


LEED v4 RATING SYSTEM REVIEW


LOCATION & TRANSPORTATION
SUSTAINABLE SITES
WATER EFFICIENCY
ENERGY & ATMOSPHERE
MATERIALS & RESOURCES
INDOOR ENVIRONMENTAL QUALITY

LEED FOR BUILDING OPERATIONS AND MAINTENANCE


 PRESENTED BY USGBC

CONTINUING EDUCATION

This course is registered for:




**1.5 hours with GBCI
(LEED Specific: O+M)**



1.5 hours with AIA/CES (LU/HSW)

If you are a webinar subscriber, USGBC will automatically report both your GBCI and AIA hours. If you are not a subscriber, you need to report GBCI hours as Professional Development/ Continuing Education Courses. USGBC will still report your AIA hours.

MODERATOR



Jenny Carney
LEED AP O+M
Principal, YR&G

WHAT

WHY

WHEN

WHO

HOW

WHAT

WHY

WHEN

WHO

HOW

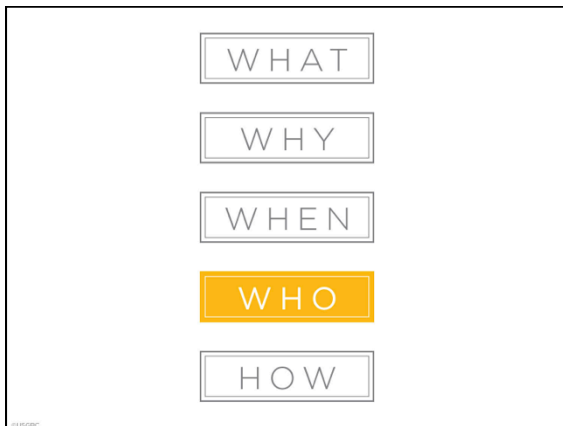
WHAT

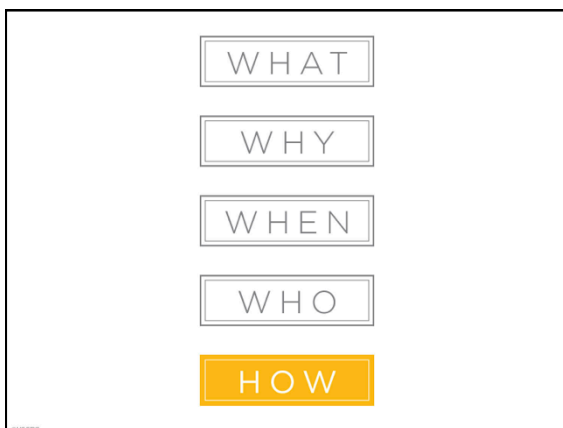
WHY

WHEN

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HOW







LEED v4 RATING SYSTEM REVIEW

LEED FOR BUILDING
OPERATIONS AND MAINTENANCE

LOCATION & TRANSPORTATION
SUSTAINABLE SITES
WATER EFFICIENCY
ENERGY & ATMOSPHERE
MATERIALS & RESOURCES
INDOOR ENVIRONMENTAL QUALITY

LEARNING OBJECTIVES

1
Identify the **intent, requirements**, and **strategies** for success with Energy and Atmosphere credits.

2
Recognize how a holistic approach of addressing the **reduction of energy use**, **ongoing system performance**, and **renewable energy** applications are reflected in the credits.

3
Recognize how to **implement energy metering** to support better energy management.

4
Identify **synergies** between multiple credits.

SPEAKERS

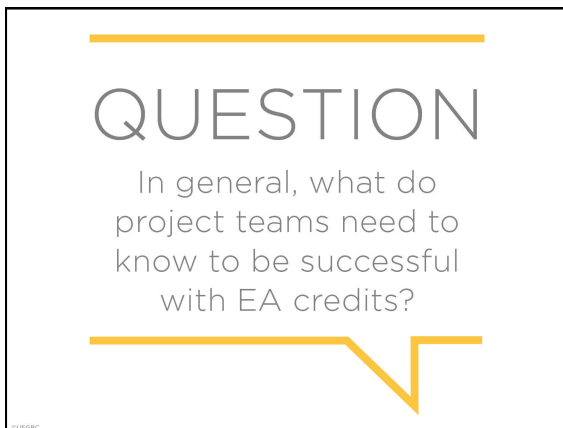


Jeremy Poling
PE, LEED AP BD+C and O+M
Senior Energy Engineer
Goby, LLC



Tia Henegan
LEED AP O+M
President
Zia for Buildings










| ENERGY & ATMOSPHERE | |
|--|---|
| PREREQUISITE | CREDIT |
| Energy efficient best management practices | Existing building commissioning—analysis Existing building commissioning—implementation Ongoing commissioning |
| Minimum energy performance | Optimize energy performance |
| Building-level energy metering | Advanced energy metering |
| Fundamental refrigerant management | Enhanced refrigerant management |



EA Prerequisite
Energy Efficiency
Best Management Practices
 Evaluate and establish operating strategies

