

1 pt

**EQc1.1**  
IAQ Best Management Practices  
IAQ Management Program

Y  M  N

1 pt

**EQp2**  
Environmental Tobacco Smoke Control

**EQc1.5**  
IAQ Management for Facility Alterations

**EQc2.1**  
Occupant Comfort: Occupant Survey

**EQc3.9**  
Green Housekeeping: Integrated Pest Mgmt

**EQp3**  
Low Environmental Impact Cleaning Policy

**MRc3**  
Sustainable Purchasing Facility Alterations

## Energy Metrics

**EAp2**  
Minimize Energy Performance

**2**

Required

**EAc1.1-15**  
Optimize Energy

Y  M  N

13 pts

**EAc6**  
Emission Reduction Reporting

Y  M  N

1 pt

**EAp3**  
Ozone Protection

Y  M  N

Required

**EAc5**  
Refrigerant Management

Y  M  N

1 pt

## Operational Effectiveness

**EAc2.2**  
Commissioning: Implementation

Y  M  N

2 pts

**EAc2.3**  
Continuous Commissioning

Y  M  N

2 pts

**EAc2.1**  
Commissioning: Investigation & Analysis

Y  M  N

2 pts

**EAc3.1**  
Building Automation System

Y  M  N

1 pt

**EAc3.3**  
Energy: System-Level Metering - 80%

Y  M  N

1 pt

**WEc1.2**  
Water: Subsystem Metering

Y  M  N

1 pt

**EAc3.2**  
Energy: System-Level Metering - 40%

Y  M  N

1 pt

**WEc1.1**  
Water: Whole Building Water Meter

Y  M  N

1 pt

**WEc2**  
Indoor Fixture Efficiency 10%/20%/30%

Y  M  N

3 pts

**WEp1**  
Minimum Indoor Plumbing Fixture Efficiency

Y  M  N

Required

**WEc4.1**  
Cooling Tower Water Management

Y  M  N

1 pt

**WEc4.2**  
Cooling Tower - Non Potable

Y  M  N

1 pt

Metered Data

**EAp1**  
Best Management Practices: Systems Documentation

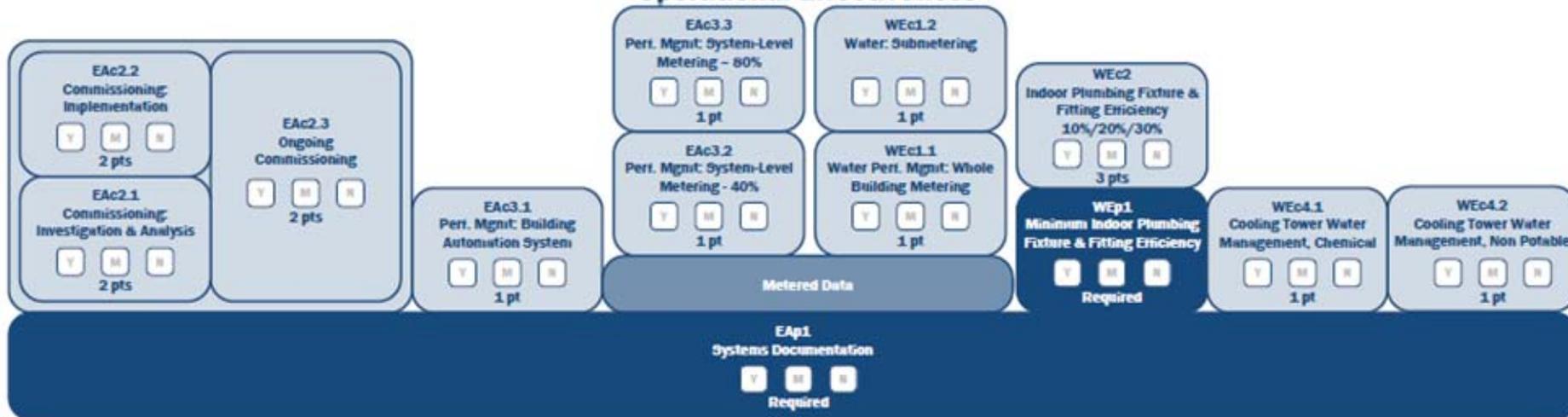
Y  M  N

Required



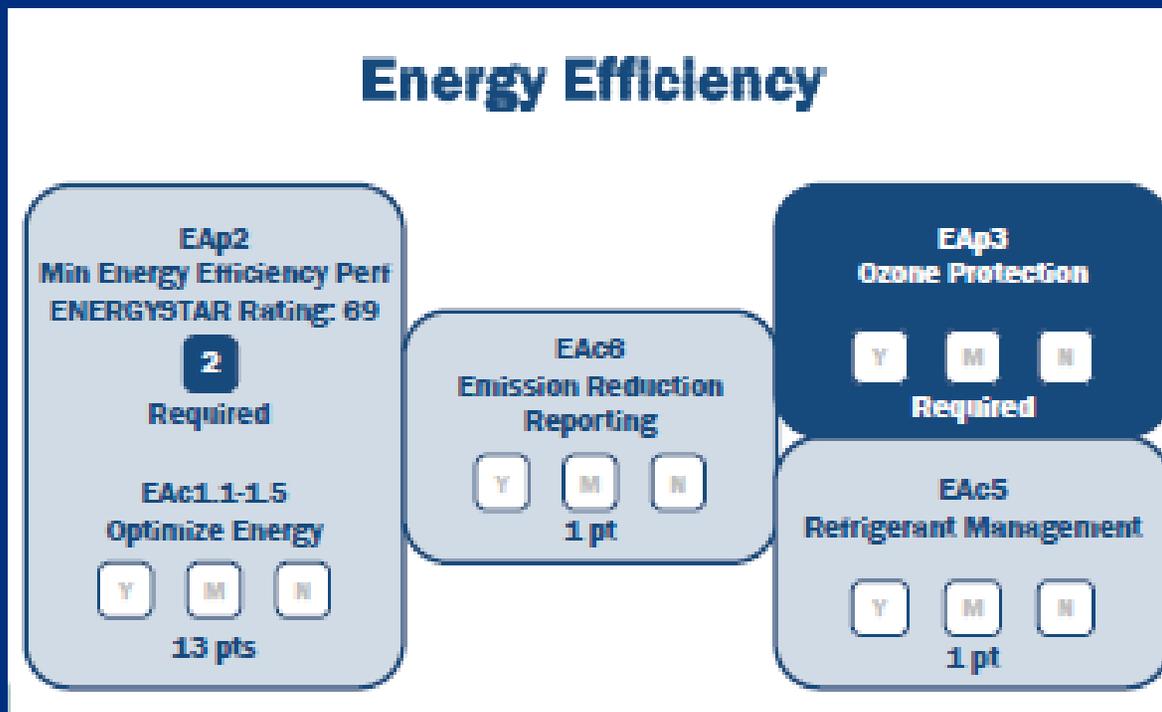
# Foundation

## Operational Effectiveness





# Metrics





# IEQ

## Occupant Health and Productivity

<b>EQc1.3</b> Increased Ventilation <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt					
<b>EQp1</b> Minimum IAQ Performance <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N Required	<b>EQc1.2</b> Outside Air Delivery Monitoring <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt	<b>EQc1.4</b> Reduce Particulates in Air Distribution <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt	<b>EQc2.3</b> Thermal Comfort Monitoring <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt	<b>EQc2.2</b> Occupant-Controlled Lighting <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt	
<b>EQc1.1</b> IAQ Management Program <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt					
<b>EQp2</b> Environmental Tobacco Smoke Control	<b>EQc1.5</b> IAQ Management for Facility Alterations	<b>EQc2.1</b> Occupant Comfort: Occupant Survey	<b>EQc3.9</b> Green Housekeeping: Integrated Pest Mgmt	<b>EQp3</b> Low Environmental Impact Cleaning Policy	<b>MRc3</b> Sustainable Purchasing Facility Alterations



