LEED V4 TRAINING PROGRAM

ENERGY AND ATMOSPHERE

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ENERGY AND ATMOSPHERE

TITLE			D/C	SCORE
EA	PREREQUISITE	1 BASIC COMMISSIONING AND VERIFICATION	C	PREREQUISITE
EA	PREREQUISITE	2 MINIMUM ENERGY PERFORMANCE	D	PREREQUISITE
EA	PREREQUISITE	3 BUILDING LEVEL ENERGY MEASUREMENT	D	PREREQUISITE
EA	PREREQUISITE	4 BASIC REFRIGERANT MANAGEMENT	D	PREREQUISITE
EA	CREDIT	1 ADVANCED COMMISSIONING	C	6
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EA	CREDIT	3 ADVANCED ENERGY MEASUREMENT	D	1
EA	CREDIT	4 DEMAND-RESPONSIVE ENERGY SYSTEMS	C	2
EA	CREDIT	5 RENEWABLE ENERGY (PRODUCTION)	D	3
EA	CREDIT	6 ADVANCED REFRIGERANT MANAGEMENT	D	1
EA	CREDIT	7 GREEN ENERGY AND CARBON CERTIFICATE	C	2

2

CLIMATE CHANGE

- Climate changes are atmospheric or astronomical changes studied in the field of climatology.
- The greenhouse effect is the inability of heat to escape from the atmosphere due to greenhouse gases such as CO2 (Carbon dioxide), CH4 (Methane), and C4H10 (Butane). Therefore, thermal energy either remains too much due to matter particles, causing an increase in heat; separates from matter quickly, causing heat loss; or changes periodically.
- This leads to continuous changes in the climate of Earth. For example, today, climate change can be observed in excessively warm and humid winter weather or late high temperatures in summer.
- Climate changes are entirely or largely the result of global warming.

- Green building practices reduce energy consumption.
- As a result, less greenhouse gas emissions are released into the atmosphere for energy production.
- Reducing greenhouse gas emissions aims to lessen the contribution of buildings in combating climate change.

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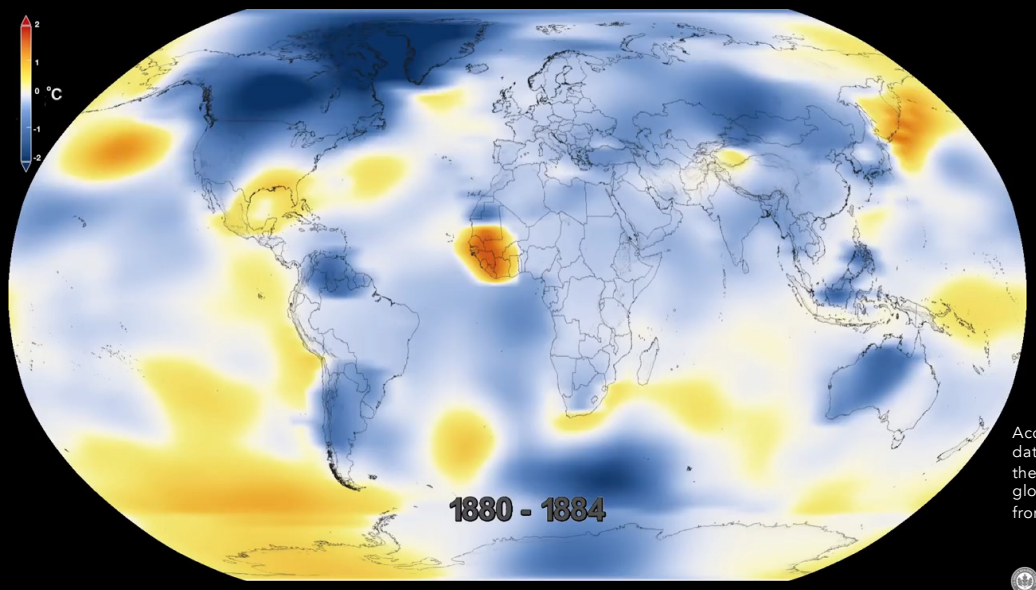
INCREASE IN GLOBAL TEMPERATURE



According to NASA data, the increase in global temperature from 1880 to 2016.

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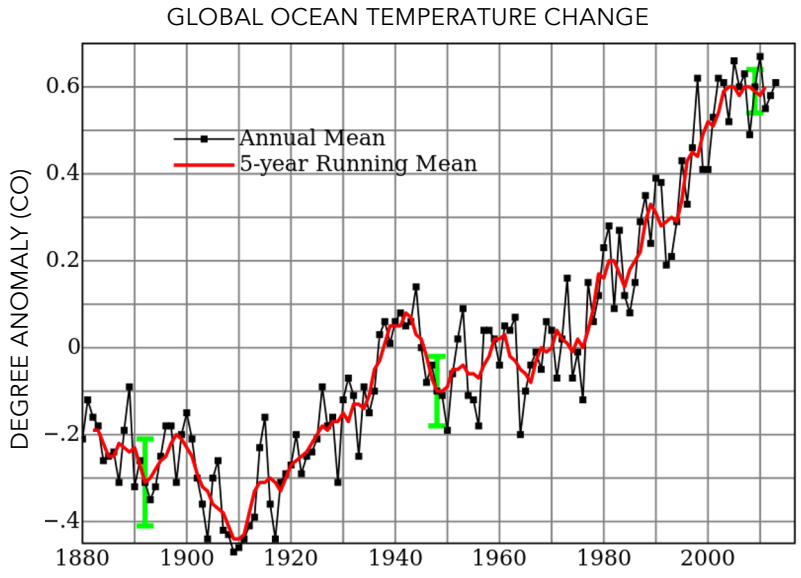
INCREASE IN OCEAN TEMPERATURES



A graph showing carbon dioxide (CO2) emissions released into the atmosphere from fossil fuel sources, compared to five of the IPCC's "SRES" emission scenarios. The declines shown in the graph are related to periods of global economic recession. Image Source: Skeptical Science

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Climate Change

How Did It Occur?

- The increasing heat around the world due to global warming has changed all air currents on Earth. The changing air currents have adversely affected the water balance in the atmosphere.
- Another effect of global warming has resulted in temperature increases in the oceans. This effect altered the movements of warm water currents like the Gulf Stream and also cold water currents like the Labrador current.
- Additionally, changes in the salt concentration in the oceans have also affected the currents, leading to adverse changes in their locations and speeds.
- The transformation of ocean currents has caused an irreversible change in the global climate. As a result, all heat movements on Earth have changed, meaning the climate has changed.

The slowing down or even complete stop of Gulf Stream currents as a result of global warming is causing concern among scientists. BBC News: By Matt McGrath

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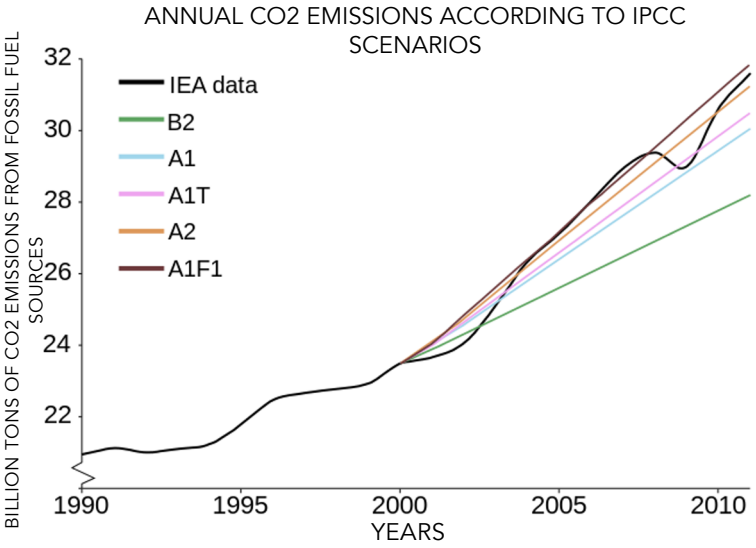
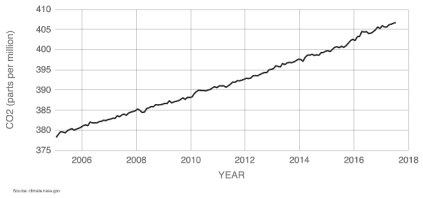
INCREASE IN GREENHOUSE GAS EMISSIONS





A graph showing carbon dioxide (CO2) emissions released into the atmosphere from fossil fuel sources compared to the five "SRES" emission scenarios of the IPCC. The decreases in the graph are related to global economic recession periods.
Image Source: Skeptical Science

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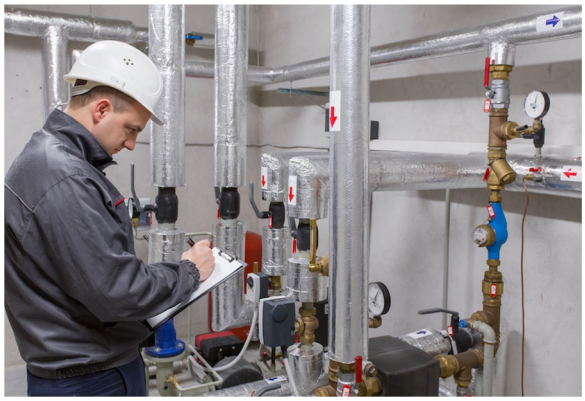
EA PREREQUISITE 1: FOUNDAMENTAL COMMISSIONING

PURPOSE

It is necessary to verify that the building's energy-related systems are installed, calibrated, and constructed in accordance with the owner's requests, design criteria, and technical specifications. Newly commissioned buildings achieve an average energy efficiency of 15% worldwide.