ESTABLISHMENT

1. Conduct energy audit
2. Create current facilities requirements
3. Create operations and maintenance plan

WHAT WHY WHEN WHO HOW

CFR

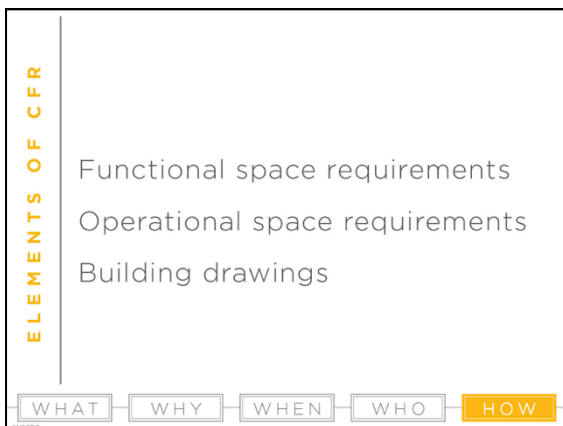
current facilities requirements

O&M plan

operations and maintenance plan







| FUNCTIONAL SPACE REQUIREMENTS | OPERATIONAL SPACE REQUIREMENTS | BUILDING DRAWINGS |
|-------------------------------------|--------------------------------------|----------------------|
| Building functions by space type | Temperature setpoints | As-built drawings |
| Occupancy schedules | Lighting levels | Tenant drawings |
| Cleaning schedules | Humidity setpoints | MEP schedules |

| O & M PLAN | Systems narrative |
|------------|---------------------------------|
| | Description of building systems |
| | Building operating plan |
| | Sequences of operation |
| | Preventive maintenance plan |

| SYSTEMS NARRATIVE INCLUDES | HVAC |
|----------------------------|---|
| | Electrical |
| | Plumbing |
| | Building automation system (BAS) |
| | Process equipment |
| | Heating and cooling systems for process equipment |
| | Supplemental heating and cooling systems |

| | |
|--------------------------------|--|
| BUILDING OPERATING PLAN | Building occupancy schedule |
| | Equipment run-time schedule |
| | Setpoints for HVAC and lighting |
| | Unoccupied setpoints |
| | Vacant-space setpoints |
| | Minimum outside air requirements |
| | Temperature requirements |
| | Humidity requirements |
| | CO ₂ level requirements |
| | Seasonal, day of week, and time of day differences |

| |
|--|
| <p>SEQUENCE OF OPERATIONS/CONTROL SEQUENCES</p> <p>Programmed system responses to external conditions</p> |
|--|

| |
|--|
| <p>PREVENTIVE MAINTENANCE PLAN</p> <p>Schedule of maintenance activities for all building systems and equipment</p> <p>Manufacturer recommendations</p> <p>Specific tasks to be completed</p> |
|--|



REFERENCED STANDARD

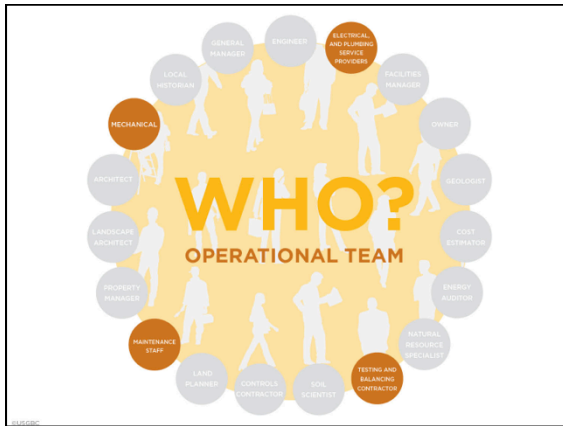
ASHRAE Procedures
for Commercial Building
Energy Audits

www.ashrae.org

Identify team to
conduct audit

WHAT WHY WHEN WHO HOW









Conduct preliminary
energy use analysis
to establish baseline
for building
performance

WHAT WHY WHEN WHO HOW

Collect 1-3 years
of utility bills

Develop energy
cost, demand, and
use indexes

WHAT WHY WHEN WHO HOW

ENERGY STAR
Portfolio Manager


CBECS

Labs21

WHAT WHY WHEN WHO HOW

Establish target
for energy and cost
reduction goals

WHAT WHY WHEN WHO HOW



DETERMINE
BREAKDOWN OF
ENERGY USE

WHAT WHY WHEN WHO HOW

Perform ASHRAE
Level 1
walk-through
assessment

WHAT WHY WHEN WHO HOW



GENERATE LIST OF POTENTIAL IMPROVEMENTS

WHAT WHY WHEN WHO **HOW**

ASHRAE LEVEL 1 REPORT


- Comparison with similar building types
- Current energy indexes
- Energy use breakdown
- Financial assessment, maintenance implications of improvement opportunities

WHAT WHY WHEN WHO **HOW**

Make necessary modifications to CFR and O&M plans


WHAT WHY WHEN WHO **HOW**

DATA CENTERS



ADAPTATION SPECIFIC CREDITS

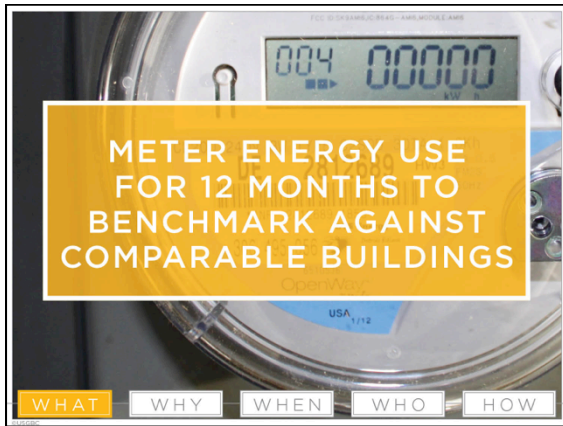
Use web-based DC Pro Profiling tool
If using DES, include downstream building systems