# Leverage the Synergies

- Understand your systems (EAp1)
- Control systems (EAac3.1)
- Measure Use (EAp1;EAac1; EAac3.2-3.3)
- Optimize systems (EAac2)
  - 6 potential points
  - Improves Energy Star score



# Building an On-going Cx



**GovEnergy**  
[www.govenergy.gov](http://www.govenergy.gov)



# Existing Building Cx

A **systematic** process for **investigating** how and **why** an existing building's **systems** are operated and identifying ways to improve and optimize.





# Overarching Goals

- Document the performance requirements of the occupants
  - Operating Plan
- Operate efficiently
  - while satisfying occupants needs
- Provide a safe and healthy workplace
- A well-trained operations staff



# High Performance Operations

## Occupant Health and Productivity

**EQc1.3**  
Increased Ventilation

Y  M  N

1 pt

**EQp1**  
Outside Air and Exhaust

Y  M  N

Required

**EQc1.2**  
Outside Air Delivery Monitoring

Y  M  N

1 pt

**EQc1.4**  
Reduce Particulates in Air Distribution

Y  M  N

1 pt

**EQc2.3**  
Thermal Comfort Monitoring

Y  M  N

1 pt

**EQc2.2**  
Occupant Controlled Lighting

Y  M  N

1 pt

**EQc1.1**  
IAQ Best Management Practices  
IAQ Management Program

Y  M  N

1 pt

**EQp2**  
Environmental Tobacco Smoke Control

**EQc1.5**  
IAQ Management for Facility Alterations

**EQc2.1**  
Occupant Comfort: Occupant Survey

**EQc3.9**  
Green Housekeeping: Integrated Pest Mgmt

**EQp3**  
Low Environmental Impact Cleaning Policy

**MRc3**  
Sustainable Purchasing Facility Alterations

## Energy Metrics

**EAp2**  
Minimize Energy Performance

2  
Required

**EAc1.1-15**  
Optimize Energy

Y  M  N

13 pts

**EAc6**  
Emission Reduction Reporting

Y  M  N

1 pt

**EAp3**  
Ozone Protection

Y  M  N

Required

**EAc5**  
Refrigerant Management

Y  M  N

1 pt

## Operational Effectiveness

**EAc2.2**  
Commissioning: Implementation

Y  M  N

2 pts

**EAc2.3**  
Continuous Commissioning

Y  M  N

2 pts

**EAc2.1**  
Commissioning: Investigation & Analysis

Y  M  N

2 pts

**EAc3.1**  
Building Automation System

Y  M  N

1 pt

**EAc3.3**  
Energy: System-Level Metering - 80%

Y  M  N

1 pt

**WEc1.2**  
Water: Subsystem Metering

Y  M  N

1 pt

**EAc3.2**  
Energy: System-Level Metering - 40%

Y  M  N

1 pt

**WEc1.1**  
Water: Whole Building Water Meter

Y  M  N

1 pt

**WEc2**  
Indoor Fixture Efficiency 10%/20%/30%

Y  M  N

3 pts

**WEp1**  
Minimum Indoor Plumbing Fixture Efficiency

Y  M  N

Required

**WEc4.1**  
Cooling Tower Water Management

Y  M  N

1 pt

**WEc4.2**  
Cooling Tower - Non Potable

Y  M  N

1 pt

Metered Data

**EAp1**  
Best Management Practices: Systems Documentation

Y  M  N

Required



# High Performance Operations

## Occupant Health and Productivity

**EQc1.3 Increased Ventilation**  
 Y  M  N  
 1 pt

**EQp1 Outside Air and Exhaust**  
 Y  M  N  
 Required

**EQc1.2 Outside Air Delivery Monitoring**  
 Y  M  N  
 1 pt

**EQc1.4 Reduce Particulates in Air Distribution**  
 Y  M  N  
 1 pt

**EQc2.3 Thermal Comfort Monitoring**  
 Y  M  N  
 1 pt

**EQc2.2 Occupant Controlled Lighting**  
 Y  M  N  
 1 pt

**EQc1.1 IAQ Best Management Practices IAQ Management Program**  
 Y  M  N  
 1 pt

**EQp2 Environmental Tobacco Smoke Control**

**EQc1.5 IAQ Management for Facility Alterations**

**EQc2.1 Occupant Comfort: Occupant Survey**

**EQc3.9 Green Housekeeping: Integrated Pest Mgmt**

**EQp3 Low Environmental Impact Cleaning Policy**

**MRc3 Sustainable Purchasing Facility Alterations**

## Energy Metrics

**EAp2 Minimize Energy Performance**  
 2  
 Required

**EAc6 Emission Reduction Reporting**  
 Y  M  N  
 1 pt

**EAp3 Ozone Protection**  
 Y  M  N  
 Required

**EAc5 Refrigerant Management**  
 Y  M  N  
 1 pt

**EAc1.1-15 Optimize Energy**  
 Y  M  N  
 13 pts

## Operational Effectiveness

**EAc2.2 Commissioning: Implementation**  
 Y  M  N  
 2 pts

**EAc2.1 Commissioning: Investigation & Analysis**  
 Y  M  N  
 2 pts

**EAc2.3 Continuous Commissioning**  
 Y  M  N  
 2 pts

**EAc3.1 Building Automation System**  
 Y  M  N  
 1 pt

**EAc3.3 Energy: System-Level Metering - 80%**  
 Y  M  N  
 1 pt

**EAc3.2 Energy: System-Level Metering - 40%**  
 Y  M  N  
 1 pt

**WEc1.2 Water: Subsystem Metering**  
 Y  M  N  
 1 pt

**WEc1.1 Water: Whole Building Water Meter**  
 Y  M  N  
 1 pt