Systems Included:

- Building automation system
- HVAC&R
- Lighting and daylight controls
- Hot water systems
- Renewable energy systems



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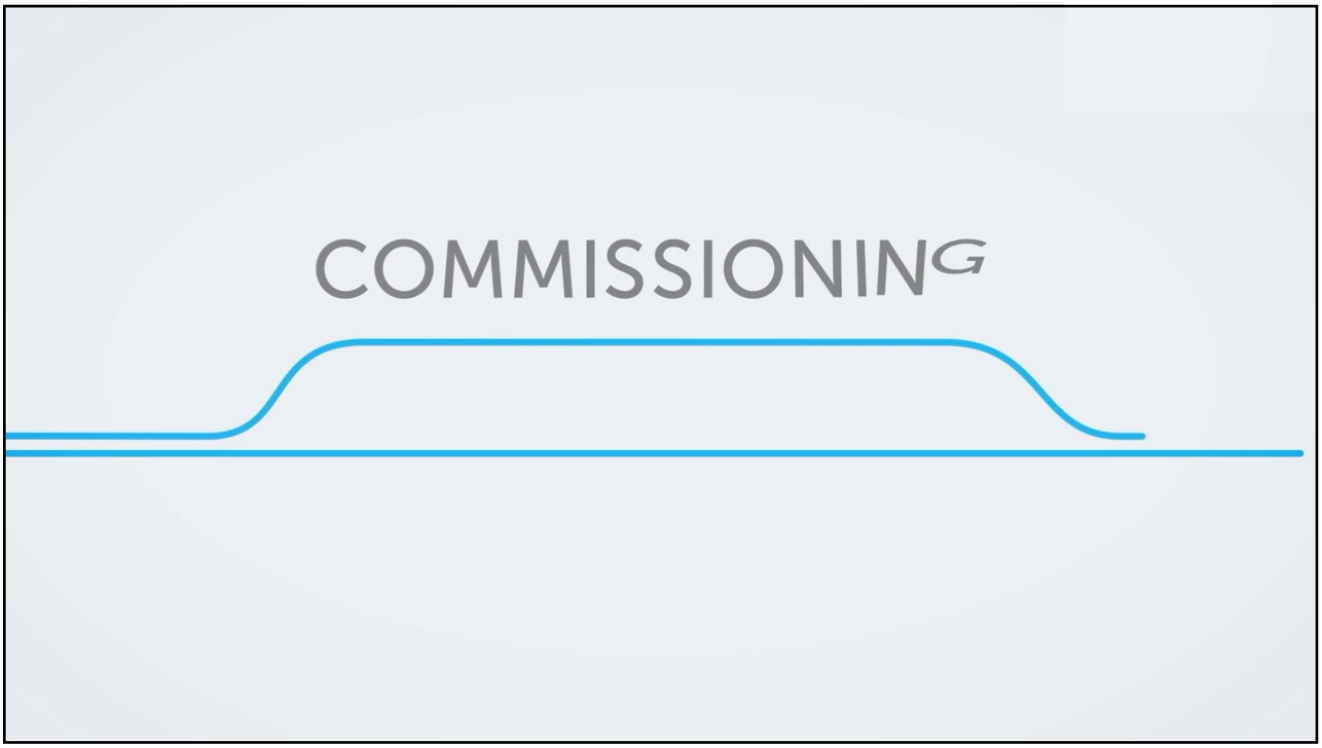

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EA PREREQUISITE 1: FOUNDAMENTAL COMMISSIONING

REQUIREMENTS

- Commissioning works will be carried out by the appointed authority (CxA - Commissioning Authority: Commissioning Specialist)
- CxA reviews the Owner's Project Requirements (OPR) and some Basis of Design (BOD) of the Project Team Design. CxA is responsible for updating any missing issues in collaboration with the project owner and design team.
- The addition of commissioning requirements to technical specifications,
- Preparation and implementation of the commissioning plan,
- Approval of the installations and performances of the systems to be commissioned,
- Preparation of the commissioning summary report and its presentation to the building owner are required.

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PREREQUISITE 1: FOUNDAMENTAL COMMISSIONING

REQUIREMENTS

Design and Pre-Period	Actions Required for Commissioning (Cx)	Basic Cx	Advanced Cx
Selection of Designers	CxA assignment	Building Owner	Building Owner
Design Criteria	Documentation of the building owner's requirements and determination and documentation of design criteria	Building Owner CxA or Designers	Building Owner CxA or Designers
Concept Project	Examination and interpretation of the building owner's requirements and design criteria	CxA	CxA
Preliminary Project	Preparation and implementation of the Cx plan	Project Team CxA	Project Team CxA
Construction Documents	Inclusion of Cx requirements in technical specifications	Project Team CxA	Project Team CxA
Construction Documents	Review of the design by CxA before the completion of the implementation project and interpretation from a commissioning perspective	-	CxA

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EA PREREQUISITE 1: FOUNDAMENTAL COMMISSIONING

REQUIREMENTS

Construction Period	Requirements for Commissioning (Cx)	Basic Cx	Advanced Cx
Equipment Purchases	Monitoring of equipment/device approvals related to Cx by CxA	-	CxA
Conducting Tests	Necessary equipment/device tests as per Cx plan	CxA	CxA
Building Systems Handbook	Preparation of a system handbook for systems that have undergone Cx	CxA	Project Team or CxA
Personnel Training	Confirmation of the training of operational personnel	-	Project Team or CxA
Delivery	Writing of summary Cx report	CxA	CxA
Operation	Operation in accordance with instructions	Operational Personnel	Operational Personnel
Monitoring	Re-evaluation of building systems 10 months after the start of operation	-	CxA

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EA PREREQUISITE 1: FOUNDAMENTAL COMMISSIONING

REQUIREMENTS

CxA Possible Experts			
Individuals, Units	Basic Cx <50,000 ft2	Basic Cx >50,000 ft2	Advanced Cx
An employee or subcontractor of the main contractor	✓		
An employee or subcontractor of the construction management firm holding the subcontracting agreements	✓		
An employee of the architectural or engineering group	✓		
An employee unrelated to the project at the main contractor or construction management firm	✓	✓	
An employee unrelated to the project at the architectural or engineering group	✓	✓	
A subcontractor or consultant unrelated to the project at the architectural or engineering group	✓	✓	✓
A construction management firm not holding subcontractor agreements	✓	✓	✓
An independent consultant working for the project owner	✓	✓	✓

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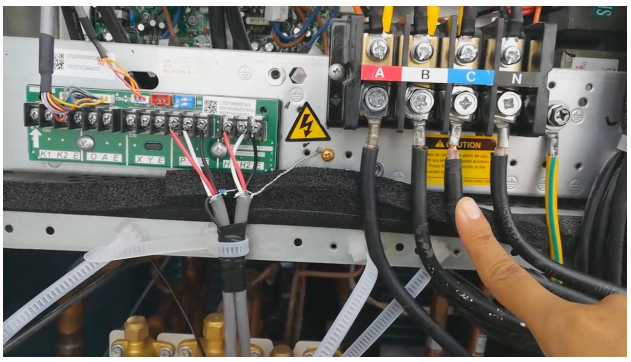
EA PREREQUISITE 1: FOUNDAMENTAL COMMISSIONING

REQUIREMENTS

- The commissioning specialist must have previously carried out documented commissioning work on at least two similar building projects and must have knowledge about the design, implementation, commissioning, testing, and operation of energy systems. These projects do not have to be LEED® projects.
- A commissioning plan must be developed.
- The section of the technical specification that includes commissioning procedures is necessary for documentation.
- Report explaining energy-consuming systems,
- Completed Check Lists,
- Commissioning report,
- Single line diagrams of mechanical and electrical systems,
- Building Operation Manual is required.



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EA PREREQUISITE 1: FOUNADMENTAL COMMISSIONING

REQUIRED DOCUMENTS

Documents	All Projects
CxA Previous Experience	✓
Verification of OPR and BOD Contents	✓
List of Commissioned Systems	✓
Review and Validation of CxA Activities	✓
Commissioning Plan	✓
Reporting of Test and Validation Procedures	✓
CFR, O&M Plan	✓
Commissioning Report	✓

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EA PREREQUISITE 1: FOUNDAMENTAL COMMISSIONING

REFERENCE STANDARDS

- ASHRAE Guideline 0–2005, The Commissioning Process
- ASHRAE Guideline 1.1–2007, HVAC&R Technical Requirements for the Commissioning Process
- NIBS Guideline 3–2012, Exterior Enclosure Technical Requirements for the Commissioning Process

- In v4, ASTM E2947-16: Standard Guide for Building Enclosure Commissioning will be used for the commissioning of building exteriors.

LEED v4 DIFFERENCES

- LEED v4 requires the commissioning authority (CxA) to be employed before the design development phase is completed.
- Electric and plumbing contents have been expanded.
- Building exterior commissioning procedures have been included in the content of OPR and BOD.
- A Design Review has become mandatory with an Operations and Maintenance Plan v4.

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EA PREREQUISITE 2: MINIMUM ENERGY PERFORMANCE

PURPOSE

- The main objective is to ensure the reduction of energy consumption in the designed building considering the health, environmental, and economic impacts, and to establish a minimum level of energy efficiency.

- Systems Included:
- Building automation system
- HVAC&R
- Lighting and daylight controls
- Hot water systems
- Renewable energy systems
- Building envelope
- Building solar orientation

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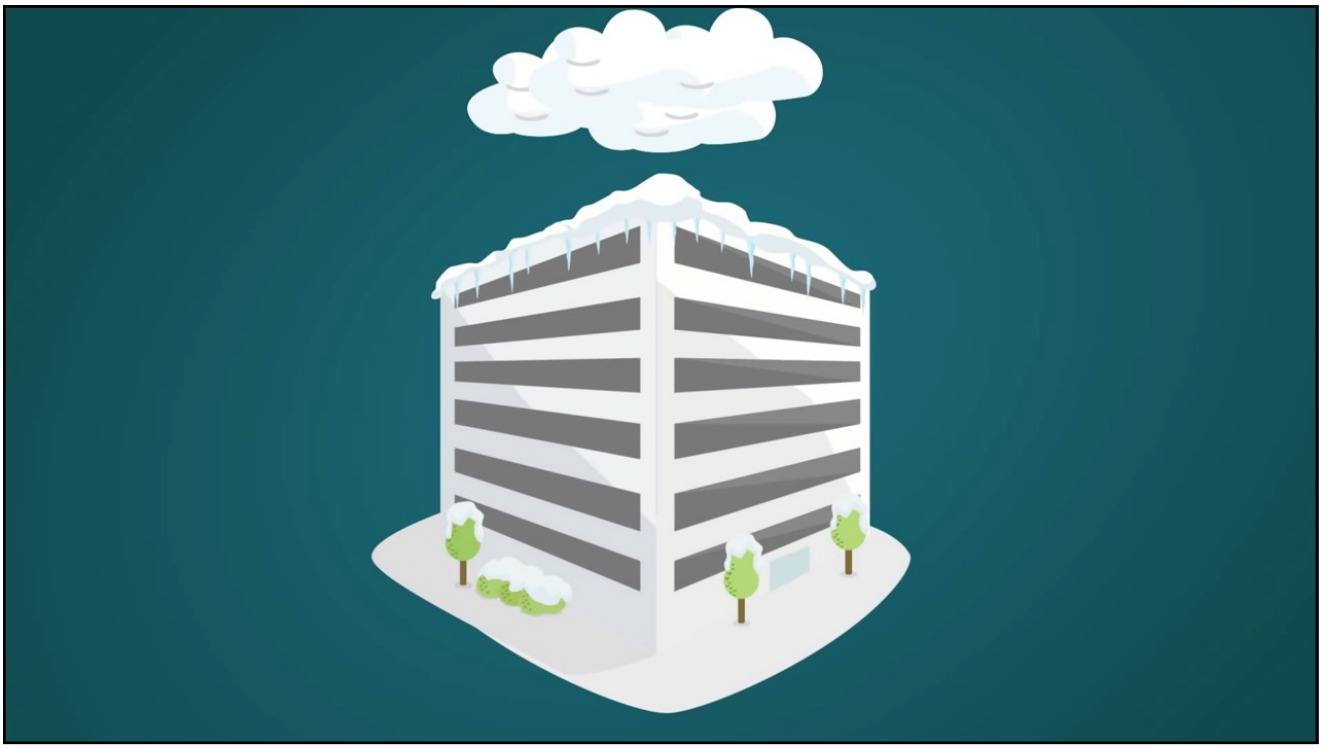

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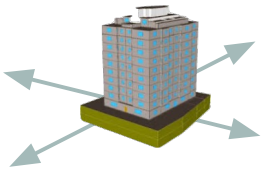
WHAT FACTORS DOES THE BASE BUILDING AND DESIGN BUILDING MODEL CONSIDER?