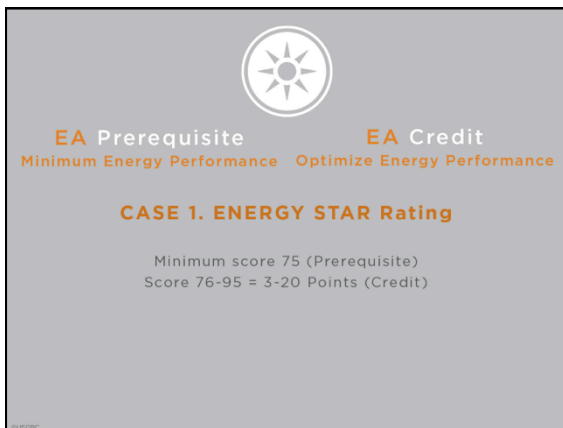


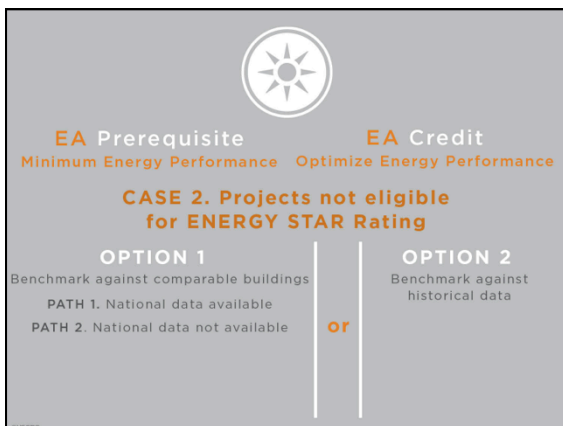
EA Prerequisite and Credit


| | |
|----------------------------|-----------------------------|
| PREREQUISITE | CREDIT |
| Minimum Energy Performance | Optimize Energy Performance |












EA Prerequisite **EA Credit**
 Minimum Energy Performance Optimize Energy Performance

CASE 2. Projects not eligible for ENERGY STAR Rating

| | | |
|--|----|---|
| <p>OPTION 1 Benchmark against comparable buildings</p> <p>PATH 1. National data available 25% better than median (Prerequisite) 26-45% better = 1-20 Points (Credit)</p> <p>PATH 2. National data not available 25% improvement over comparable buildings (Prerequisite) 27-45% improvement = 2-14 Points (Credit)</p> | or | <p>OPTION 2 Benchmark against historical data</p> |
|--|----|---|



EA Prerequisite **EA Credit**
 Minimum Energy Performance Optimize Energy Performance

CASE 2. Projects not eligible for ENERGY STAR Rating

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|--|----|---|
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|--|----|---|

PREREQUISITE

| | |
|--|--|
| <p>ESTABLISHMENT</p> <p>Calibrate energy meters</p> | <p>PERFORMANCE</p> <p>Meter energy use and achieve levels of efficiency</p> |
|--|--|

WHAT

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CREDIT

| ESTABLISHMENT | PERFORMANCE |
|---------------|---|
| None | Demonstrate increased energy efficiency |


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Confirm building's energy metering

WHAT
WHY
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WHO
HOW

DATA CENTERS



ADAPTATION SPECIFIC CREDITS

Meter and record data center
space separately

Set up ENERGY STAR
Portfolio Manager
profile

WHAT
WHY
WHEN
WHO
HOW

PORTFOLIO MANAGER CONSIDERATIONS

- 1. Create account and profile for each building**
2. Determine gross area of each space type
3. Account for all energy sources
4. Exclude up to 10% of floor area if under separate management and control
5. Enter number of computers and servers
6. Enter operating hours, if required
7. Normalize data according to climate

WHAT
WHY
WHEN
WHO
HOW

| | |
|----------------------------------|--|
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| | |
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| | <div>WHAT</div> <div>WHY</div> <div>WHEN</div> <div>WHO</div> <div>HOW</div> |

Share account access
with USGBC

Determine start of 12 month
performance period

Conduct preliminary
benchmarking before
performance period

WHAT WHY WHEN WHO HOW

IMPROVE ENERGY PERFORMANCE


Implement major efficiency upgrades

Adjust and optimize existing
equipment

Utilize ASHRAE Level 1 Energy
Audit results

Consider advanced energy
audit or commissioning

WHAT WHY WHEN WHO HOW



EA Prerequisite and Credit

| | | |
|---|-----------|---|
| <p>CASE 1 ENERGY STAR Rating</p> | <p>or</p> | <p>CASE 2 Projects not eligible for ENERGY STAR Rating</p> |
|---|-----------|---|

ENERGY STAR ELIGIBLE

BANK BRANCH
WHOLESALE CLUB/SUPERCENTER
BARRACKS OFFICE
FINANCIAL OFFICE
DATA CENTER
K-12 SCHOOL
SUPERMARKET/GROCERY STORE
MEDICAL OFFICE
HOSPITAL (GENERAL MEDICAL & SURGICAL)
SENIOR CARE COMMUNITY
DISTRIBUTION CENTER
RESIDENCE HALL/ DORMITORY
NON-REFRIGERATED WAREHOUSE
WASTEWATER TREATMENT PLANT
REFRIGERATED WAREHOUSE

WORSHIP FACILITY
HOTEL
COURTHOUSE
RETAIL STORE


INELIGIBLE FOR ENERGY STAR

Space type not listed

“Other” space area >10%

Multifamily space >10%

Less than 12 consecutive months of data




EA Prerequisite and Credit

CASE 2. ENERGY STAR Rating
Projects not eligible for ENERGY STAR Rating

OPTION 1
Benchmark against typical building
PATH 1. National data available
PATH 2. National data not available
Demonstrate 25% better than peer building

WHAT WHY WHEN WHO HOW




EA Prerequisite and Credit

CASE 2. ENERGY STAR Rating
Projects not eligible for ENERGY STAR Rating

OPTION 2
Benchmark against historical data
25% improvement from baseline (Prerequisite)
Further improvements (Credit)

WHAT WHY WHEN WHO HOW



EA Prerequisite and Credit

CASE 2. ENERGY STAR Rating
Projects not eligible for ENERGY STAR Rating

OPTION 3
Benchmark against both similar buildings and historical data
Additional points under credit