**WEc2 Indoor Fixture Efficiency 10%/20%/30%**  
 Y  M  N  
 3 pts

**WEp1 Minimum Indoor Plumbing Fixture Efficiency**  
 Y  M  N  
 Required

**WEc4.1 Cooling Tower Water Management**  
 Y  M  N  
 1 pt

**WEc4.2 Cooling Tower - Non Potable**  
 Y  M  N  
 1 pt

**EAp1 Best Management Practices: Systems Documentation**  
 Y  M  N  
 Required

Metered Data



# High Performance Operations

## Occupant Health and Productivity

**EQc1.3 Increased Ventilation**  
 Y  M  N  
 1 pt

**EQp1 Outside Air and Exhaust**  
 Y  M  N  
 Required

**EQc1.2 Outside Air Delivery Monitoring**  
 Y  M  N  
 1 pt

**EQc1.4 Reduce Particulates in Air Distribution**  
 Y  M  N  
 1 pt

**EQc2.3 Thermal Comfort Monitoring**  
 Y  M  N  
 1 pt

**EQc2.2 Occupant Controlled Lighting**  
 Y  M  N  
 1 pt

**EQc1.1 IAQ Best Management Practices IAQ Management Program**  
 Y  M  N  
 1 pt

**EQp2 Environmental Tobacco Smoke Control**

**EQc1.5 IAQ Management for Facility Alterations**

**EQc2.1 Occupant Comfort: Occupant Survey**

**EQc3.9 Green Housekeeping: Integrated Pest Mgmt**

**EQp3 Low Environmental Impact Cleaning Policy**

**MRc3 Sustainable Purchasing Facility Alterations**

## Energy Metrics

**EAp2 Minimize Energy Performance**  
 2  
 Required

**EAc6 Emission Reduction Reporting**  
 Y  M  N  
 1 pt

**EAp3 Ozone Protection**  
 Y  M  N  
 Required

**EAc5 Refrigerant Management**  
 Y  M  N  
 1 pt

**EAc1.1-15 Optimize Energy**  
 Y  M  N  
 13 pts

## Operational Effectiveness

**EAc2.2 Commissioning: Implementation**  
 Y  M  N  
 2 pts

**EAc2.3 Continuous Commissioning**  
 Y  M  N  
 2 pts

**EAc2.1 Commissioning: Investigation & Analysis**  
 Y  M  N  
 2 pts

**EAc3.1 Building Automation System**  
 Y  M  N  
 1 pt

**EAc3.3 Energy: System-Level Metering - 80%**  
 Y  M  N  
 1 pt

**WEc1.2 Water: Subsystem Metering**  
 Y  M  N  
 1 pt

**WEc2 Indoor Fixture Efficiency 10%/20%/30%**  
 Y  M  N  
 3 pts

**EAc3.2 Energy: System-Level Metering - 40%**  
 Y  M  N  
 1 pt

**WEc1.1 Water: Whole Building Water Meter**  
 Y  M  N  
 1 pt

**WEp1 Minimum Indoor Plumbing Fixture Efficiency**  
 Y  M  N  
 Required

**WEc4.1 Cooling Tower Water Management**  
 Y  M  N  
 1 pt

**WEc4.2 Cooling Tower - Non Potable**  
 Y  M  N  
 1 pt

**EAp1 Best Management Practices: Systems Documentation**  
 Y  M  N  
 Required

Metered Data



# Performance Requirements

- What is needed for **people** to function at a high level based on their work product?
  - Heating or cooling for thermal comfort
  - Lighting level
    - Video conference room
    - Piece work
    - Team collaboration



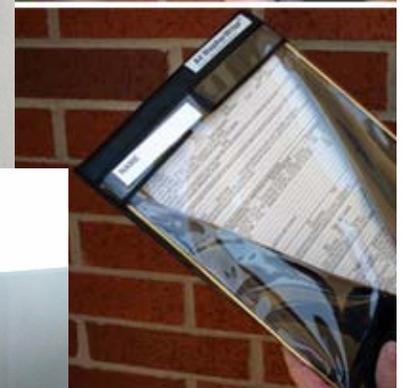
# Operate Efficiently

- Use the least amount of capital to maintain performance requirements
  - Natural (Gas, Electricity, Water, etc)
  - Financial (Dollars)
  - Human (Maintenance staff)



# Commissioning is...

- Documentation
- Testing
- Training





# Focuses on the **O** in O&M

- Maintenance programs focus on components
- Cx focuses on the operation of a system
  - *Why* a piece of equipment is operating
    - To meet performance requirements
  - Identifies root causes of operational problems



# LEED EB Cx Program

**EAc2.2**  
Commissioning:  
Implementation

Y  M  N

2 pts

**EAc2.1**  
Commissioning:  
Investigation & Analysis

Y  M  N

2 pts

**EAc2.3**  
Continuous  
Commissioning

Y  M  N

2 pts

**EAc3.1**  
Building Automation  
System

Y  M  N

1 pt

**EAc3.3**  
Energy: System-Level  
Metering - 80%

Y  M  N

1 pt

**EAc3.2**  
Energy: System-Level  
Metering - 40%

Y  M  N

1 pt

Metered Data

**EAp1**  
Best Management Practices: Systems Documentation

Y  M  N

Required



# Systems Documentation

- Building Operating Plan
- Systems narratives
- Sequence of Operations
- PM program
- Energy End Use

**EAp1**

**Best Management Practices: Systems Documentation**

Y  M  N

**Required**



# Building a program

**EAc2.2**

**Commissioning:  
Implementation**

Y

M

N

**2 pts**

**EAc2.1**

**Commissioning:  
Investigation & Analysis**

Y

M

N

**2 pts**

**EAc2.3**

**Continuous  
Commissioning**

Y

M

N

**2 pts**



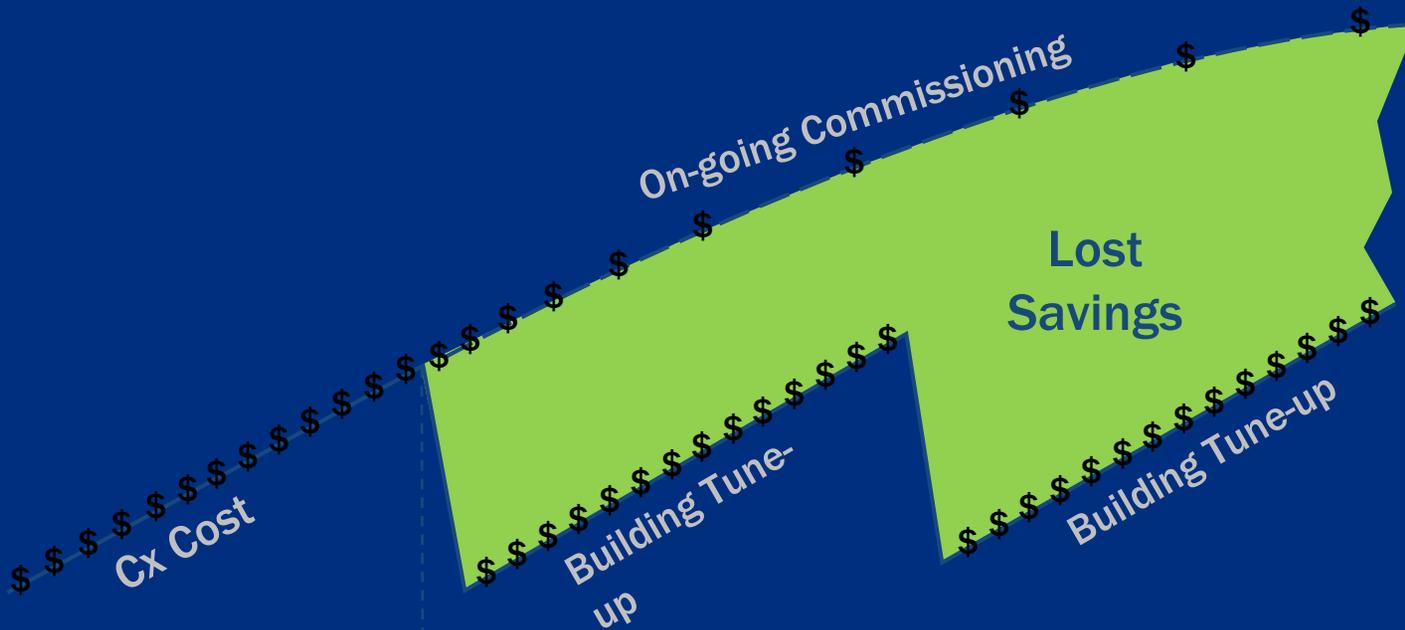
# Investigation Phase

- Often iterative
- Use trends from BAS to identify issues
- Functional test procedures
  - Written protocol for field testing
- Combination
  