ENERGY VARIABLE	DESIGNED BUILDING	BASE BUILDING - ASHRAE 90.1 Appendix G
Building Geometry	As in the design	Same
Location	As in the design	Rotated in four directions, average of energy consumptions
Insulation Values	As in the design	Recommended values in ASHRAE 90.1-2010
HVAC Systems	As in the design	Varies according to building size
Device Efficiencies	As in the design	Recommended values in ASHRAE 90.1-2010
Lighting Power Density	As in the design	Recommended values in ASHRAE 90.1-2010
Shading	As in the design	No shading elements
Window / Wall Ratio	As in the design	Same but maximum 40%
Process-Related Energy	25% of total energy consumption	According to ASHRAE definition
Renewable Energy	As in the design	None

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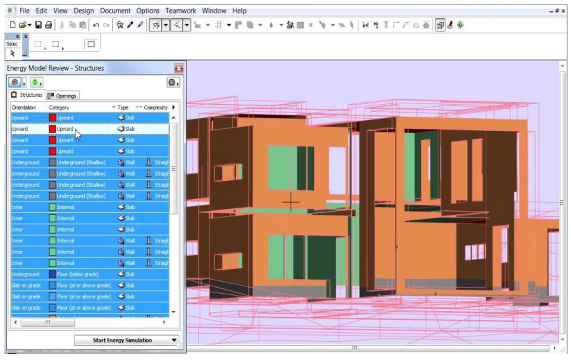
EA PREREQUISITE 2: MINIMUM ENERGY PERFORMANCE

REQUIREMENTS

- Option 1: Whole Building Energy Modeling/Simulation
- When comparing the performance values of the base building with the designed building values; it must be demonstrated that there is an improvement of 5% for New Buildings, 3% for Comprehensive Renovations, and 2% for Core and Shell Buildings. The performance values of the base building should be calculated using an energy simulation model performed according to ANSI/ASHRAE/IESNA Standard 90.1–2010, Appendix G. (An equivalent or comparable standard approved by USGBC may be used for projects outside the United States).
- Projects must meet the minimum savings rates required before obtaining the Renewable Energy Systems credit.



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EA PREREQUISITE 2: MINIMUM ENERGY PERFORMANCE

REQUIREMENTS

- Option 1: Whole Building Energy Modeling/Simulation. The proposed design must also meet the following criteria:
- It must comply with the mandatory conditions of ANSI/ASHRAE/IESNA Standard 90.1–2010 (an equivalent or comparable standard approved by USGBC can be used for projects outside the USA);
- It must include all energy consumption amounts related to the Building Project and their costs; and
- It should be compared with the baseline building prepared in accordance with ANSI/ASHRAE/IESNA Standard 90.1–2010, Appendix G. An equivalent or comparable standard approved by USGBC can be used for projects outside the USA.

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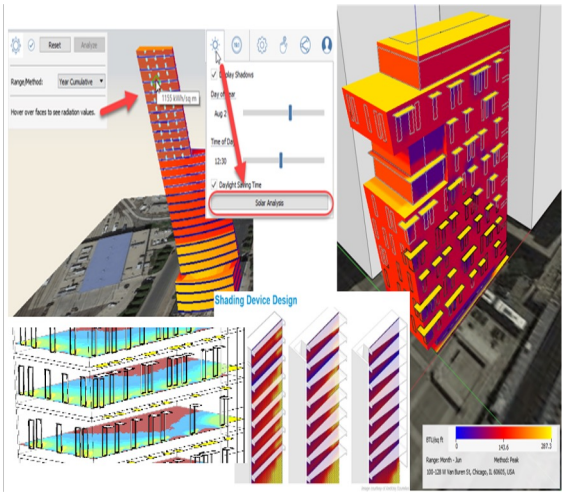
EA PREREQUISITE 2: MINIMUM ENERGY PERFORMANCE

REQUIREMENTS

- Option 1: Full Building Energy Modeling/Simulation. The proposed design must also meet the criteria below:
- Input predictions in the energy model must be based on irregular loads and must be reported. The requirement to model irregular loads is done to reflect how much energy the building can actually consume.
- If the irregular loads are not the same for both the base building and the designed building performance values, the simulation program cannot accurately calculate savings. In this case, an exceptional calculation method should be used (ANSI/ASHRAE/IESNA Standard 90.1–2010, G2.5). Alternatively, the COMNET Modeling Guidelines and Procedures technique can also be used for modeling the decreases in irregular loads.



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EA PREREQUISITE 2: MINIMUM ENERGY PERFORMANCE

REQUIREMENTS

- Option 2: Compliance with ASHRAE % 50 Advanced Energy Design Guide Criteria
- Compliance with the mandatory and enforceable criteria of ANSI/ASHRAE/IESNA Standard 90.1–2010 (or an equivalent standard approved by the USGBC for projects outside the United States).
- Compliance with HVAC and service water heating requirements, which include the efficiency of equipment such as economizers, ventilation, ventilation ducts, and hoods. Chapter 4, Design Strategies and Recommendations by Climate Zone, ASHRAE 50% Advanced Energy Design Guide and Climate Zones Section covers the following buildings:
- ASHRAE 50% Advanced Energy Design Guide for Small and Medium Office Buildings, for Office Buildings less than 100,000 ft2 (9,290 m2);
- ASHRAE 50% Advanced Energy Design Guide for Medium and Large Retail Buildings, for commercial buildings between 20,000-100,000 ft2 (1,860-9,290 m2);
- ASHRAE 50% Advanced Energy Design Guide for K–12 School Buildings; or
- ASHRAE 50% Advanced Energy Design Guide for Large Hospitals, for hospital buildings larger than 100,000 ft2 (9,290 m2).
- For projects outside the United States, ASHRAE/ASHRAE/IESNA Standard 90.1–2010, Appendix B and D, are guides to define the appropriate climate zone.

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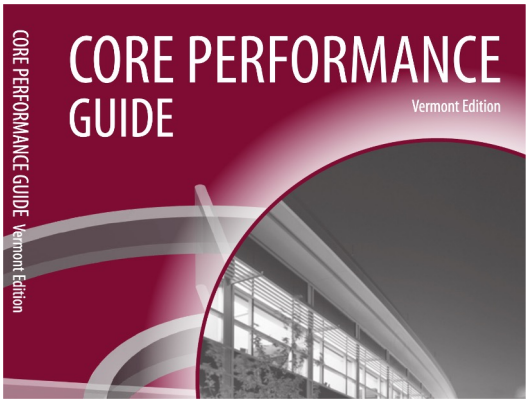
EA PREREQUISITE 2: MINIMUM ENERGY PERFORMANCE

REQUIREMENTS

- Option 3: Compliance with the "Advanced BuildingsTM Core PerformanceTM Guide" Criteria for Advanced Buildings
- Compliance with ANSI/ASHRAE/IESNA Standard 90.1-2010 is mandatory. For projects outside the US, an equivalent or comparable standard approved by the USGBC may also be used.
- Section 1 Eligibility: Design Process Strategies,
- Section 2: Basic Performance Requirements, and the following three strategies
- from Section 3: Advanced Performance Strategies, if applicable.
- When standards conflict with each other, the requirements of the more stringent one should be followed. For projects outside the US, ASHRAE/ASHRAE/IESNA Standard 90.1–2010, Appendices B and D will serve as a guide for identifying the appropriate climate zone.



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EA PREREQUISITE 2: MINIMUM ENERGY PERFORMANCE

REQUIRED DOCUMENTS

Documents	Option 1	Option 2	Option 3
Appendix G Energy Modeling Inputs	✓		
Input-output Reports from Modeling Software	✓		
Exceptional Calculations (If Necessary)	✓		
Energy Consumption and Demand values by End User and Fuel Type for Each Building	✓		
Fuel Ratios	✓		
AEDG Compliance Tables		✓	
Target Finding Results, Summary			✓
Confirmation that All Requirements in CPG Section 1 and 2 Have Been Met			✓
Building Configuration Analyses			✓
Building Loads and Mechanical System Capacity Designs			✓
Insulation Application Details			✓
Building Shell Details			✓
Domestic Hot Water Efficiency			✓
Summaries and Reports for CPG Advanced Performance Strategies			✓
Data Center Calculations (if applicable)	✓		
Commercial Transaction Energy Calculator (if applicable)	✓		

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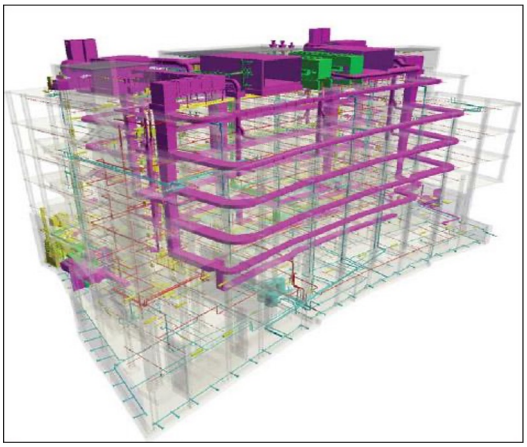
EA PREREQUISITE 2: MINIMUM ENERGY PERFORMANCE

REFERENCE STANDARDS

- ASHRAE 90.1–2010
- ASHRAE 50% Advanced Energy Design Guides
- Advanced Buildings Core Performance Guide
- COMNET Commercial Buildings Energy Modeling Guidelines



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EA PREREQUISITE 2: MINIMUM ENERGY PERFORMANCE

DIFFERENCES FROM LEED v3 2009

- Option 1: Whole Building Energy Simulation
- ASHRAE 90.1–2007 has been replaced by ASHRAE 90.1–2010.
- The operating energy in the Energy Modeling of Base and Designed Buildings has changed.
- The desired energy savings figures are obtained from the costs of the Renewable Energy Source generated on site without being included in the conditioning.
- For Data Centers, 2% of the 5% required for energy cost reductions must come from energy use in building installed capacity and cooling infrastructure.
- Option 2: Should comply with ASHRAE %50 Advanced Energy Design Guide and Option 3 Advanced Buildings Core Performance Guide.
- For Option 2, the degree of savings for the PREREQUISITE has been increased from 30% to 50% as per AEDG.
- This means a 50% savings compared to ASHRAE 90.1–2004.
- For Options 2 and 3, to meet the project prerequisite, the requirements of ASHRAE 90.1–2010 must be adhered to.

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EA PREREQUISITE 2: MINIMUM ENERGY PERFORMANCE

LEED v4.1 CHANGES

- Option 1: Whole Building Energy Simulation
- ASHRAE 90.1–2010 has been replaced by ASHRAE 90.1–2016.
- Country energy mx CO2 emissions values will be taken from the Energy Agency CO2 Emissions from Fuel Combustion 2017 report to calculate GHG emissions.
- ISO 52000-1:2017: Greenhouse gas emission factors will be accepted in accordance with building types and energy sources based on the region of the project as per ISO Standard 52000-1:2017 values.

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EA PREREQUISITE 3: BUILDING LEVEL ENERGY MEASUREMENT

PURPOSE

- The primary aim is to measure and monitor the amount of energy consumed at the building level to support Energy Management and achieve additional energy savings.
- It is necessary to use existing energy measuring devices (meters) at the building level, or to install new ones, and to obtain data showing the total energy consumption of the building through these means.
- Measurements should be made for electricity, natural gas, cooling tower water, steam, fuel oil, propane, and biomass consumption.
- Suction meters are only acceptable if they measure the entire building's energy consumption.

