LEED Certification

Energy & Atmosphere

Background

- 37% of energy produced in US
- 68% of electricity produced in US

Stats from US Dept. of Energy

Green Building Solutions

- Reduce energy required
  - Increase energy performance
- Producing energy from benign forms
Prerequisites

- Fundamental Commissioning of the Building Energy Systems
- Minimum Energy Performance
- Fundamental Refrigerant Management

Fundamental Commissioning of the Building Energy Systems
Prerequisite 1

- Building’s energy related systems are installed, calibrated and perform according to the owner’s
  - project requirements
  - basis of design
  - construction documents
Systems

- HVAC&R
- Lighting & daylight controls
- Domestic hot water
- Renewable energy
- Building envelope

Requirements

- Designate an individual as the Commissioning Authority (CxA) to lead, review and oversee the completion of the commissioning process activities
  - CxA have experience from at least 2 other projects
  - Independent of design & construction management
  - Report results, findings and recommendations directly to the owner
  - If under 50,000 SF, may have qualified persons from design & construction teams assist

Requirements

- Owner has to document the Owner’s Project Requirements (OPR)
- Design team develops Basis of Design (BOD)
- CxA reviews both documents
Owner Project Requirement - OPR

- Owner & user requirements
- Environmental & sustainability goals
- Energy efficiency goals
- Indoor environmental quality requirements
- Equipment & system expectations
- Building occupant & O&M personnel requirements

Basis of Design

- Must be documented for the systems to be commissioned prior to approval of contractor submittal
- Primary design assumptions
- Standards
- Narrative description

Other Requirements

- Develop & Incorporate commissioning requirements into construction documents
- Develop & implement a commissioning plan
- Verify the installation & performance of the systems to be commissioned
- Complete a summary commissioning report
Commissioning Plan

- Commissioning Program Overview
  - Goals & Objectives
  - General project information
  - Systems to be commissioned
- Commissioning Team
  - Team members, roles & responsibilities
  - Communication protocol, coordination, meetings & management

- Description of Commissioning Process Activities
  - Documenting the OPR
  - Preparing a BOD
  - Developing systems functional test procedures
  - Verifying systems performances
  - Reporting deficiencies & the resolution process
  - Accepting the building system

Verification of commissioned system

- Installation inspection
- Systems performance testing
- Evaluation of results compared to OPR/BOD

Summary Commissioning Report

- Executive summary of process & results of the commissioning program
- History of system deficiencies identified & how they were resolved
- System test results & performance
Benefits

• Lower operating costs
• Reduced contractor callbacks
• Better building documentation
• Improved occupants productivity
• Verification that the systems perform in accordance with the owner's project requirements

Minimum Energy Performance Prerequisite 2

• Establish the minimum level of energy efficiency for the proposed building and systems
• Design the building envelope, HVAC, lighting and other systems to maximize energy performance.
• Use ASHRAE/IESNA Standard 90.1-2004

Includes

• Building Envelope
• HVAC
• Water heating
• Power
• Lighting
• Other equipment
Fundamental Refrigerant Management
Prerequisite 3

- Reduce ozone depletion
- Zero use of CFC-based refrigerants in HVAC&R system

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>ODP</th>
<th>GWP</th>
<th>Common Building Applications</th>
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</thead>
<tbody>
<tr>
<td>Chlorofluorocarbons</td>
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<td></td>
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</tr>
<tr>
<td>CFC-11</td>
<td>1.0</td>
<td>4,060</td>
<td>Centrifugal chillers</td>
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<tr>
<td>CFC-12</td>
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<td>Refrigeration, chillers</td>
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<td>Centrifugal chillers, humidifiers</td>
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<td>Hydrofluorocarbons</td>
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<tr>
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<td>CFC-11 replacement</td>
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<td>Hydrocarbons</td>
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<td>Ultra-low-temperature refrigeration</td>
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<tr>
<td>HC-134</td>
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<td>CFC-12 or HCFC-22 replacement</td>
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<td>1,000</td>
<td>Insulation agent, centrifugal chillers</td>
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<td>HC-404A</td>
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<td>HCFC-407C</td>
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<td>3,700</td>
<td>HCFC-22 replacement</td>
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<td>HCFC-507A</td>
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<td>Low-temperature refrigeration</td>
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<td>Natural Refrigerants</td>
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<td>Carbon Dioxide (CO2)</td>
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<tr>
<td>Ammonia (NH3)</td>
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<tr>
<td>Propane</td>
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Optimize Energy Performance
EA credit 1

- Achieve increasing levels of energy performance above the baseline in the prerequisite standard
- 3 options & must achieve at least 2 pts
- Whole building energy simulation
- Prescriptive compliance path
- Prescriptive compliance path: Advanced Buildings™ Core Performance™ Guide
Whole Building Energy Simulation

- ASHRAE/IESNA standard 90.1-2004
- % based on minimum energy cost savings
- Compared to a baseline building