- Begin with the end in mind
  - On going Cx process



# Why On-going Cx?

Operating Effectiveness



Initial Cx Investment:  
Analysis & Implementation

Time



**GovEnergy**  
[www.govenergy.gov](http://www.govenergy.gov)

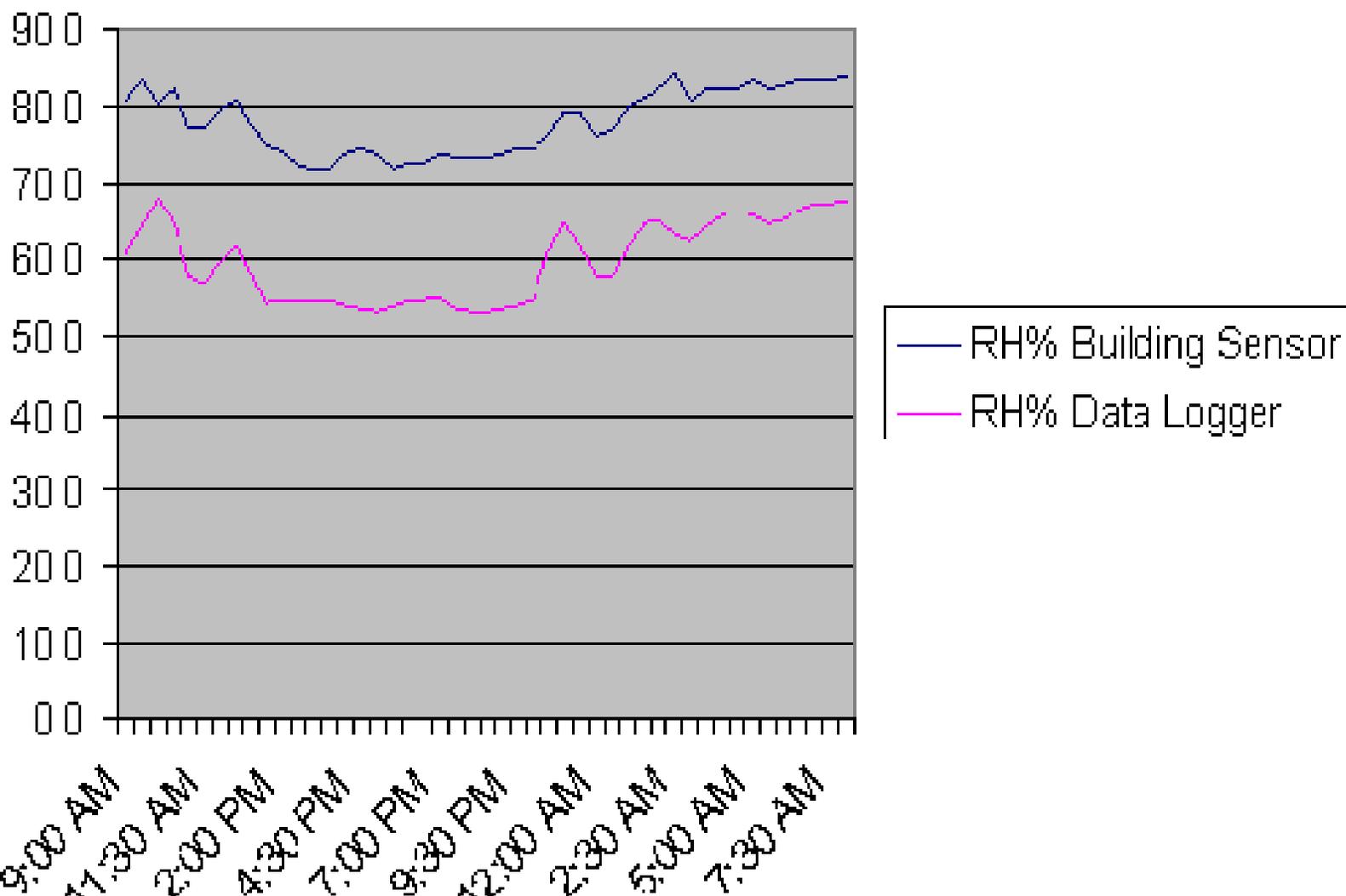


# Sensor Calibration Plan

Air Handling Units 1-5 Calibration Points		
POINT	Acceptable Range	Frequency
Duct Static Pressure	±10%	Annually
Discharge Air Temperature	±2 Degrees F	Annually
Return Air Temperature	±2 Degrees F	Annually
Outdoor Air Temperature	±2 Degrees F	6 months
Mixed Air Temperature	±2 Degrees F	Annually
Return Air Humidity	±2 % Points	Annually
Outdoor Air Humidity	±2 % Points	Annually
Hot Water Supply Temp	±2 Degrees F	Annually
Hot Water Return Temp	±2 Degrees F	Annually
Chilled Water Supply Temp	±2 Degrees F	Annually
Chilled Water Return Temp	±2 Degrees F	Annually
Minimum Outside Air Flow	±10%	Annually



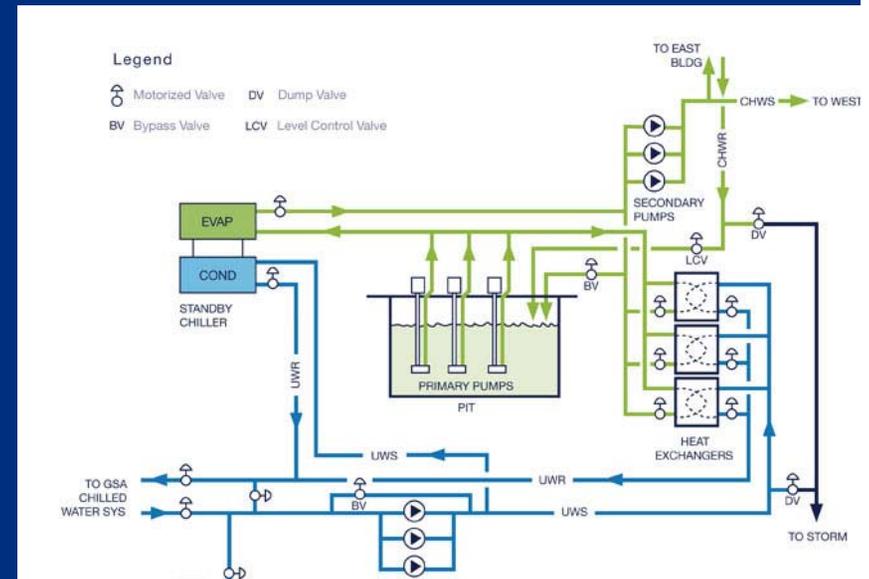
# RH is reading 18% higher





# Other findings

- OA sensor 5 deg off
  - Critical sensor
  - Consider second OA sensor
- Mixed Air sensor location – against coil