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EA PREREQUISITE 3: BUILDING LEVEL ENERGY MEASUREMENT

REQUIREMENTS

- It is required to provide a commitment that the collected building energy consumption and electricity demand data and documents (if measurable) will be shared with USGBC for 5 years following either the building's commencement of operations or its acceptance into the LEED Certification Process (whichever comes first).
- Energy consumption should be monitored at least in 1-month periods.
- This commitment lasts for 5 years or until the building changes ownership.

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EA PREREQUISITE 3: BUILDING LEVEL ENERGY MEASUREMENT

REQUIRED DOCUMENTS

Documents	All Projects
Locations of All Meters	✓
Ownership of Meters	✓
Letter Demonstrating the Commitment of the Project Owner	✓
Measured Systems	✓

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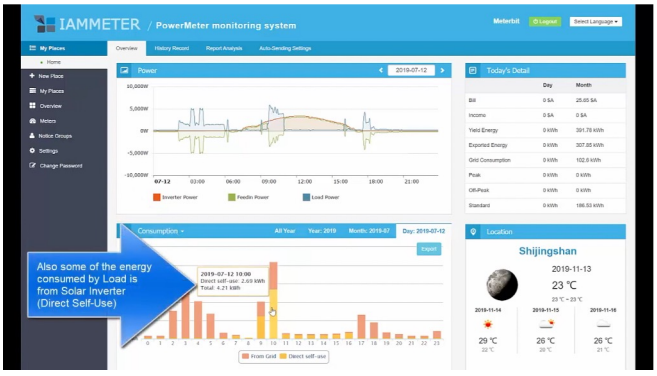
EA PREREQUISITE 3: BUILDING LEVEL ENERGY MONITORING

REFERENCE STANDARDS

- American National Standards Institute, ANSI C12.20, Class 0.2 (±0.2)
- American National Standards Institute, ANSI B109
- EN Standard, EN-1434:Thermal Energy (Btu meter or heat meter)

DIFFERENCES FROM LEED v3 2009

- This is a new prerequisite.
- Minimum Program Requirements: The requirements for monitoring and reporting continuous energy consumption are the same as those listed under MPR 6, which are also required for all LEED 2009 Projects.



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EA PREREQUISITE 4: BASIC REFRIGERANT MANAGEMENT

OBJECTIVE

The primary aim is to prevent damage to the ozone layer by refrigerants.

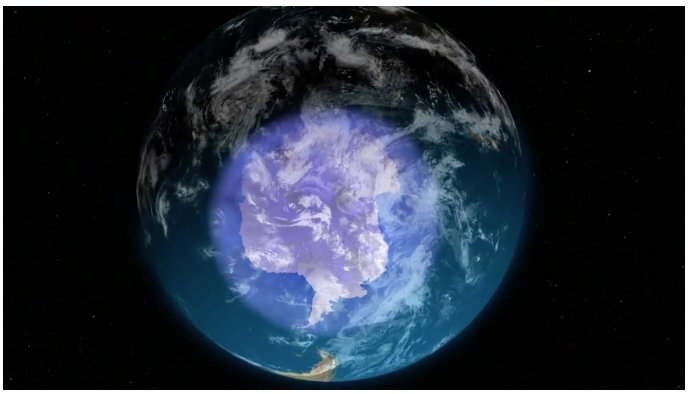
In buildings targeting LEED Certification, CFC (Chlorofluorocarbon) refrigerants should not be used.

In the restoration and renovation of existing buildings, CFC-based fluids present in ventilation systems need to be replaced with non-restricted refrigerants.

CFC : Chlorofluorocarbon

HCFC : Hydrochlorofluorocarbon

HFC: Hydrofluorocarbon



Taking measures in Green Buildings to prevent damage to the ozone layer by refrigerants is a very important step against the risk of climate change.

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WHAT ARE FLUORO GREENHOUSE GASES? 'F' GASES

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EA PREREQUISITE 4: FOUNDAMENTAL REFRIGERANT MANAGEMENT

REQUIREMENTS

- The fluids used must have low GWP (Global Warming Potential) and ODP (Ozone Depletion Potential) values.
- Various measures should be taken to prevent fluid leaks.
- The recycling of fluids should be done in accordance with EPA regulations.
- LEED has banned the use of CFC-based refrigerants in projects aimed at certification.

Refrigerant	Ozone Depletion Potential (*ODP*)	Global Warming Potential (*GWP*)
R-11 Trichlorofluoromethane	1.0	4000
R-12 Dichlorodifluoromethane	1.0	2400
R-13 B1 Bromotrifluoromethane	10	
R-22 Chlorodifluoromethane	0.05	1700
R-32 Difluoromethane	0	650
R-113 Trichlorotrifluoroethane	0.8	4800
R-114 Dichlorotetrafluoroethane	1.0	3.9
R-123 Dichlorotrifluoroethane	0.02	0.02
R-124 Chlorotetrafluoroethane	0.02	620
R-125 Pentafluoroethane	0	3400
R-134a Tetrafluoroethane	0	1300
R-143a Trifluoroethane	0	4300
R-152a Difluoroethane	0	120
R-245a Pentafluoropropane	0	
R-401A (53% R-22, 34% R-124, 13% R-152a)	0.37	1100
R-401B (61% R-22, 28% R-124, 11% R-152a)	0.04	1200
R-402A (38% R-22, 60% R-125, 2% R-290)	0.02	2600
R-404A (44% R-125, 52% R-143a, R-134a)	0	3300
R-407A (20% R-32, 40% R-125, 40% R-134a)	0	2000
R-407C (23% R-32, 25% R-125, 52% R-134a)	0	1600
R-502 (48.8% R-22, 51.2% R-115)	0.283	4.1
R-507 (45% R-125, 55% R-143)	0	3300
R-717 Ammonia - NH_3	0	0
R-718 Water - H_20	0	
R-729 Air	0	
R-744 Carbon Dioxide - CO_2		1*

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EA PREREQUISITE 4: FOUNDAMENTAL REFRIGERANT FLUID MANAGEMENT

REQUIREMENTS

REFRIGERANT FLUID	ODP	GWP	APPLICATION AREA
Chlorofluorocarbons - CFC			
CFC-11	1	4,680	Chiller
CFC-12	1	10,720	Refrigerator, Chiller
CFC-14	0.94	9,800	Chiller
CFC-500	0.605	7,900	Chiller, Humidifier
CFC-502	0.221	4,600	Low-temperature cooling
Hydrochlorofluorocarbons - HCFC			
HCFC-22	0.04	1,780	Air conditioning, Chiller
HCFC-123	0.02	76	Replaced by CFC-11

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EA PREREQUISITE 4: REFRIGERANT FLUID MANAGEMENT

REQUIREMENTS

REFRIGERANT FLUID	ODP	GWP	APPLICATION AREA
Hydrofluorocarbons -HFC			
HFC-23	≃ 0	12,240	Ultra low-temperature refrigeration
HFC-134a	≃ 0	1,320	Instead of CFC-12 or HCFC-12
HFC-245fa	≃ 0	1,020	Insulation contribution, Chiller
HFC-404A	≃ 0	3,900	Low-temperature refrigeration
HFC-407C	≃ 0	1,700	Replacing HCFC-22
HFC-410A	≃ 0	1,700	Air conditioning systems
HFC-507A	≃ 0	1,890	Low-temperature refrigeration
Natural Refrigerant Fluids			
CO2	0	1	
Ammonia (NH3), Water	0	0	

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EA PREREQUISITE 4: REFRIGERANT MANAGEMENT

LEGISLATION IN YOUR COUNTRY-EXAMPLE TURKEY

Within the framework of the legal regulations in Turkey; the Ministry of Environment and Forestry has prepared a Regulation on the Reduction of Substances that Deplete the Ozone Layer. This Regulation specifies the procedures and principles regarding the usage of the substances that are controlled according to the Montreal Protocol on Substances that Deplete the Ozone Layer, to which our country is a party, and its amendments, as well as their gradual reduction and elimination within a specified timeline. This regulation covers the foreign trade, usage, marketing of controlled substances, as well as the import and usage from the year 2006 onwards and the informing of the public.

The regulation has been prepared in parallel with the provisions of the Vienna Convention for the Protection of the Ozone Layer dated 20.06.1990 and the provisions of the Montreal Protocol on Substances that Deplete the Ozone Layer dated 19.12.1991.

According to the Montreal Protocol and its amendments, the production, consumption, and trade of controlled substances, including chlorofluorocarbons, trichlorofluoromethane (CFC-11), dichlorodifluoromethane (CFC-12), trichlorofluoromethane (CFC-113), dichlorotetrafluoroethane (CFC-114), and chloropentafluoroethane (CFC-115) for service purposes are completely prohibited from 01.01.2006 onwards.

From the date this regulation enters into force, it is prohibited to produce any of the substances controlled by the Montreal Protocol and its amendments that deplete the ozone layer or to establish new facilities for their production.

The use of ozone-depleting substances and carbon tetrachloride is limited to laboratory and essential use requirements only following the publication of this regulation.

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EA PREREQUISITE 4: BASIC REFRIGERANT FLUID MANAGEMENT

MONTREAL PROTOCOL

The issue of ozone layer depletion was first discussed in 1976 at the Governing Council of the United Nations Environment Programme (UNEP). Following the establishment of the Ozone Layer Coordination Committee (CCOL) by UNEP and the World Meteorological Organization (WMO) to periodically assess ozone depletion, experts on the ozone layer gathered for a meeting in 1977.
The first intergovernmental contacts regarding the reduction of substances that deplete the ozone layer (ODS) began in 1981, culminating in the adoption of the Vienna Convention for the Protection of the Ozone Layer in March 1985. The Vienna Convention promoted intergovernmental cooperation on research, systematic observation of the ozone layer, monitoring of CFC production, and information sharing. The parties to the Convention are tasked with taking general measures against anthropogenic activities that alter the structure of the ozone layer and aimed at protecting the environment and human health. It is a framework agreement that does not contain legally binding controls or targets.

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EA PREREQUISITE 4: BASIC REFRIGERANT FLUID MANAGEMENT

MONTREAL PROTOCOL

Following the agreement on the Vienna Convention, work was started on a protocol that would ensure the control of the use and production of ozone-depleting substances without delay.
In September 1987, the Montreal Protocol on Ozone-Depleting Substances was adopted. With the detection of the ozone hole over Antarctica in 1985, governments concluded that drastic measures were needed to reduce the production and consumption of many CFCs and some halons. The Montreal Protocol was created in such a way that the emancipation schedule could be revised based on periodic scientific and technological evaluations. Following these technical and scientific evaluations, it was revised in 1990 (London), 1992 (Copenhagen), 1995 (Vienna), 1997 (Montreal), 1999 (Beijing) and 2007 (Montreal) in order to accelerate the reduction of the calendar of the Protocol. In addition, these regulations have led to the inclusion of new control clauses and new measures in the agreement.
The Montreal Protocol, to which 196 countries are parties, is described as the most successful multilateral agreement on the environment. In June 1990, a "Multilateral Fund (MLF)" was established in London, which was seen as a great success of the protocol and was created with the contributions of developed countries. This fund is provided to the industry of developing countries; Technical specialization is used for new technologies and equipment in projects aimed at eliminating OTİM.