WHAT WHY WHEN WHO HOW

Normalize energy use intensity (EUI) according to climate zone

Convert site energy use to source energy use

WHAT WHY WHEN WHO HOW

Enter performance
period dates

Collect and upload
metered energy data

WHAT WHY WHEN WHO HOW

Benchmark data
according to case, option,
and path selected

WHAT WHY WHEN WHO HOW

Confirm prerequisite
performance requirements
are met


Determine credit
points based on
performance results

WHAT WHY WHEN WHO HOW

Update
benchmarking
data routinely


WHAT WHY WHEN WHO **HOW**

DATA CENTERS




ADAPTATION SPECIFIC CREDITS


Segregate data center spaces
within larger building



EA Prerequisite
Building-level Energy Metering
Capture data on total building-level
energy consumption



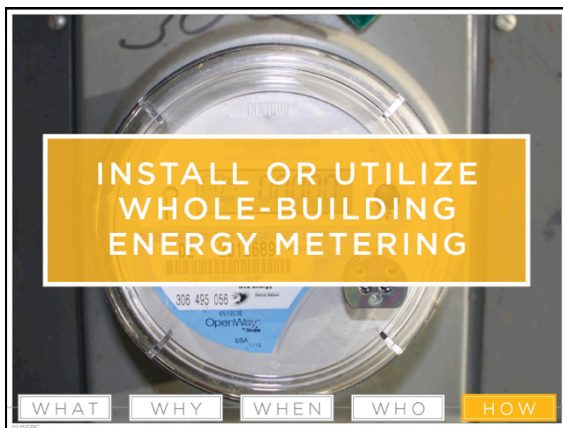
EA Credit
 Advanced Energy Metering
 (1 Point)
 Track system-level energy use

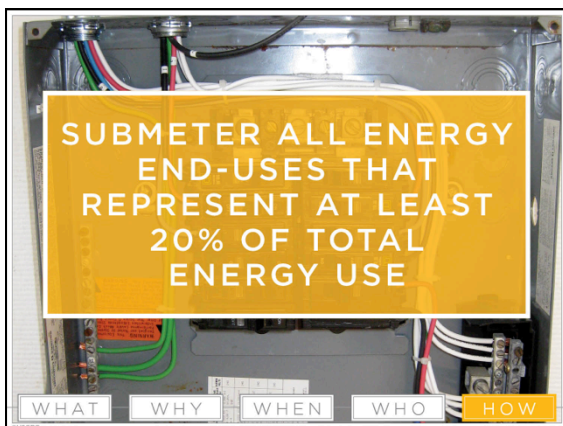


| ESTABLISHMENT | PERFORMANCE |
|------------------------------|---|
| Install or use energy meters | Compile data and share with USGBC |
| | Program systems to alarm when readings deviate more than 5% from expected |

WHAT WHY WHEN WHO HOW







Use ASHRAE Level 1
(and Level 2 if completed)
walk-through analysis
results if end-use data
not available

WHAT WHY WHEN WHO **HOW**

SYSTEM METERING EXAMPLES

Chilled water system -
chillers, chilled water pumps

Condenser water system -
cooling tower, condenser
water pumps

Air-handling system -
supply fan, return fan,
damper motors

**COMMERCIAL BUILDING
ENERGY CONSUMPTION
SURVEY (2003)**

End-Use Consumption
Tables for Non-Mall Buildings

End-Use Consumption
Tables for All Buildings

Strike a balance
when determining
what information
to share with
building operators

WHAT WHY WHEN WHO HOW

EA CREDIT ADVANCED ENERGY METERING

Use building automation system
or software for data collection

System must generate alarm
if more than 5% demand or
consumption over set interval


WHAT WHY WHEN WHO HOW

EA CREDIT ADVANCED ENERGY METERING

Record and compare
peak demand and total
consumption each month


WHAT WHY WHEN WHO HOW

DATA CENTERS



ADAPTATION SPECIFIC CREDITS

IT energy metered separately



EA Prerequisite and Credit

| | |
|--|---|
| PREREQUISITE Fundamental Refrigerant Management | CREDIT Enhanced Refrigerant Management |
|--|---|

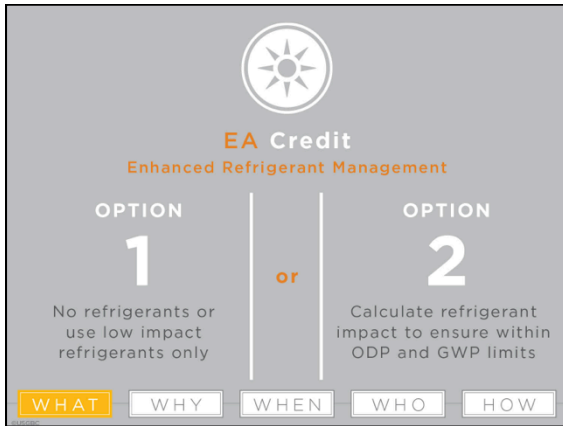
EA PREREQUISITE Fundamental Refrigerant Management