# Building Operating Strategies

- Comfort
- Energy Efficiency
- Sequence of Operations
  - Defines the functional performance of control systems
  - At turnover often generic parameters
    - 2 hour override on lights (WHY)



# Critical Control Strategies

- Air Side Economizer Cycle
- Demand Ventilation
- Adaptive thermal comfort
  - 75 (or higher) summer (when OA above X)
  - 70 winter
- Energy Cost Savings vs. Energy Savings
  - Time of Day
- Iterative



# Metering



**GovEnergy**  
[www.govenergy.gov](http://www.govenergy.gov)



# Metering Strategy

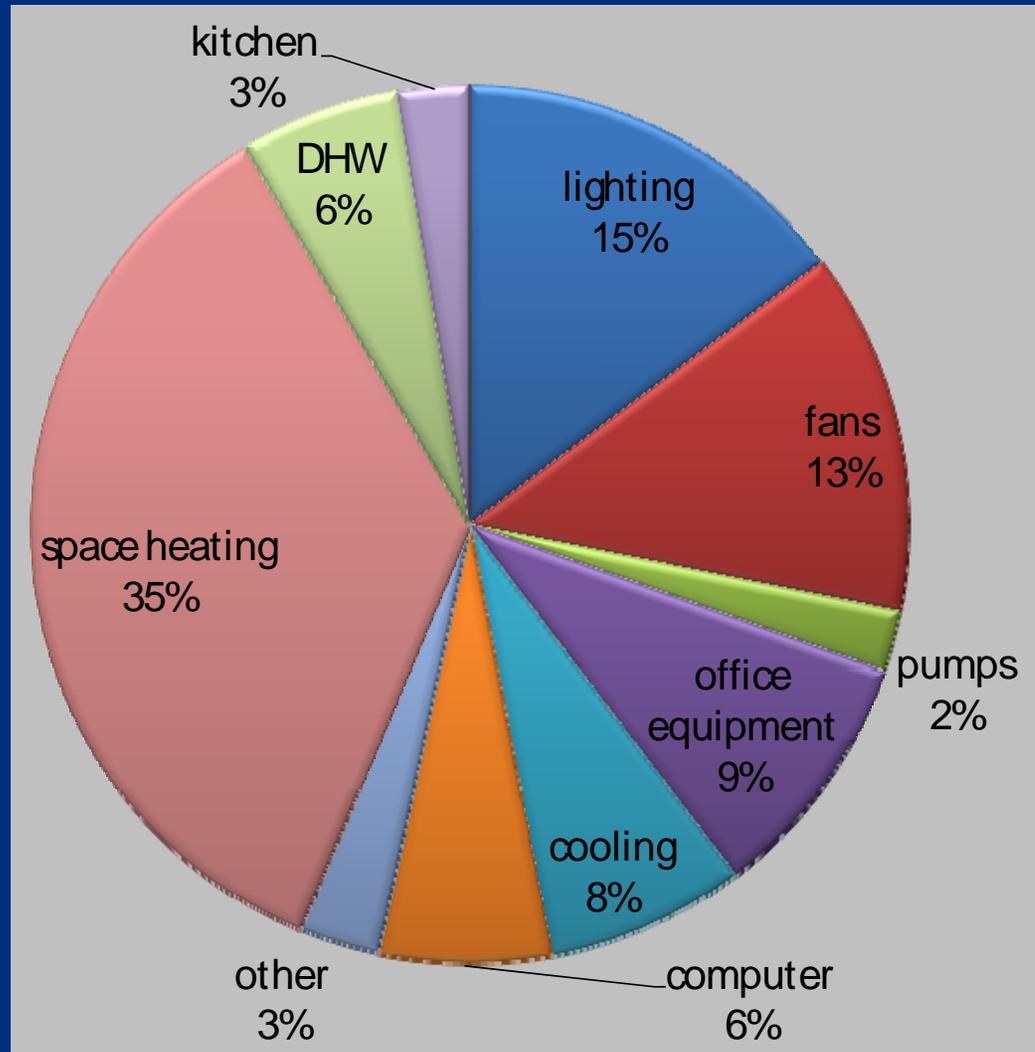
*"If you don't collect it, you can't measure it"*

*"If you don't measure it, you can't manage it"*

- A good metering strategy is an essential energy management tool
- Whole building meters do not help identify where and why a building is performing badly
- Sub-metering helps to identify where and when energy is being wasted.