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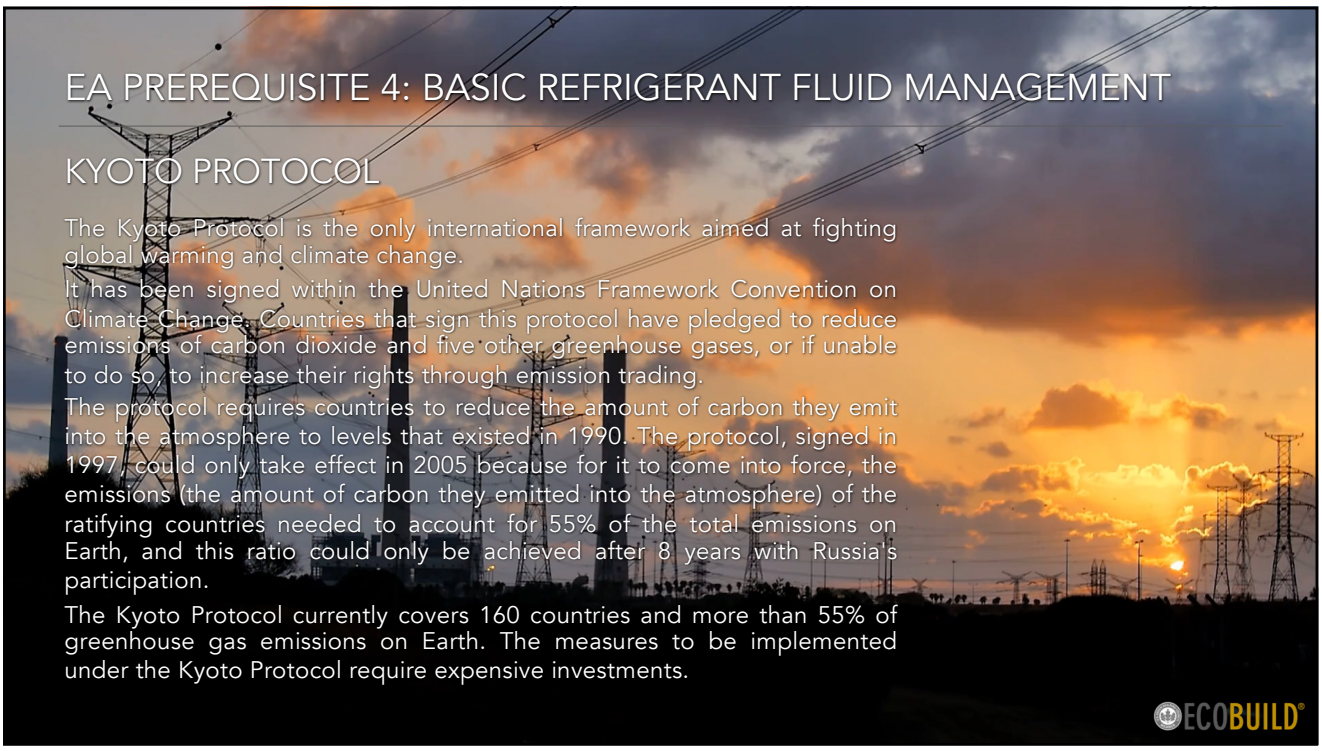

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EA PREREQUISITE 4: MANAGEMENT OF BASIC REFRIGERANTS

KYOTO PROTOCOL

- According to the agreement;
- The amount of greenhouse gases released into the atmosphere will be reduced by 5%,
- Legislation aimed at reducing greenhouse gas emissions from industry, motor vehicles, and heating will be reorganized,
- It will be ensured that heating requires less energy, long-distance travel is done with vehicles that consume less energy, and technology systems that consume less energy are installed in industry; environmentalism will be a fundamental principle in transportation and waste disposal,
- Efforts will be directed towards alternative energy sources to reduce the amount of methane and carbon dioxide released into the atmosphere,
- Instead of fossil fuels, bio-diesel fuels, for example, will be used,
- Waste management processes in high energy-consuming industries such as cement, iron-steel, and lime factories will be reorganized,
- Systems and technologies that emit less carbon will be implemented in thermal power plants,
- The use of solar energy will be promoted, and since nuclear energy has zero carbon, this energy will be highlighted globally.
- Higher taxes will be imposed on those who consume excessive fuel and produce excessive carbon.

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EA PREREQUISITE 4: BASIC REFRIGERANT FLUID MANAGEMENT

REQUIRED DOCUMENTS

Documents	All Equipment	Requires Phaseout
Equipment type	✓	✓
Commitment that New or Existing Equipment will not contain CFCs	✓	✓
Refrigerant Types	✓	✓
CFC Phase-Out or Replacement Plan		✓
Refrigerant Leak Rates and Quantities		✓
Phase-out Completion Date		✓

REFERENCE STANDARDS

- US EPA Clean Air Act, Title VI, Section 608, Compliance with the Section 608 Recycling Rule
- These regulations contain the standards established for the recycling of refrigerants.

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EA CREDIT 1: ADVANCED COMMISSIONING

OBJECTIVE

- The main objective is to verify that the building's systems related to energy, water, indoor environmental quality, and durability have been installed, calibrated, constructed, and operated in accordance with the owner's requests, design criteria, and technical specifications.
- Unlike EA Prerequisite 1:
- In EA Prerequisite 1, the commissioning process of energy-related systems is examined. In EA Credit 1, the commissioning specialist must be involved with the project team from the beginning of the process.
- CxA should review the commissioning documentation.
- Training for staff is necessary close to the project's completion.
- Review of operations is required 10 months after project completion,
- A guide for the systems used in the building must be prepared.

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EA CREDIT 1: ADVANCED COMMISSIONING

REQUIREMENTS

- Commissioning Specialist
- When the design development phase is completed, a Commissioning Specialist with the following qualifications should be appointed.
- The commissioning specialist (CxA) must have previously conducted certified commissioning work on at least two similar building projects and should have knowledge about the design, implementation, commissioning, testing, and operation of energy systems. It is not a requirement for these projects to be LEED® projects.
- The Commissioning Specialist (CxA) can be a qualified employee of the project owner, an independent consultant, or a member of the design or construction firm that is not part of the design or construction team of this project. Alternatively, it can also be an employee of a subcontractor who is unrelated to the subject matter.

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EA CREDIT 1: ADVANCED COMMISSIONING

REQUIREMENTS

- Option 1: Advanced System Commissioning (3-4 points)
- Path 1: Advanced Commissioning (3 points)
- The following Commissioning Processes (CxP) must be completed in accordance with ASHRAE Guideline 0–2005 and ASHRAE Guideline 1.1–2007 HVAC&R Systems Sections for mechanical, electrical, plumbing, and renewable energy systems and system communities. These include sections related to energy, water, indoor environmental quality, and resilience.
- Review of documentation submitted by subcontractors.
- Verification that system operation manuals requirements are incorporated into the construction documents.
- Verification that training requirements for operators and building occupants are included in the construction documents.
- Ensuring that system operation manuals are updated and distributed.
- Monitoring the effective use of training documents for operators and building occupants.
- Conducting seasonal tests.
- Reviewing building operation systems 10 months after the building's completion.
- A Continuous Commissioning Plan needs to be developed.

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EA CREDIT 1: ADVANCED COMMISSIONING

REQUIREMENTS

- Option 1: Advanced System Commissioning (3-4 points)
- Path 2: Advanced and Monitoring-Based Commissioning (4 points)
- Requirements from Path 1 must be met.
- Development of monitoring-based operations and defining the scores to be received by systems consuming energy and water is necessary.
- All measurement scores and procedures must be included in the Commissioning Plan and the following should be shown:
- Roles and responsibilities are listed below;
- Measurement requirements (meters, scores, measurement systems, data access);
- Breakpoints and frequencies should be determined to monitor system trends;
- Acceptable threshold values and measurement values for Breakpoints (when applicable, predictive algorithms can be used to compare ideal values with actual values);
- Elements used for performance improvement should include conflicts between these elements across systems, unusual movements of system parts, and energy and water consumption profiles;
- Preparation of an action plan that identifies and corrects operational errors and deficiencies;
- Planning of necessary repairs for sustained performance; and
- The frequency of analyses to be conducted in the first year of operation must be determined to be at least every 3 months.

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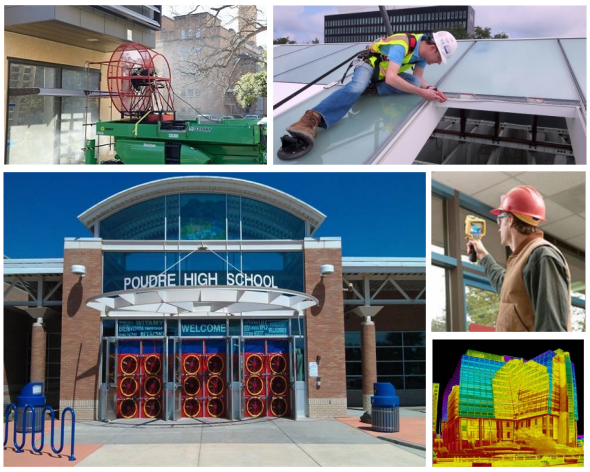
EA CREDIT 1: ADVANCED COMMISSIONING

REQUIREMENTS

- Option 2: Building Envelope Commissioning (2 points)
- It is necessary to meet all the Basic Commissioning and Verification requirements in the EA PREREQUISITE, which must also be applied to the Building's External Thermal Envelope in addition to the mechanical and electrical systems and equipment.
- All activities of the Commissioning Process (CxP) for the building's thermal envelope must be completed in accordance with ASHRAE Guideline 0–2005 and the National Institute of Building Sciences (NIBS) Guideline 3–2012, Exterior Enclosure Technical Requirements for the Commissioning Process standards. These standards pertain to energy, water, indoor air quality, and durability.



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EA CREDIT 1: ADVANCED COMMISSIONING

REQUIREMENTS

- The Commissioning Specialist must complete the following tasks:
- Reviewing the documents submitted by subcontractors.
- Verifying that the requirements for system operation manuals are included in the Construction Documents.
- Confirming that the training requirements for operators and building users are included in the Construction Documents.
- Ensuring that the system operation manuals are updated and distributed.
- Monitoring the effective use of training documents for operators and building users.
- Conducting seasonal tests.
- Reviewing the building operation systems 10 months after the completion of the building.
- Developing a continuous Commissioning Plan.