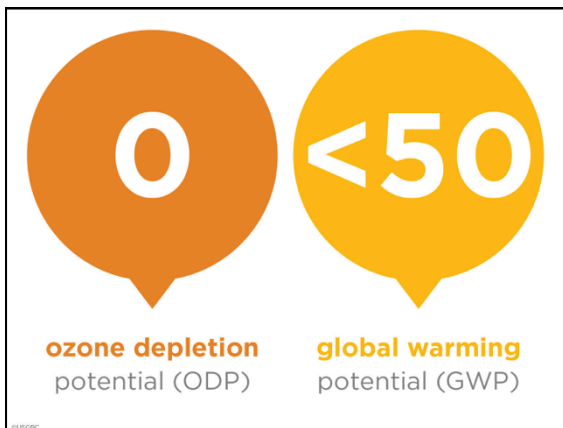
Do not use chlorofluorocarbon (CFC)-based refrigerants

or

Complete CFC phase-out or conversion

WHAT
WHY
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WHO
HOW







EA PREREQUISITE FUNDAMENTAL REFRIGERANT MANAGEMENT

Identify all HVAC and
equipment that uses
refrigerants


WHAT
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HOW



REPLACE OR RETROFIT EXISTING EQUIPMENT THAT USES CFC REFRIGERANTS

(exempt: small equipment
with < 0.5 lbs (225g) refrigerant)

WHAT
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HOW

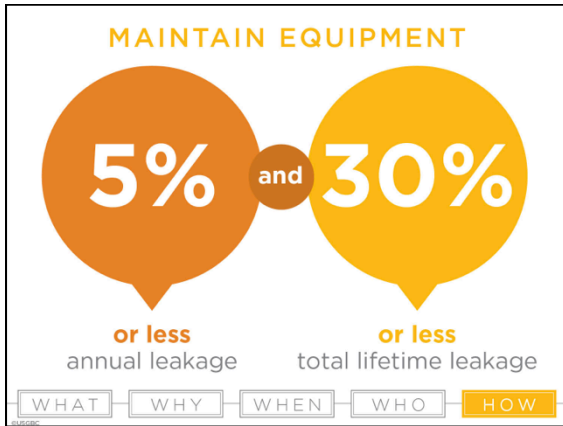


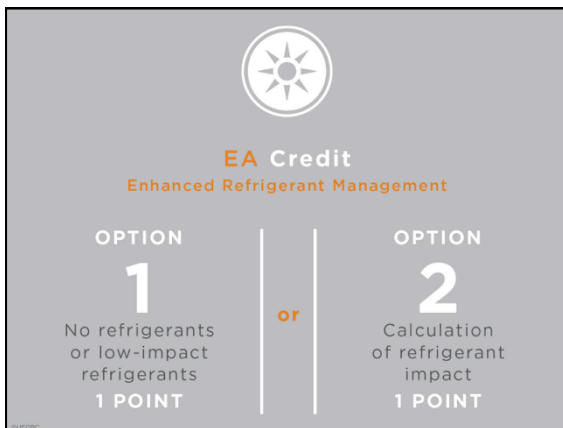
PAYBACK ANALYSIS

simple
payback

$$\frac{\text{cost of replacement or conversion}}{\text{resulting annual energy cost difference} + \text{resulting annual maintenance and refrigerant cost difference}}$$

> 10





| REFRIGERANT ODP/GWP (EXAMPLES) | | | |
|-----------------------------------|------|--------|-------------------------------------|
| REFRIGERANT | ODPr | GWPr | COMMON BUILDING APPLICATIONS |
| CHLOROFLUOROCARBONS | | | |
| CFC-11 | 1.0 | 4,680 | Centrifugal chillers |
| CFC-12 | 1.0 | 10,720 | Refrigerators, chillers |
| HYDROCHLOROFLUOROCARBONS | | | |
| HCFC-123 | 0.02 | 76 | CFC-11 replacement |
| HYDROFLUOROCARBONS | | | |
| HFC-23 | -0 | 12,240 | Ultra-low-temperature refrigeration |
| NATURAL REFRIGERANTS | | | |
| Carbon dioxide (CO ₂) | 0 | 1.0 | |
| Ammonia (NH ₃) | 0 | 0 | |

refrigerant charge (Rc)

(noun)

ratio of the total refrigerant used to the cooling capacity measured in lbs/ton (kg/kW)

RETAIL




ADAPTATION SPECIFIC CREDITS


Additional requirements for commercial refrigeration

Cx

Commissioning




EA Credit
Existing Building Commissioning - Analysis
Evaluate performance relative to CFR and O&M plan
(2 Points)

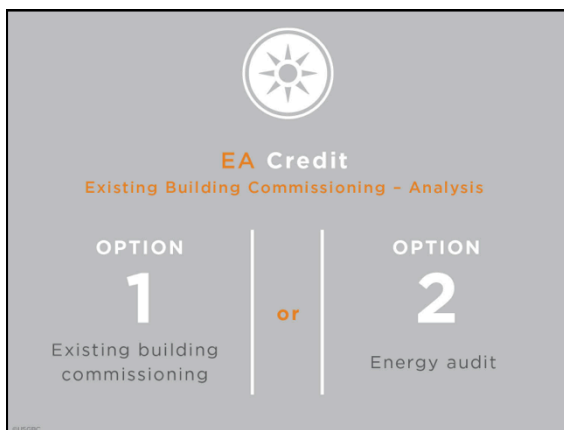


EA Credit
Existing Building Commissioning - Analysis

| OPTION | | OPTION |
|---------------------------------|----|--------------|
| 1 | or | 2 |
| Existing building commissioning | | Energy audit |











Review the CFR
and O&M plan

WHAT — WHY — WHEN — WHO — **HOW**


[illegible]

Estimate or
measure resources
used by each major
energy end use

WHAT — WHY — WHEN — WHO — **HOW** —

Develop existing building Cx or energy audit plan

WHAT WHY WHEN WHO HOW




EA Credit
Existing Building Commissioning - Analysis

| | | |
|---|----|------------------------------------|
| OPTION 1 Existing building commissioning; Develop Cx schedule | or | OPTION 2 Energy audit |
|---|----|------------------------------------|