# Sample Building Energy End Use





# Metering Strategy

- Meters do not save money

## Data Analysis

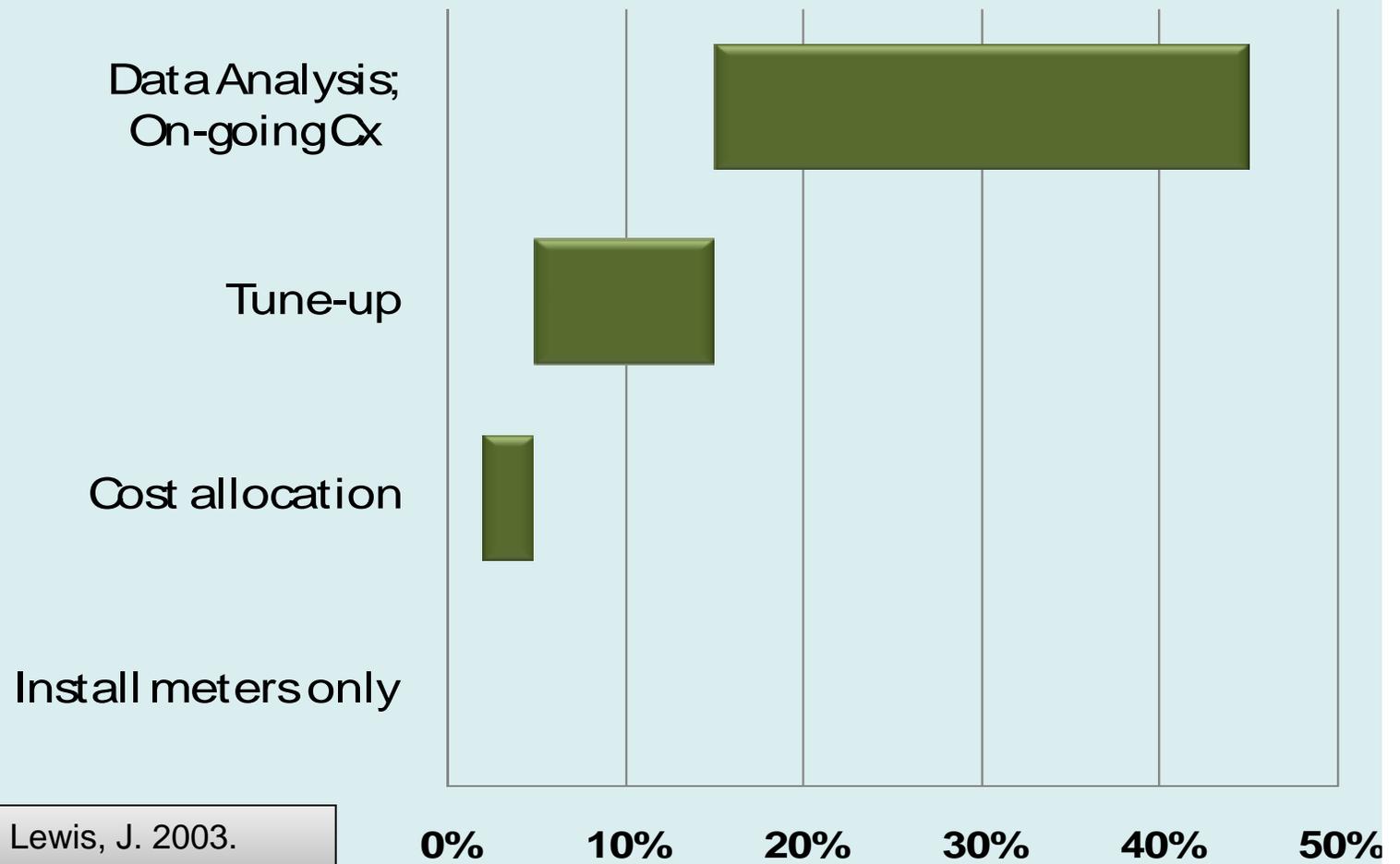
– Interpretation of data

+ On-Going Commissioning Program

= Savings



# Energy Savings Potential



# Computrols' Building Automation System

Text View

Hardware View

Graphics View

System

Reports

## AHU: #4

### Outside Conditions

Temperature  
**73.1** Deg. F

Humidity  
**78.4** % RH

### Navigation

Stores  
Roof  
Upper Level  
Lower Level  
Communications

Home

Free Cooling  
**ON**

Mixed Temp  
**78.6 DEG F**

Supply Inlet Vane  
**80 %OPEN**  
PID Control Loop

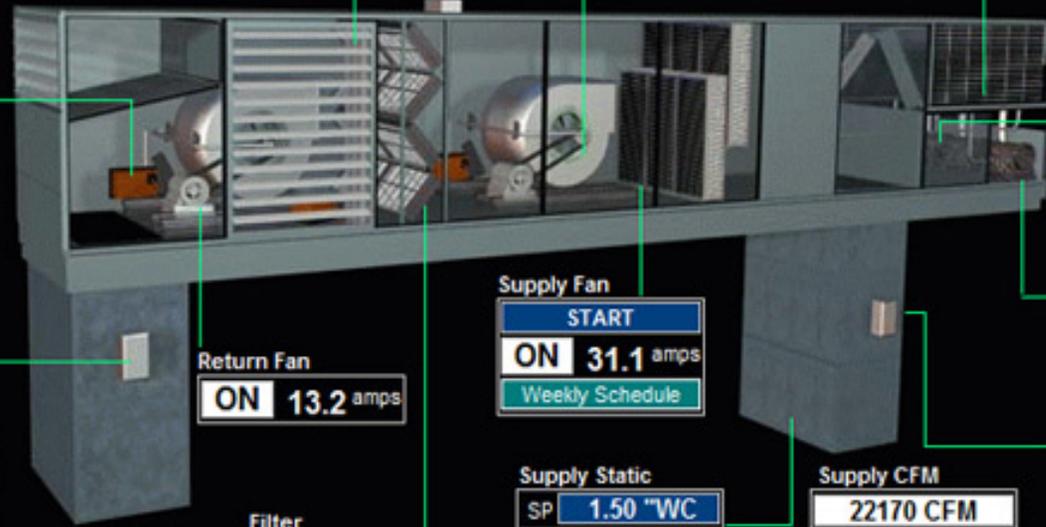
Stages Needed  
**3**

Mixed Damper  
**100 %OPEN**  
PID Control Loop

Compressor 3:  
**ON** **START**  
22.5 amp  
**UNLOAD**

Return Inlet Vane  
**81 %OPEN**  
Logic 1 Programming

Compressor 1:  
**ON** **START**  
39.0 amp  
**UNLOAD**



Compressor 2:  
**OFF** **STOP**  
0.0 amp  
**UNLOAD**

Return Temp  
**73.6 DEG F**

Supply Fan  
**START**  
**ON** **31.1** amps  
Weekly Schedule

Supply Temp  
SP **53.5** DEGR  
**54.1** DEG F

Compressor 2 Cycles Per Day  
**RUN** **0**

Compressor 3 Cycles Per Day  
**RUN** **0**

Compressor 1 Cycles Per Day  
**RUN** **0**

Return Fan  
**ON** **13.2** amps

Filter  
**0.00** "WC

Supply Static  
SP **1.50** "WC  
**1.42** "WC

Supply CFM  
**22170** CFM

AHU 4 System Performance LL

AHU 4 System Performance UL

# Computrols' Building Automation System

Text View

Hardware View

Graphics View

System

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## AHU: #4

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Filter  
**0.00** "WC

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SP **1.50** "WC  
**1.42** "WC

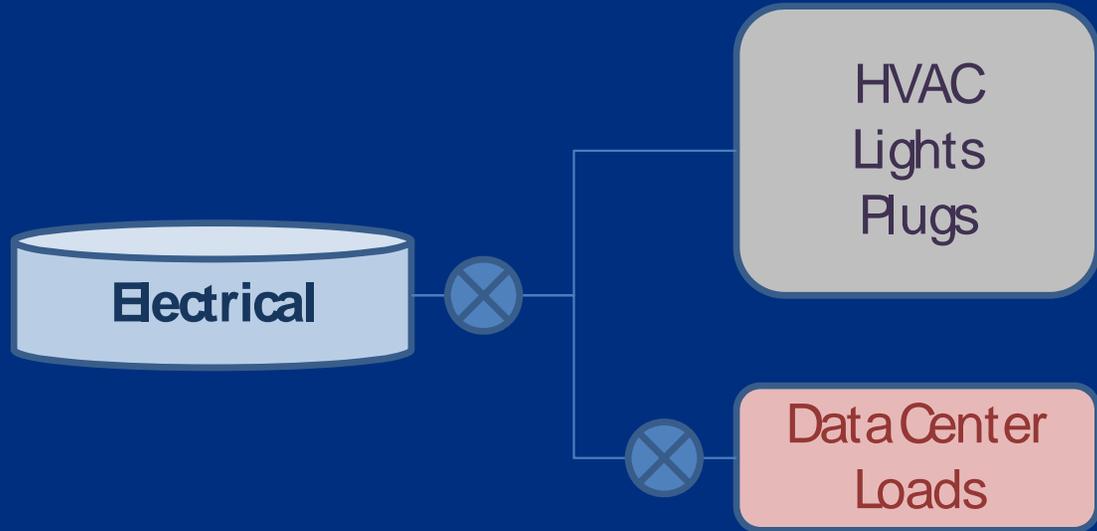
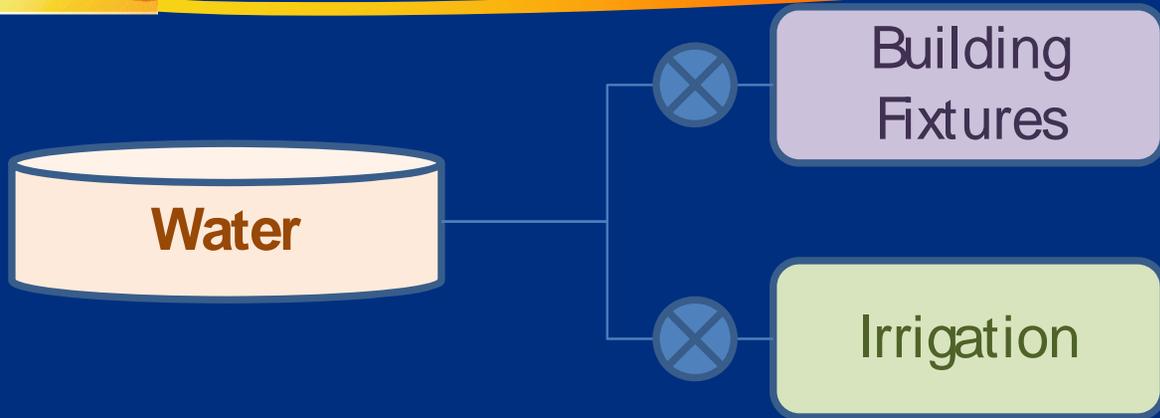
Supply CFM  
**22170** CFM