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EA CREDIT 1: ADVANCED COMMISSIONING

REQUIREMENTS

CxA Potential Experts			
Individuals, Departments	Basic Cx <50,000 ft2	Basic Cx >50,000 ft2	Advanced Cx
An employee or subcontractor of the main contractor	✓		
An employee or subcontractor of the construction management company holding subcontracting agreements	✓		
An employee of the architectural or engineering group	✓		
An employee of the main contractor or construction management company not related to the project	✓	✓	
An employee of the architectural or engineering group not related to the project	✓	✓	
A subcontractor or consultant from the architectural or engineering group not related to the project	✓	✓	✓
A construction management company not holding subcontract agreements	✓	✓	✓
An independent consultant working for the project owner	✓	✓	✓

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EA CREDIT 1: ADVANCED COMMISSIONING

REQUIRED DOCUMENTS

Documents	Option 1 Path 1	Option 2 Path 2	Option 2
A list of all tasks completed as part of the Cx Commissioning Activities	✓	✓	✓
Training Content and List of Participants	✓	✓	✓
Verification of the Distribution of the System Manuals	✓	✓	✓
Ongoing Commissioning Plan (Cx)	✓	✓	✓
Inclusion of Monitoring and Recording Sections in the Commissioning Plan		✓	
Inclusion of Building Envelope in the Commissioning Plan			✓
Extra Verification Requirements for Data Centers (data centers only)	✓	✓	

REFERENCE STANDARDS

- ASHRAE Guideline 0–2005, The Commissioning Process
- ASHRAE Guideline 1.1–2007, HVAC&R Technical Requirements for the Commissioning Process
- NIBS Guideline 3–2012, Exterior Enclosure Technical Requirements for the Commissioning Process

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EA CREDIT 2: OPTIMUM ENERGY PERFORMANCE

PURPOSE

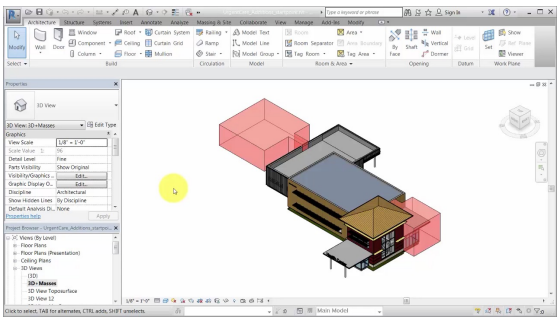
The primary aim is to reduce the environmental and economic impacts of energy consumption of the designed buildings and systems, ensuring that the minimum energy efficiency level defined as a prerequisite is exceeded in terms of energy efficiencies.

An energy performance target should be set before the schematic design phase of the building is completed.

This target should be obtained in terms of energy resource usage kBtu/ft2/year (kWh/m2/year).

Creating an energy model in building projects prevents irreversible energy problems from the design phase. It is possible to determine how much energy buildings will consume while still in the project phase. This information is a very important requirement for the building owner.

$$\%\ \text{Energy Improvement} = \frac{100 \times (1 - \text{Proposed Building Performance})}{\text{Baseline Building Performance}}$$



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EA CREDIT 2: OPTIMUM ENERGY PERFORMANCE

REQUIREMENTS

- One of the following options must be selected.
- Option 1: Whole Building Energy Simulation (1–18 points for Schools and Hospitals excluded, 1–16 points for Schools, 1–20 points for Hospitals)
- A building designed and implemented to be at least 5% more energy efficient for new buildings compared to the minimum efficiency criteria specified in the ANSI/ASHRAE/IESNA 90.1-2010 Energy Standard for Buildings Except Low Rise Residential Buildings, at least 3% more for building renovations and retrofits, and at least 2% more for core-shell buildings.
- During the design phase, energy efficiencies must be analyzed and the results of this analysis should shape design decisions; energy simulation should be used to explore efficiency opportunities, past energy simulation analyses of similar buildings should be evaluated, or printed data from analyses of similar buildings should be reviewed (e.g., Advanced Energy Design Guides).
- The Minimum Energy Performance prerequisite for EA is conducted to show a percentage improvement based on baseline building data for the proposed building. The points given for these improvement percentages are listed in Table 1 below.

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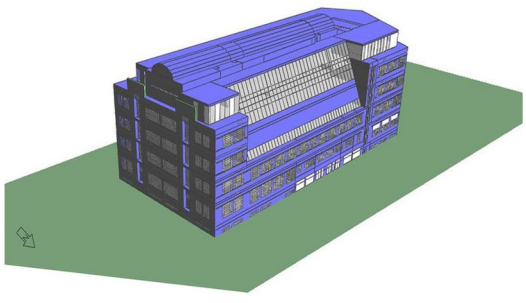
EA CREDIT 2: OPTIMUM ENERGY PERFORMANCE

SCORES

New Building	Comprehensive Repair	Core Shell	Scores (Outside Hospitals and Schools)	Scores Hospital	Scores Schools
6%	4%	3%	1	3	1
8%	6%	5%	2	4	2
10%	8%	7%	3	5	3
12%	10%	9%	4	6	4
14%	12%	11%	5	7	5
16%	14%	13%	6	8	6
18%	16%	15%	7	9	7
20%	18%	17%	8	10	8
22%	20%	19%	9	11	9
24%	22%	21%	10	12	10
26%	24%	23%	11	13	11
29%	27%	26%	12	14	12
32%	30%	29%	13	15	13
35%	33%	32%	14	16	14
38%	36%	35%	15	17	15
42%	40%	39%	16	18	16
46%	44%	43%	17	19	-
50%	48%	47%	18	20	-



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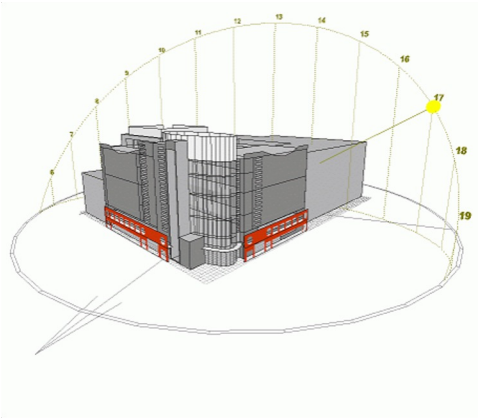
EA CREDIT 2: OPTIMAL ENERGY PERFORMANCE

REQUIREMENTS

- One of the following options must be selected.
- Option 2: Compliance with the ASHRAE Advanced Energy Design Guide (1–6 points)
- To be eligible for Option 2, they must use the Option 2 of the Minimum Energy Performance criteria, which is an EA Prerequisite.
- It is necessary to design according to the Design Criteria and Recommendations by Climate Zones Chapter 4, ASHRAE %50 Advanced Energy Design Guide, and Climate Zone Documents, and to implement the strategies here. For projects outside the U.S., ASHRAE/ASHRAE/IESNA Standard 90.1–2010, Appendixes B and D can be utilized to find the appropriate climate zone.



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EA CREDIT 2: OPTIMUM ENERGY PERFORMANCE

REQUIREMENTS

- One of the following options must be selected.
- ASHRAE %50 Advanced Energy Design Guide for Small to Medium Office Buildings
- (Building Energy Design Criteria for Small and Medium Office Buildings)
- Building Envelope, Opaque Surfaces: ceilings, walls, floor coverings, concrete blocks, doors, and continuous air barriers (1 point)
- Building Envelope, Glazed Surfaces: vertical windows (1 point)
- Interior Lighting; including Daylight and Interior Finishes (1 point)
- Exterior Lighting (1 point)
- Cable Loads, including equipment and controls (1 point)

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EA CREDIT 2: OPTIMUM ENERGY PERFORMANCE

REQUIREMENTS

- One of the following options must be selected.
- ASHRAE %50 Advanced Energy Design Guide for Medium to Large Box Retail Buildings
- (Building Energy Design Criteria for Medium and Large Office Buildings)
- Building Envelope, Opaque Surfaces: ceilings, walls, floor coverings, concrete blocks, and ducts (1 point)
- Building Envelope, reflective surfaces: windowing according to all orientations (1 point)
- Interior Lighting; excluding lighting power densities for the sales floor (1 point)
- Extra interior lighting for the sales floor (1 point)
- Exterior Lighting (1 point)
- Cable Loads, including equipment selections and controls (1 point)

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EA CREDIT 2: OPTIMUM ENERGY PERFORMANCE

REQUIREMENTS

- One of the following options must be selected.
- The ASHRAE %50 Advanced Energy Design Guide for K–12 School Buildings includes Advanced Energy Design Criteria for K12 Schools.
- Building Envelope, Opaque Surfaces: ceilings, walls, floor coverings, concrete blocks, and doors (1 point)
- Building Envelope, Transparent Surfaces: vertical glazing (1 point)
- Interior Lighting; including daylight and interior finishes (1 point)
- Outdoor Lighting (1 point)
- Cable Loads, equipment selections, controls, and kitchen equipment included (1 point) can be obtained.

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EA CREDIT 2: OPTIMUM ENERGY PERFORMANCE

REQUIREMENTS

- One of the options below must be selected.
- The ASHRAE %50 Advanced Energy Design Guide for Large Hospitals includes Advanced Energy Design Criteria for Large Hospitals.
- Building Envelope, Opaque Surfaces: ceilings, walls, floor coverings, concrete blocks, continuous air barriers, and ducts (1 point)
- Building Envelope, Transparent Surfaces: vertical glazing (1 point)
- Interior Lighting: including daylight and interior product preferences (1 point)
- Exterior Lighting (1 point)
- Cable Loads, including equipment selections and kitchen equipment controls (1 point)

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EA CREDIT 2: OPTIMUM ENERGY PERFORMANCE

REQUIRED DOCUMENTS

Documents	Option 1	Option 2
Appendix G energy modeling inputs	✓	
Input-output Reports from Modeling Software	✓	
Renewable Energy (if applicable)	✓	
Exceptional Calculations (If Necessary)	✓	
Target Finding Results and Summary	✓	✓
Energy Consumption and Demand values by End User and Fuel Type for Each Building	✓	
Fuel Ratios	✓	
AEDG Compliance tables		✓
Equipment Efficiency Lists of Operations (for commercial use only)		✓

REFERENCE STANDARDS

- ASHRAE 90.1–2010
- ASHRAE 50% Advanced Energy Design Guides
- Advanced Buildings Core Performance Guide
- COMNET Commercial Buildings Energy Modeling Guidelines

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EA CREDIT 2: OPTIMUM ENERGY PERFORMANCE

LEED V4 DIFFERENCES

- Option 1: Whole Building Energy Simulation
- ASHRAE 90.1–2007 has been replaced by ASHRAE 90.1–2010.
- Process Energy is no longer required in the Energy modeling of Base and Designed Buildings.
- The desired Energy Savings figures are obtained at PREREQUISITE without including the costs coming from the Renewable Energy Source generated in the field.
- For Data Centers, 2% of the 5% reduction in energy costs must come from energy use in building installed power and cooling infrastructure.
- Option 2: It must comply with ASHRAE %50 Advanced Energy Design Guide, and Option 3 Advanced Buildings Core Performance Guide.
- For Option 2, the savings degree for the PREREQUISITE has been raised from 30% to 50% according to AEDG.
- This also means a 50% savings over ASHRAE 90.1–2004.
- For Options 2 and 3, to meet the Project PREREQUISITE, it must comply with the requirements of ASHRAE 90.1–2010.