Develop testing procedures

WHAT WHY WHEN WHO HOW

DATA CENTERS



ADAPTATION SPECIFIC CREDITS

Use web-based DC Pro tools

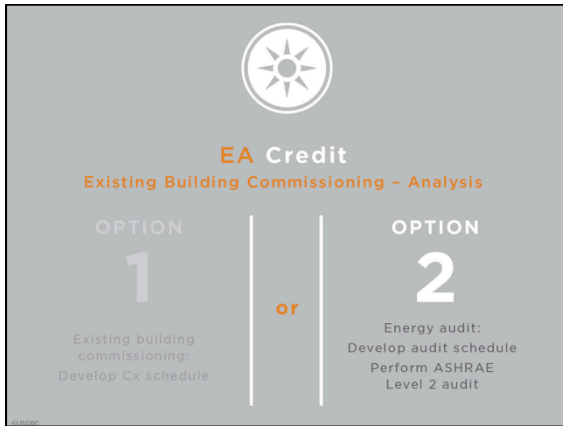
Determine criteria
for evaluating and
prioritizing issues
and opportunities

WHAT WHY WHEN WHO **HOW**

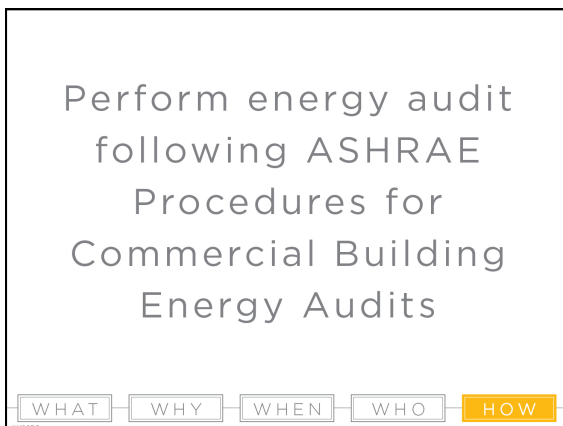


**EXECUTE Cx PLAN
DURING PERFORMANCE
PERIOD AND
DOCUMENT RESULTS**

WHAT WHY WHEN WHO **HOW**







ECM

energy conservation
measure

Document any
changes and
update documents

WHAT

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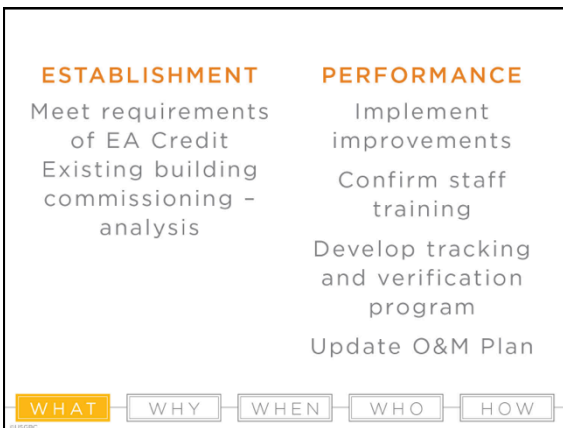


EA Credit

Existing Building Commissioning - Implementation

Implement no- or low-cost improvements and
develop five-year plan for upgrades
(2 points)







Create plan to implement
no- and low-cost measures

Prepare implementation
schedule

Determine responsibility
for implementation

WHAT WHY WHEN WHO HOW

Implement the
no- and low-cost
measures during
the performance
period

WHAT WHY WHEN WHO HOW

Create five-year
plan for equipment
replacement and
major upgrades

WHAT WHY WHEN WHO HOW

Provide training
for building
operations staff

WHAT

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TRACKING AND VERIFICATION

Verification of effectiveness

Observed costs

Operational benefits

Environmental benefits

Human health and comfort benefits

Update CFR
and O&M plan

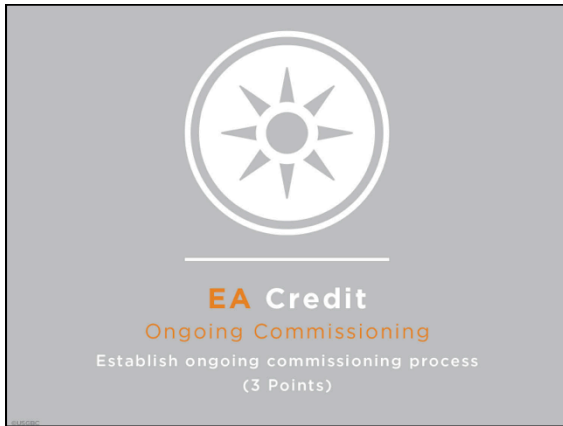
WHAT

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HOW







| ESTABLISHMENT | PERFORMANCE |
|--|---------------------------|
| Meet requirements for other Cx credits | Update systems manual |
| Establish Cx process | Provide quarterly reports |
| Develop Cx plan | Update O&M plan and CFR |

WHAT WHY WHEN WHO HOW

Confirm compliance with Cx analysis and Implementation credits

WHAT WHY WHEN WHO HOW

Modify existing building Cx plan

or

Review overlap between Cx credit and audit plan

WHAT WHY WHEN WHO HOW

Assign roles and responsibilities

WHAT WHY WHEN WHO HOW

Review and update functional testing process

or

Create testing procedures

WHAT WHY WHEN WHO HOW

Determine schedule for ongoing Cx

WHAT WHY WHEN WHO HOW

Review existing
building automation
systems or submeters
to determine systems
to monitor and trend