AHU 4 System Performance LL

AHU 4 System Performance UL



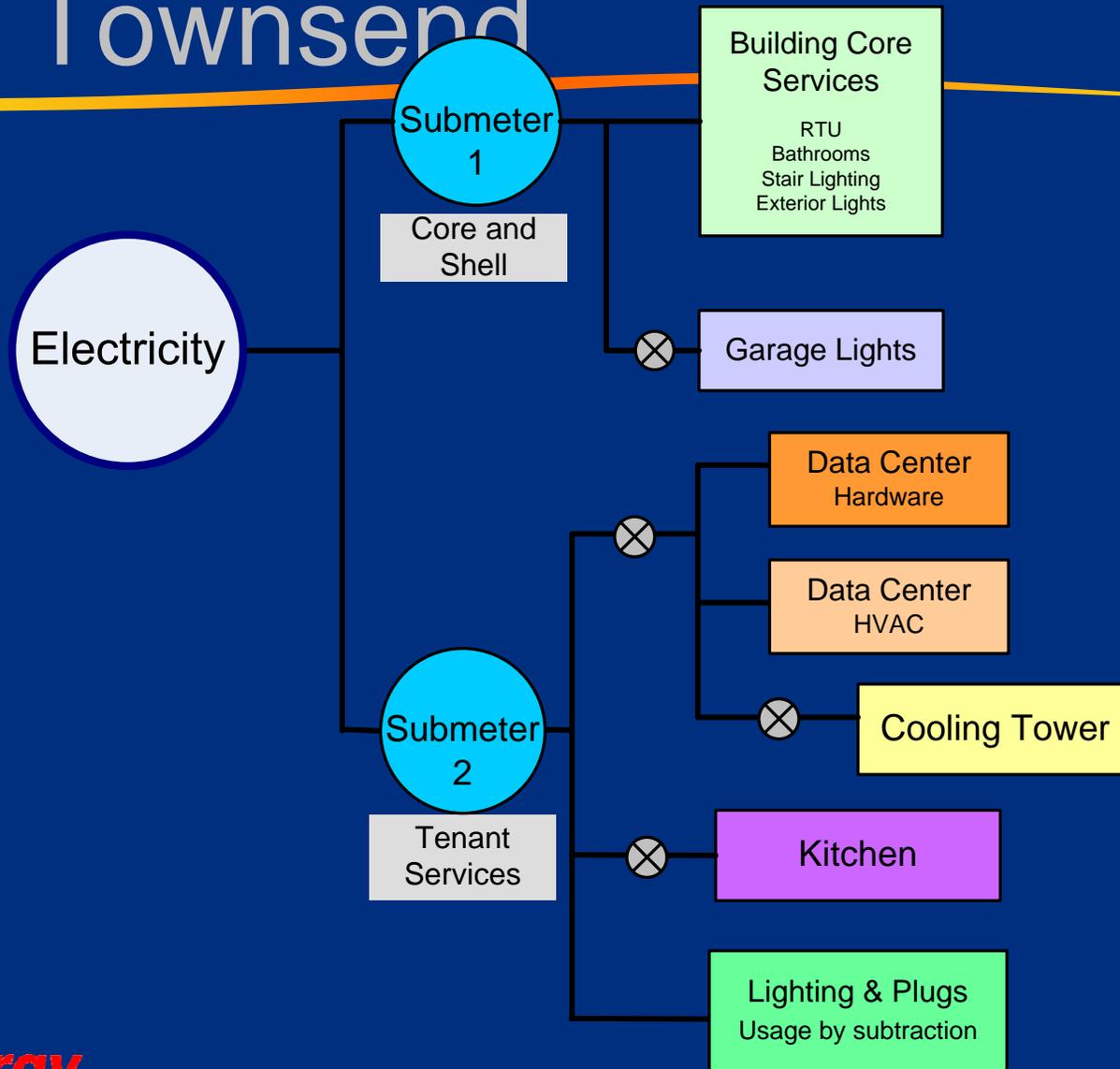
# Sample Metering Diagrams



 - Meter

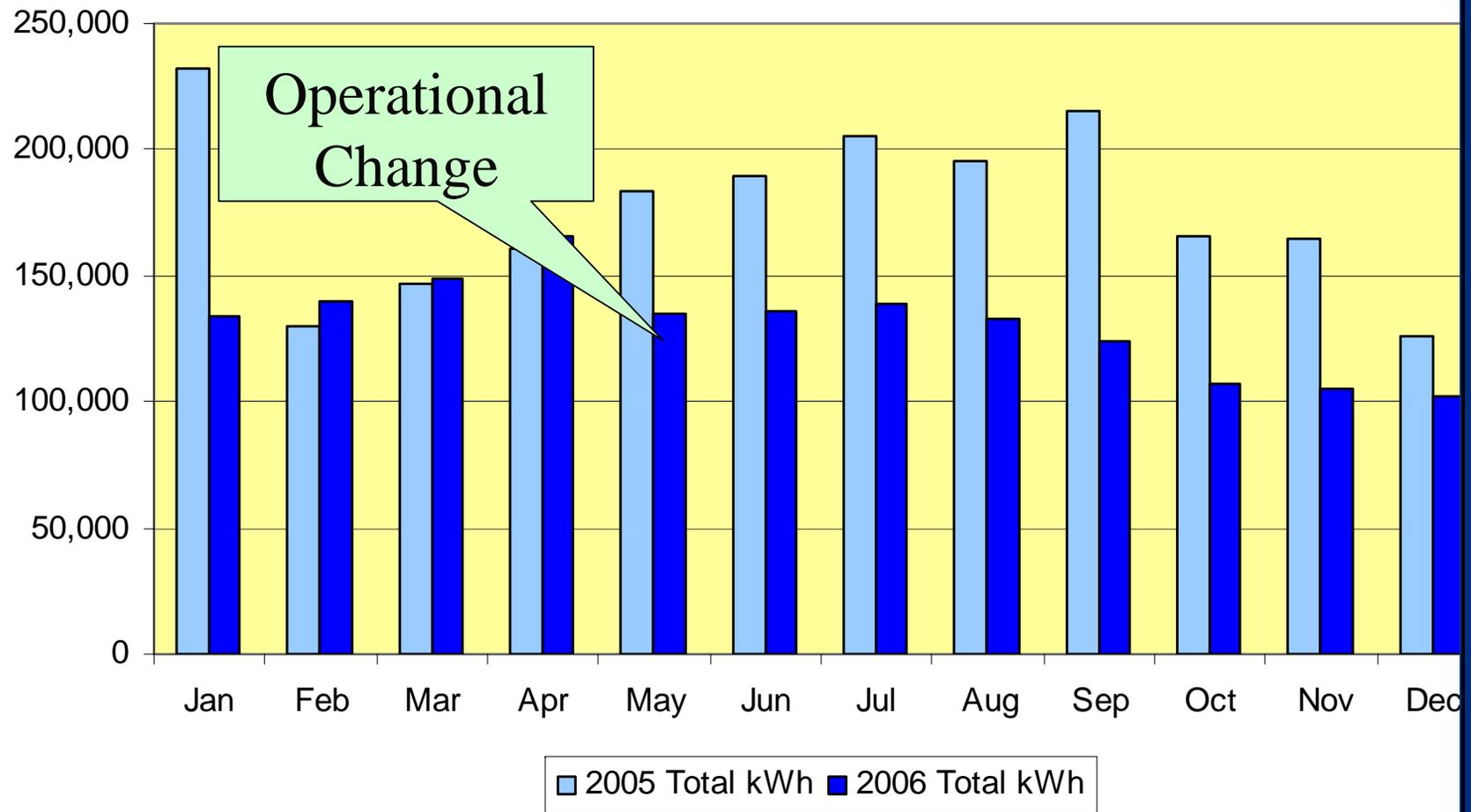


# 601 Townsend



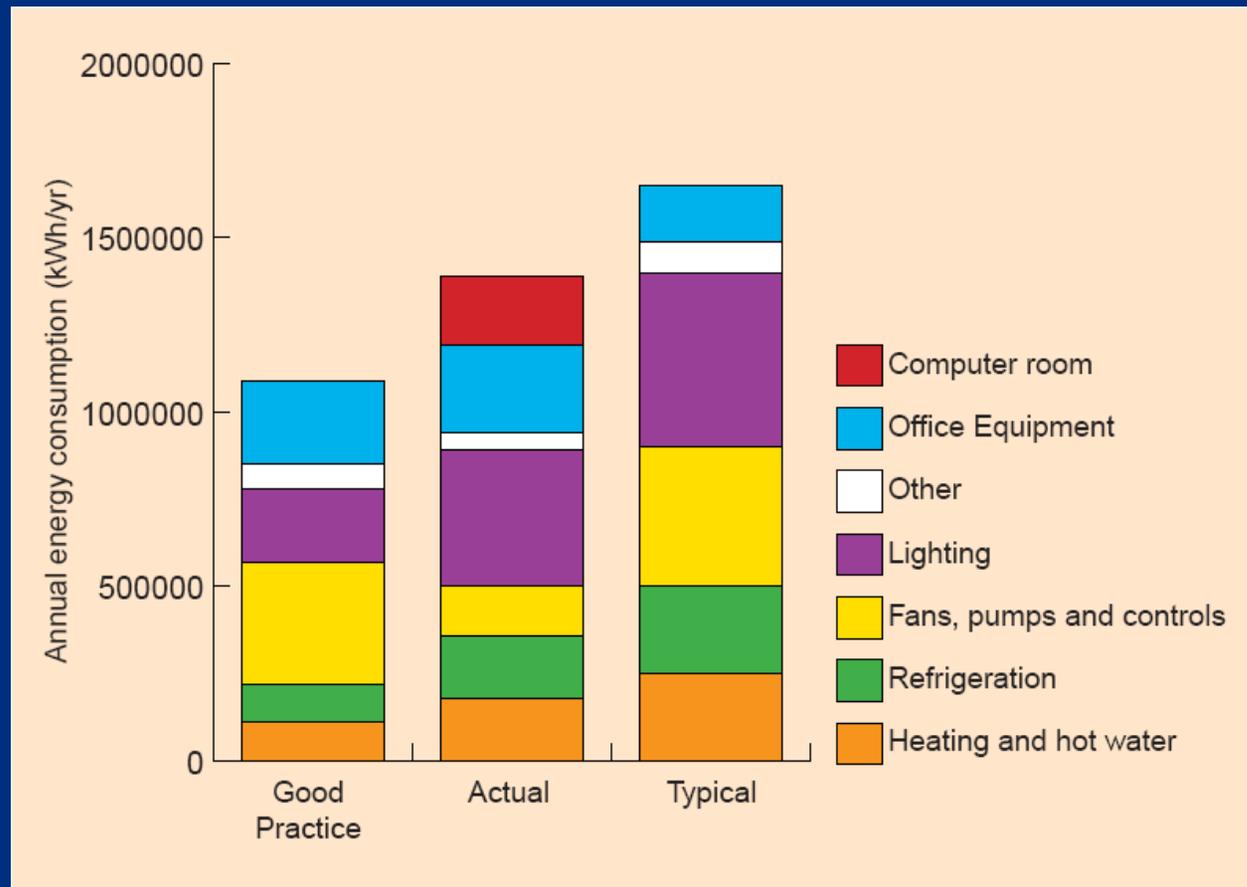


# Identifies Savings





# How do you compare?





# No metering? Starting Steps

- Start with process loads
  - Data centers
  - Institutional level kitchen
- Impacts Energy Star rating
- Water
  - Irrigation
  - Cooling Tower
- Potential sewer rebate from utility



# It's all connected

## Operational Effectiveness

<b>EAc2.2</b> Commissioning: Implementation <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 2 pts	<b>EAc2.3</b> Continuous Commissioning <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 2 pts	<b>EAc3.1</b> Building Automation System <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt	<b>EAc3.3</b> Energy: System-Level Metering - 80% <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt	<b>WEc1.2</b> Water: Subsystem Metering <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt
<b>EAc2.1</b> Commissioning: Investigation & Analysis <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 2 pts			<b>EAc3.2</b> Energy: System-Level Metering - 40% <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt	<b>WEc1.1</b> Water: Whole Building Water Meter <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N 1 pt
<b>Metered Data</b>				
<b>EAp1</b> Best Management Practices: Systems Documentation <input type="checkbox"/> Y <input type="checkbox"/> M <input type="checkbox"/> N Required				



# What is the LEED-EB?

- Flexible
  - Align credits to match your organization structure
  - Use synergies to develop your program
- Business Tool to Measure Your Success
  - *“You can’t manage what you can’t measure”*



## For More Information

- Would you like to know more about this session?
- Barry Giles - BuildingWise
- [barry@buildingwise.net](mailto:barry@buildingwise.net)
  
- Tia Heneghan – CTG Energetics
- [theneghan@ctgenergetics.com](mailto:theneghan@ctgenergetics.com)

Don't forget to fill out and drop off your session evaluations!