<table>
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<tr>
<th>New Buildings</th>
<th>Existing Building Baseline</th>
<th>Points</th>
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<tr>
<td>10.5%</td>
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<tr>
<td>14%</td>
<td>37%</td>
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<tr>
<td>17.5%</td>
<td>40%</td>
<td>3</td>
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<tr>
<td>21%</td>
<td>44%</td>
<td>4</td>
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<tr>
<td>24.5%</td>
<td>47.5%</td>
<td>5</td>
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<tr>
<td>28%</td>
<td>51%</td>
<td>6</td>
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<tr>
<td>31.5%</td>
<td>55.5%</td>
<td>7</td>
</tr>
<tr>
<td>35%</td>
<td>60%</td>
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<tr>
<td>38.5%</td>
<td>65%</td>
<td>9</td>
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<tr>
<td>42%</td>
<td>70%</td>
<td>10</td>
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</table>

Prescriptive compliance path

- 4 points possible
- Comply with ASHRAE Advanced Energy Design Guide for Small Office Buildings
- Buildings must be under 20,000 SF
- Building must be office occupancy
- Must comply with all applicable criteria from AEDG for the climate zone where building will be built

PCP: Advanced Buildings™

- Developed by New Buildings Institute
- 2 – 5 possible points
- Buildings under 100,000 SF
- Not applicable for health care, warehouse or laboratory projects
- Must comply with Design Process Strategies & Core Performance Requirements
PCP: Advanced Buildings™

- Minimum pts option (2-3 pts)
- 3 pts: schools, office, public assembly & retail projects under 100,000 SF that comply with Core Performance sections
- 2 pts: all projects under 100,000 SF that comply with basic requirements in Core Performance sections

Additional Points

- Up to 2 additional pts available if performance strategies are implemented under enhanced performances
- 1 pt for every 3 strategies implemented

On-Site Renewable Energy
EA Credit 2

- Use on-site renewable energy in order to reduce environmental & economic impacts associated with fossil fuel energy use.
- Based on cost

<table>
<thead>
<tr>
<th>% Renewable Energy</th>
<th>Points</th>
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</thead>
<tbody>
<tr>
<td>2.5%</td>
<td>1</td>
</tr>
<tr>
<td>7.5%</td>
<td>2</td>
</tr>
<tr>
<td>12.5%</td>
<td>3</td>
</tr>
</tbody>
</table>
Non-polluting & Renewable Energy Possibilities

- Solar
- Wind
- Geothermal
- Low-impact hydro
- Biomass strategies
- Bio-gas strategies
Enhanced Commissioning
EA Credit 3
• During the commissioning process, execute additional activities after systems performance verification is completed.
• More commissioning beyond EA Prereq 1

<table>
<thead>
<tr>
<th>Task</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designate Commissioning Authority (CA)</td>
<td>If you are only meeting EA Prereq 1… Owner or Project Team</td>
</tr>
<tr>
<td>Document Owner’s Project Requirements (OPF)</td>
<td>Owner or Project Team</td>
</tr>
<tr>
<td>Develop Basis of Design</td>
<td>Design Team</td>
</tr>
<tr>
<td>Integrate commissioning requirements into the construction documents</td>
<td>Project Team or CEA</td>
</tr>
<tr>
<td>Conduct commissioning design review prior to in-residence documents</td>
<td>N/A, CEA</td>
</tr>
<tr>
<td>Develop and implement a commissioning plan</td>
<td>Project Team or CEA</td>
</tr>
<tr>
<td>Release contract/submittals applicable to systems being commissioned</td>
<td>N/A, CEA</td>
</tr>
<tr>
<td>Verify the installation and performance of commissioned systems</td>
<td>CEA, CEA</td>
</tr>
<tr>
<td>Develop systems manual for the commissioned systems</td>
<td>N/A, Project Team and CEA</td>
</tr>
<tr>
<td>Verify that the requirements for training are completed</td>
<td>N/A, Project Team and CEA</td>
</tr>
<tr>
<td>Compile a summary commissioning report</td>
<td>CEA, CEA</td>
</tr>
<tr>
<td>Review building operation within 30 months after substantial completion</td>
<td>N/A, CEA</td>
</tr>
</tbody>
</table>

Enhanced Refrigerant Management
EA Credit 4
• Reduce ozone depletion & support early compliance with the Montreal Protocol while minimizing direct contributions to global warming
• 2 options
  – Do not use refrigerants
  – Minimize or eliminate the emission compounds that contribute to ozone depletion
Measurement & Verification
EA credit 5

• Provide for the ongoing accountability of building energy consumption over time.
• Develop and implement a measurement & verification (M&V) plan that will cover no less than 1 year of post construction occupancy

Green Power - EA credit 6

• Encourage the development and use of grid source, renewable energy technologies on a net zero pollution basis
• Provide at least 35% of the building’s electricity from renewable sources by engaging in at least a 2 yr renewable energy contract
• Use EA credit 1 or CBECs to estimate electrical usage
Purchasing Green Power

• State w/ open electrical market, select Green-e certified power provider
• State w/ closed electrical market, may have a Green-e accredited utility program
• If Green-e certified power is not available, purchase of Green-e accredited Tradable Renewable Certificates (RECs) is possible