WHAT
WHY
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HOW

ACTION PLAN

Develop process to identify
operational errors and
deficiencies

Establish plan for correcting

Create process to evaluate

Add plan to tracking and
verification program

WHAT
WHY
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WHO
HOW

NON-OPTIMAL OPERATION

Conflicts between systems,
such as simultaneous heating
and cooling

Out-of-sequence operation of
systems components

Unexpected energy and water
usage profiles

Recurring system alarms

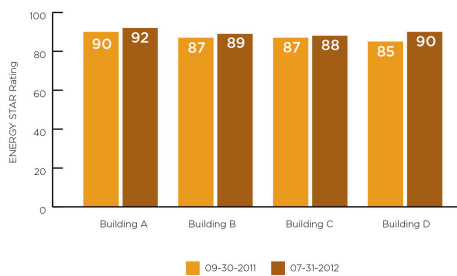
Create ongoing commissioning report template

WHAT WHY WHEN WHO HOW

ENERGY STAR IMPROVEMENTS DUE TO ONGOING Cx PROGRAM

| BUILDING | ENERGY STAR RATING | |
|----------|--------------------|-----------|
| | 9/30/2011 | 7/31/2012 |
| A | 90 | 92 |
| B | 87 | 89 |
| C | 87 | 88 |
| D | 85 | 90 |

ENERGY STAR IMPROVEMENTS DUE TO ONGOING Cx PROGRAM




Cx Commissioning

QUESTION and ANSWER

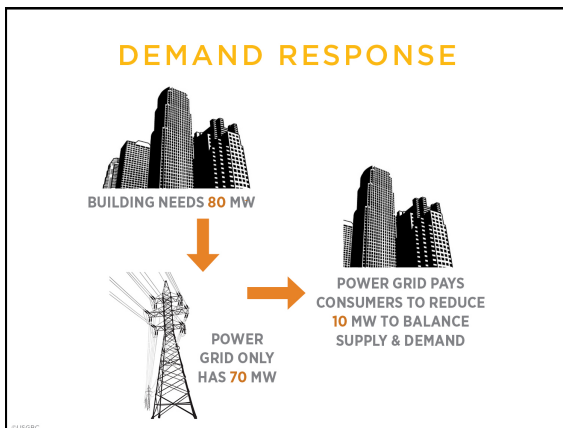
QUESTION

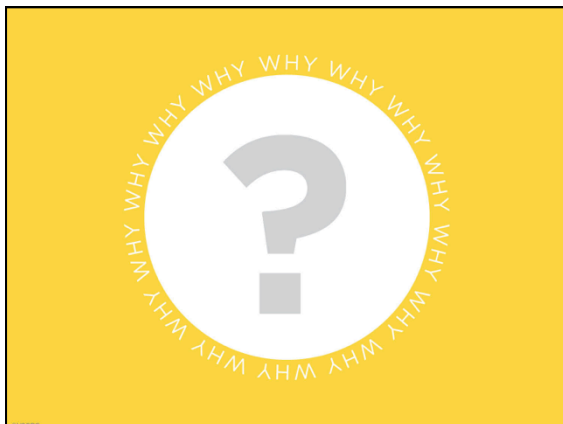
What is the importance
of commissioning in
LEED for Building
Operations & Maintenance?



EA Credit
Demand Response

| CASE 1 | or | CASE 2 | or | CASE 3 |
|-----------------------------------|----|---------------------------------------|----|-------------------------|
| Demand response program available | | Demand response program not available | | Permanent load shifting |
| 3 POINTS | | 1 POINT | | 2 POINTS |







ESTABLISHMENT
Demand Response

CASE 1. Demand response program available
 Participate in demand response programs

CASE 2. Demand response program not available
 Provide infrastructure for future participation

CASE 3. Permanent load shifting
 Shift electrical load from peak to off peak

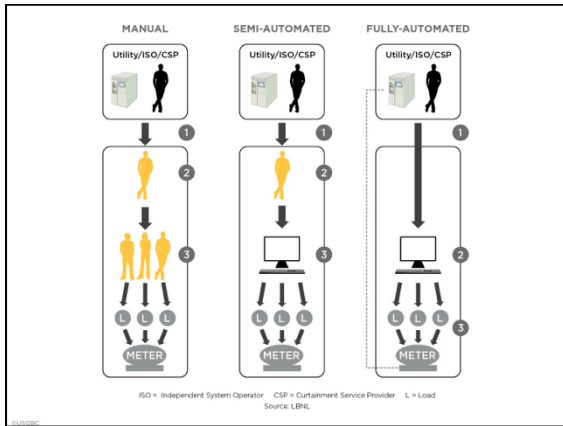
WHAT WHY WHEN WHO HOW

Contract between owner
 and service provider

or

Express interest in future
 program to local utility
 or service provider

WHAT WHY WHEN WHO HOW







System must have
capacity for full
automation
(but program can be
semi-automated)

WHAT WHY WHEN WHO HOW



minimum
contract length

WHAT WHY WHEN WHO HOW


CASE 2.
Demand response not available

1. Confirm project capable of participating and system requirements met
2. Prepare plan for peak demand reduction
3. Conduct test of plan
4. Contact utility or service provider


WHAT WHY WHEN WHO HOW

CASE 3.
Permanent load shifting
 Maintain or install systems
 capable of shifting load to
 off-peak on continuous basis

WHAT WHY WHEN WHO **HOW**



EA Credit
Renewable energy and carbon offsets
 Meet some of energy use with renewable energy
 or purchase green power, carbon offsets or RECs
 (1-5 Points)



| WHAT | WHY | WHEN | WHO | HOW |
|--|-----|------|-----|-----|
| <p>ESTABLISHMENT</p> <p>Demonstrate portion of energy use met with renewable systems and/or contract in place to purchase resources</p> | | | | |
| | | | | |



| WHAT | WHY | WHEN | WHO | HOW |
|------|-----|------|-----|-----|
| | | | | |

SCOPE 1

Direct greenhouse gas emissions from sources owned/controlled by the entity

SCOPE 2

Indirect GHG emissions associated with generation of purchased electricity, steam, hot water, or chilled water