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EA CREDIT 2: OPTIMUM ENERGY PERFORMANCE

V4.1 CHANGES SCORES ACCORDING TO PRICE COST INDEX

New Building	Hospitals, Comprehensive Renovation, CS	Scores (Excluding Schools and Hospitals)	Hospital Scores	School Scores
%5	%2	1	1	1
10%	%5	2	2	2
%15	%10	3	3	3
%20	%15	4	4	4
%25	%20	5	5	5
%30	%25	6	6	6
%35	%30	7	7	7
%40	%35	8	8	
%45	%40	9	9	8
%50	%45	ExP	10	ExP
	%50		ExP	

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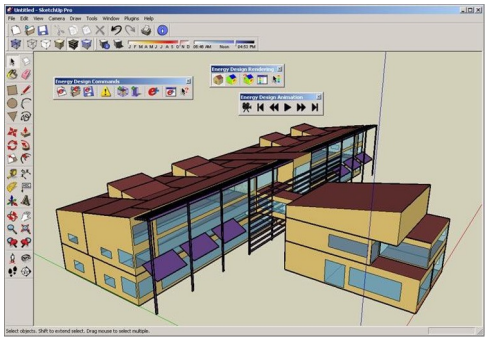
EA CREDIT 2: OPTIMUM ENERGY PERFORMANCE

v4.1 CHANGES ACCORDING TO GREENHOUSE GAS EMISSIONS SCORES

New Building	Hospitals, Comprehensive Repairs, CS	Scores (Outside of Schools and Hospitals)	Scores Hospitals	Scores Schools
%5	%2	1	1	1
%10	%5	2	2	2
%16	%10	3	3	3
%24	%16	4	4	4
%32	%24	5	5	5
%40	%32	6	6	6
%50	%40	7	7	7
%65	%50	8	8	
%80	%65	9	9	8
%100	%80	ExP	10	ExP
	%100		ExP	



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EA CREDIT 3: ADVANCED ENERGY METERING

OBJECTIVE

The main objective is to measure and monitor the amount of energy consumed at the building level to support Energy Management and provide additional energy savings.

It is essential to use existing energy measurement devices at the building level (i.e., analyzers), employ flow meters, or install new ones to obtain data reflecting the total energy consumption of the building. These include:

Electricity expenses,

Natural gas expenses,

Cooling tower water consumption,

Steam water consumption,

Fuel oil, propane, and biomass, which are

data related to the building's energy and water consumption. Flow meters are only acceptable if they measure the total energy consumption of the entire building.

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EA CREDIT 3: ADVANCED ENERGY MEASUREMENT

REQUIREMENTS

- The following advanced energy measurement meters must be installed in buildings:
- All energy sources used by the building.
- Any energy end-use unit representing 10% or more of the building's total annual consumption.
- The advanced energy measurement system must have the following features:
- The meters must be permanently installed, recorded at intervals of one hour or less, and able to transmit data to a remote location.
- Electricity meters must record both consumption and demand. Electricity meters should also record the power factor when necessary.
- The data collection system should use a local area network, building automation system, wireless network, or similar communication infrastructure.
- The system must be capable of storing all measurement data for at least 36 months.
- Data must be accessible remotely.
- All meters in the system must have the capability to report hourly, daily, monthly, and annual energy usage.

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EA CREDIT 3: ADVANCED ENERGY MEASUREMENT

REQUIREMENTS

- Advanced Energy Measurement Systems must have the following features:
- Counters must be permanently installed, all consumption records for 1 hour and under must be kept, and the collected data must be transferred to a data center.
- Electric Meters must record both consumption and demand. All building electricity meters should also record the power factor if possible.
- Data Collection Systems should utilize local area networks (LAN), building automation systems, wireless networks, or comparative communication infrastructures.
- The system must have the capacity to retain records for at least 36 months.
- Data must be remotely accessible.
- All meters within the system must have the capability to report energy consumption data on an hourly, daily, monthly, and annual basis.

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EA CREDIT 3: ADVANCED ENERGY MEASUREMENT

REQUIRED DOCUMENTS

Documents	All Projects
Locations of All Meters	✓
Ownership of Meters	✓
Letter Showing Commitment of the Project Owner	✓
Measured Systems	✓

REFERENCE STANDARDS

- American National Standards Institute, ANSI C12.20, Class 0.2 (±0.2)
- American National Standards Institute, ANSI B109
- EN Standard, EN-1434:Thermal energy (Btu meter or heat meter)

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EA CREDIT 4: DEMAND-RESPONSIVE ENERGY SYSTEMS

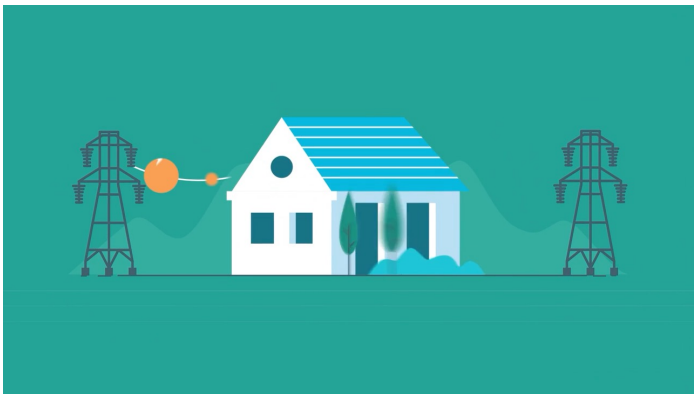
EA CREDIT 4: GRID HARMONIZATION (COMPATIBILITY)

PURPOSE

The main aim is to increase the use of energy production systems and technologies that respond to demand, making energy production and distribution systems more effective and efficient, increasing reliability, and reducing greenhouse gas emissions.

It is necessary to design the capacities of buildings and equipment with programs that respond to the demands of the users of the building and to adjust this by distributing or cutting the load at times.

Electricity production within the project site does not meet the content of this credit header.



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EA CREDIT 4: DEMAND RESPONSE ENERGY SYSTEMS

REQUIREMENTS

- 1. Condition: The Feasibility of Participating in Demand Response Programs (2 points)
- It is necessary to participate in an existing Demand Response (DR) program and complete the activities below:
- The system must be designed to be capable of real-time, fully automated DR based on external initiation by a DR Program Provider. It can practically be used in systems with semi-automation.
- It is necessary to commit to a contract with the DR Program Provider for at least 1 year. This contract must guarantee the provision of additional energy amounting to at least 10% of the estimated peak hour electricity capacity with the intent of renewing in the future. Peak hour demand is determined under the energy model with Minimum Energy Performance credit as the EA PREREQUISITE.
- A comprehensive plan should be made for building consumptions to determine the energy coverage rates pledged in the contract with the DR Program Provider.
- DR processes should be included in the job description of the Commissioning Specialist, and the Commissioning Specialist must involve at least 1 full testing operation included in the DR plan.

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EA CREDIT 4: DEMAND RESPONSE ENERGY SYSTEMS

REQUIREMENTS

- 2. Status: Situation of the Impossibility of the Program Responding to Demand (1 point)
- In order to enable the necessary infrastructure for future programs capable of responding to demand or dynamic, real-time pricing programs, the following activities need to be carried out:
- It is necessary to install meters that can log data at certain time intervals, ensure that they communicate via the building's automation system, and can accept external price and control signals.
- A comprehensive plan must be developed to distribute at least 10% of the building's projected peak hour energy demand when necessary.
- The peak hour demand is determined by an energy model under the credit title of Minimum Energy Performance, which is a PREREQUISITE for EA.
- DR processes must be included in the job description of the Commissioning Specialist, and the Commissioning Specialist should be involved in at least one full test procedure outlined in the DR plan.
- Contact should be established with representatives of local users to enable their participation in future DR Programs.

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EA CREDIT 4: ENERGY SYSTEMS THAT RESPOND TO DEMAND

REQUIRED DOCUMENTS

Documents	Status 1	Status 2
It must be proven that enrollment in the DR Program has taken place	✓	
Proof that 10% of peak hour energy demand can be distributed	✓	✓
Verification that the system is adequate for receiving and implementing external signals	✓	✓
Action plan to meet drop requirements during operations	✓	✓
Inclusion of the Commissioning Authority (CxA) in system test plans	✓	✓

REFERENCE STANDARDS

- None

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EA CREDIT 4: GRID INTEGRATION

LEED V4.1 CHANGES

- The requirement to test the Demand Responsive Business Plan has been added.
- Option 3: Load Flexibility and Management Strategies (1-2 points)
- Analyze the annual load shape and peak load of the building as calculated for the Minimum Energy Performance prerequisite.
- Review the regional grid load profile using the peak load or peak carbon emission metric. (The U.S. Environmental Protection Agency (EPA) provides Avoided Emissions and the genRation Tool (AVERT) regional grid emission data; local utilities may also provide this data.)
- Coordinate the examination of the building load shape and peak load by reviewing the regional load profile to identify the best value load management strategies the building can provide.
- Implement one or more of the load flexibility and management strategies up to a maximum of two points. These strategies are listed in the next screenshot.
- All projects must install interval meters so that the communication and interautomation system can accept an external price signal.

EA CREDIT 4: GRID RESILIENCE

LEED V4.1 CHANGES

- Load Flexibility and Management Strategies:
- Peak Load Optimization: demonstrate that the strategy reduces peak load by at least 10%. (1 point)
- Flexible Work Scenarios: the strategy's peak load should be at least 10% lower during a 2-hour time period (1 point)
- On-site thermal and/or electrical storage: the strategy's peak load should be at least 10% compared to peak electrical demand (1 point)
- Grid Flexibility Technologies: Leverage strategies such as utilities with on-site flexibility programs and partial load operation automatically earn this credit (1 point)
- Include the established technology in the scope of work of the authority that is being commissioned. Add load flexibility and management strategies and established technologies to the building systems guideline or include the existing facility requirements and operational maintenance plan if the project EA credit Enhanced Commissioning process is not being carried out.
- Contact local utility representatives to discuss participation in future DR programs and provide information about the benefits of building load flexibility and management strategies.

EA CREDIT 5: RENEWABLE ENERGY

PURPOSE

The main goal is to support and increase the use of renewable energy to minimize the environmental impact of fossil fuels.

Current Types of Renewable Energy:

Photovoltaic PV Systems
Wind Energy Systems
Solar Energy Systems
Bio-Fuel Systems (excluding burning of waste and painted wood)
Geothermal Heating Systems
Geothermal Electric Systems
Low Environmental Impact Hydroelectric Systems
Wave and Tidal Energy Systems

Note: Ground-source heat pumps, passive solar applications, daylighting strategies, etc. are not considered valid renewable energy systems.

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EA CREDIT 5: RENEWABLE ENERGY PRODUCTION

REQUIREMENTS

Renewable energy systems should be used to balance the energy consumption of the building. To find the percentage of renewable energy within the total energy consumption, the following equation is used:

% Renewable Energy = Equivalent cost of the usable energy produced by the renewable energy system / Equivalent cost of the building's total annual energy consumption.

If Option 1 has been implemented; the annual total energy cost of the building calculated under the Minimum Energy Performance, which is a prerequisite for EA, is used in the calculations.

If this option has not been implemented, these data are obtained from the U.S. Department of Energy's Commercial Buildings Energy Consumption Survey (CBECS) database, and the building's total annual energy consumption and cost is estimated.

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EA CREDIT 5: RENEWABLE ENERGY PRODUCTION

REQUIREMENTS

Solar panel fields and collective renewable energy systems are permitted with the fulfillment of at least one of the following requirements:

The project itself must have such a system or a lease agreement of at least 10 years must be signed.

If the system is positioned in the same service area as the technical public utility used.

The credits title has points as specified in Table 1 based on the fulfillment percentages of the leasing and ownership ratios mentioned in the lease agreement.