WHAT
WHY
WHEN
WHO
HOW

| APPLICATION OF OPTIONS | |
|---------------------------------|---------------------------------------|
| SOURCE | OPTIONS |
| non-electricity used on site | carbon offsets |
| electricity or purchased energy | REC's, green power, or carbon offsets |

WHAT
WHY
WHEN
WHO
HOW

SCOPE 1

Direct greenhouse gas emissions from sources owned/controlled by the entity

SCOPE 2

Indirect GHG emissions associated with generation of purchased electricity, steam, hot water, or chilled water

WHAT
WHY
WHEN
WHO
HOW

Conduct cost-benefit analysis

WHAT
WHY
WHEN
WHO
HOW

ELIGIBLE RENEWABLE ENERGY TYPES

Photovoltaic

Solar thermal

Wind

Low-impact hydroelectricity


Wave and tidal energy

Geothermal energy (some cases)

Biofuel (some cases)

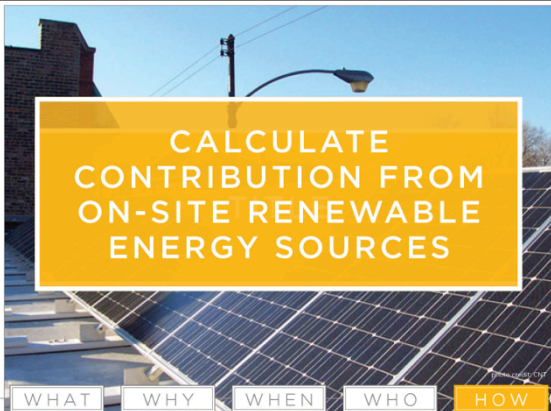
**SET GOAL FOR
AMOUNT OF ENERGY
OR EMISSIONS TO
ADDRESS THROUGH
GENERATION AND
PURCHASING**

WHAT
WHY
WHEN
WHO
HOW




CALCULATE POINTS

points = $\frac{\% \text{ renewable energy generated}}{1.5\%} + \frac{\% \text{ energy purchased/offset (not to exceed 100\%)}}{25\%}$



CALCULATE CONTRIBUTION FROM ON-SITE RENEWABLE ENERGY SOURCES

WHAT
WHY
WHEN
WHO
HOW



7.5%

of energy consumed
during performance period = renewable

Calculate total percentage of green power, RECs, and/or offsets required to meet goals

WHAT WHY WHEN WHO HOW



PURCHASE FROM A GREEN-e PROVIDER

Green-e®

WHAT WHY WHEN WHO HOW



GLOBAL LEED

Green power, RECs and carbon offsets must be Green-e certified


or

Demonstrate equivalency



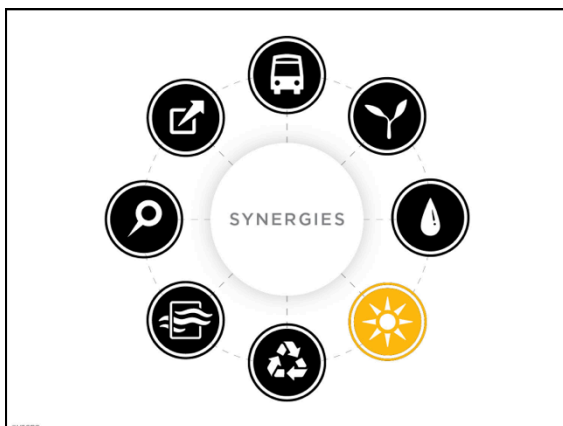
2

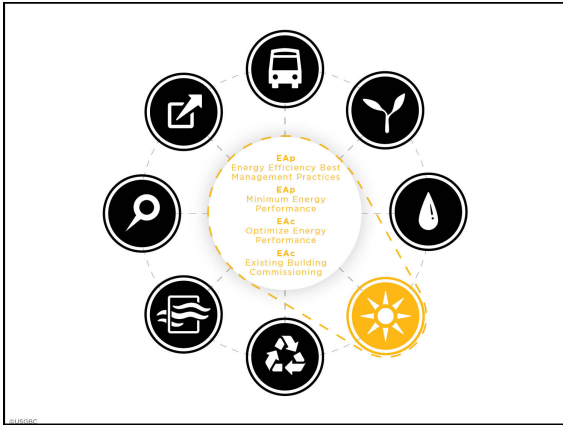
years minimum contract length
with commitment to review



CALCULATE POINTS

points = $\frac{\% \text{ renewable energy generated}}{1.5\%} + \frac{\% \text{ energy purchased/offset (not to exceed 100\%)}}{25\%}$









RECERTIFICATION

Track continuously

RECERTIFICATION

Include details in
your tracking system

RECERTIFICATION

Use ongoing commissioning to keep
building performance on track

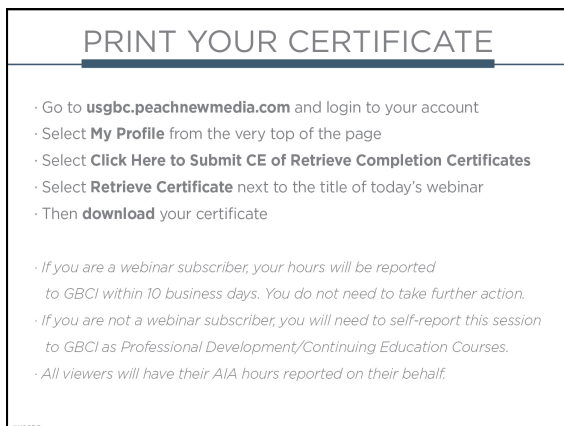


QUESTION
and
ANSWER



QUESTION

How do the establishment/
performance aspects of
O+M help project teams build
on a D+C certification?



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