Renewable Energy %	Points	
	(outside C&S)	(C&S)
1%	1	1
3%	—	2
5%	2	3
10%	3	—

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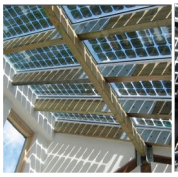
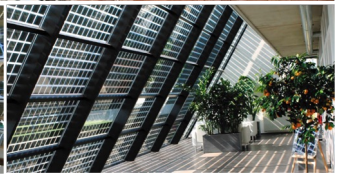
EA CREDIT 5: RENEWABLE ENERGY PRODUCTION

STRATEGIES

- Building Renewable Energy System Selection
- Positioning buildings suitable for Renewable Energy Systems
- Research on Renewable Energy Systems
- Ensuring the compatibility of Renewable Energy Systems with the building energy project





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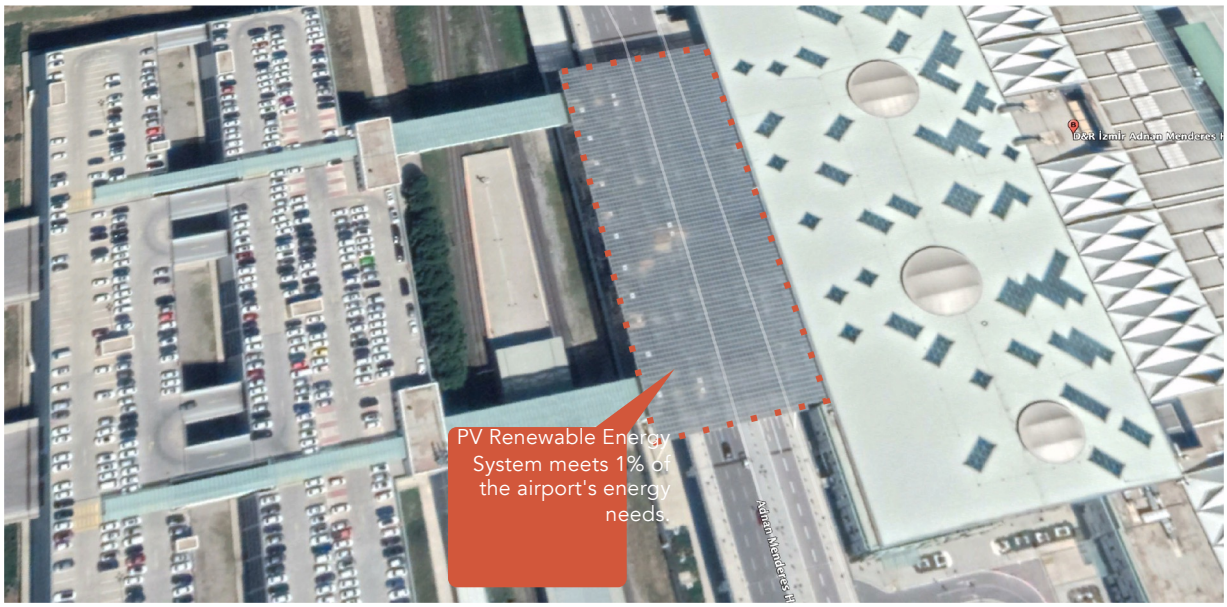
Izmir Adnan Menderes Airport PV Renewable Energy System



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EA CREDIT 5: RENEWABLE ENERGY PRODUCTION

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EA CREDIT 5: RENEWABLE ENERGY PRODUCTION

NECESSARY DOCUMENTS

Documents	Systems on Project Site	Third-party Owned Systems	Public Systems	If Selling RECs
Renewable System Rating Capacity	✓	✓	✓	✓
Calculations for Produced Energy Amount	✓	✓	✓	✓
Cost of Produced Renewable Energy	✓	✓	✓	✓
Annual Energy Cost Reporting	✓	✓	✓	✓
Contract Showing Durations		✓	✓	
Reports Showing Ownership Shares of Public Systems			✓	
Acquisition Costs for REC or Balance				✓
Green-e Certificates				✓

REFERENCE STANDARDS

- Center for Resource Solutions Green-e Program
- Commercial Building Energy Consumption Survey (CBECS)

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EA CREDIT 5: RENEWABLE ENERGY PRODUCTION

LEED V4.1 CHANGES

- Select one or more strategies for renewable energy supply from the categories below. Scores obtained in each category can be added up to a total of 5 points.
- Step 1: On-site renewable energy production
- Step 2: Facility-off renewable energy produced by a production asset/assets built in the last 5 years,
- or contracted to be operational within one year from the building's activity date and created by one of the following:
- Energy purchase in the project's grid sub-region
- or
- Purchase from a grid sub-region with higher greenhouse gas emission rates
- Step 3: Facility-off renewable energy produced by a production facility built in the last 5 years or contracted to be operational within one year after the building's occupancy

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EA CREDIT 5: RENEWABLE ENERGY PRODUCTION

LEED V4.1 CHANGES

- Select one or more strategies for renewable energy supply from the categories below. Points earned in each category can be added up to a total of 5 points.
- Phase 4: Off-site renewable energy that is certified by Green-e Energy or equivalent
- Phase 5: Off-site renewable energy produced by an eligible renewable energy resources production asset(s) that meets certification criteria (or equivalent) for preventing double counting and has a third-party eco-label standard.
- For all tiers, renewable energy must be contracted, owned, or leased for a period of 1 to 15 years. Contract lengths of less than 15 years will be rated linearly according to the 1 and 15 year values in Table 1. Shorter contract lengths may require the supply of renewable energy in amounts that exceed the building's annual energy use. For all tiers, the characteristics of the item (age, grid subregion, etc.)
- All eligible renewable electricity generation used to comply with this credit will be verified with Energy Attribute Certificates (EAC); the project owner must contract for renewable energy and demonstrate that the EACs are held on behalf of the LEED project. EACs must be purchased from renewable energy projects located in the country or region where the LEED project is located.
- Tier 1, Tier 2 and Tier 3 renewable energy can contribute to greenhouse gas reductions for the EA credit Energy Performance Optimization. When claiming the Energy Performance Optimization credit in the EA credit, it is required to calculate greenhouse gas emissions using hourly electricity greenhouse gas emission factors for the grid subregion of the projects and avoid emissions.
- Points are awarded according to Table 1 based on the total percentage of site energy use. Table 1. Points for Renewable Energy Procurement

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EA CREDIT 5: RENEWABLE ENERGY PRODUCTION

LEED v4.1 CHANGES

Points	Stage 1	Stage 2		Stage 3		Stage 4		Stage 5	
		15 Years	1 Year	15 Years	1 Year	15 Years	1 Year	15 Years	1 Year
1	2%	20%	150%	30%	225%	40%	300%	50%	375%
2	5%	30%	225%	40%	300%	60%	450%	75%	562.5%
3	10%	40%	300%	50%	375%	80%	600%		
4	20%	50%	375%	60%	450%				
5	40%	60%	450%	70%	525%				
EP	60%	70%	525%	80%	600%	100%	750%	100%	750%

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EA CREDIT 6: ADVANCED REFRIGERANT MANAGEMENT

OBJECTIVE

The main goal is to prevent damage to the ozone layer by refrigerants and minimize direct impacts on climate change by adhering to and supporting the Montreal Protocol.

Option 1: Not using refrigerants at all and using low-impact refrigerants (1 point)

Not using any refrigerants or using naturally occurring or synthetic refrigerants whose Ozone Depletion Potential (ODP) is zero or Global Warming Potential (GWP) is less than 50.

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EA CREDIT 6: ADVANCED REFRIGERANT MANAGEMENT

REQUIREMENTS

Option 2: Calculation of the Effects of Refrigerants (1 point)

The GWP and ODP values of the chosen refrigerants for the building's HVAC&R Heating, Ventilation, and Cooling Systems and Equipment must be very low.

The equipment should be selected according to the following formula:

$$LCGWP + LCODP \times 10\text{-}5 < 100$$

LCGWP: Life Cycle Global Warming Potential - GWP Global Warming Potential

LCODP: Life Cycle Ozone Depleting Potential - OPD Ozone Depletion Potential

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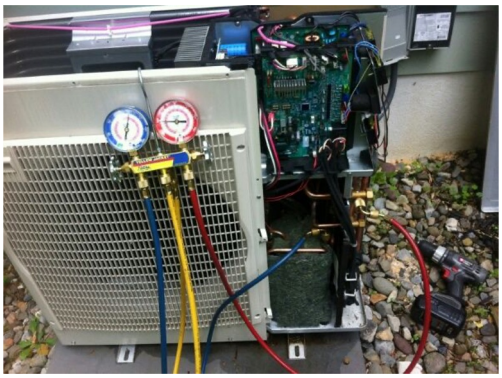
EA CREDIT 6: ADVANCED REFRIGERANT MANAGEMENT

REQUIREMENTS

LCGWP + LCODP x 105<100

LCGWP: [ODP x (Lr x Life + Mr) x Rc] / Life
LCODP: [GWP x (Lr x Life + Mr) x Rc] / Life
ODPr: lds CFC 11 / ton-year
GWPr: lbs CO2 / ton-year

Lr : Fluid leakage rate (%0.5 to %2, default %2)
Mr : Fluid end-of-life loss (%2 to %10, default %10)
Rc : Fluid amount (0.5 to 5.0 lbs per ton refrigeration capacity)
Life : Device lifespan (default 10 years)



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EA CREDIT 6: ADVANCED REFRIGERANT MANAGEMENT

REQUIREMENTS

In the Case of Different Refrigerants:

$$\Sigma \frac{(LCGWP + LCODP \times 105) \times Qunit}{Qtotal} < 100$$

Qunit : Total cooling capacity of the device (tons)
Qtotal : Total cooling capacity of the system (tons)

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EA CREDIT 6: ADVANCED REFRIGERANT MANAGEMENT

REQUIREMENTS

REFRIGERANT	ODP	GWP	APPLICATION AREA
Chlorofluorocarbons - CFC			
CFC-11	1	4,680	Chiller
CFC-12	1	10,720	Refrigerator, Chiller
CFC-14	0.94	9,800	Chiller
CFC-500	0.605	7,900	Chiller, Dehumidifier
CFC-502	0.221	4,600	Low temperature cooling
Hydrochlorofluorocarbons - HCFC			
HCFC-22	0.04	1,780	Air conditioning, Chiller
HCFC-123	0.02	76	Replaces CFC-11

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EA CREDIT 6: ADVANCED REFRIGERANT MANAGEMENT

REQUIREMENTS

REFRIGERANT	ODP	GWP	APPLICATION AREA
Hydrofluorocarbons - HFC			
HFC-23	≃ 0	12,240	Ultra-low temperature refrigeration
HFC-134a	≃ 0	1,320	As a replacement for CFC-12 or HCFC-12
HFC-245fa	≃ 0	1,020	Insulation contribution, Chiller
HFC-404A	≃ 0	3,900	Low temperature refrigeration
HFC-407C	≃ 0	1,700	Replaced HCFC-22
HFC-410A	≃ 0	1,700	Air conditioning systems
HFC-507A	≃ 0	1,890	Low temperature refrigeration
Natural Refrigerants			
CO2	0	1	
Ammonia (NH3), Water	0	0	

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EA CREDIT 6: ADVANCED REFRIGERANT MANAGEMENT

Abbreviation	Factor	Drop Down	Window AC, heat pumps	Window AC, heat pumps
	Equipment Type	#	R-410a	R-22
N	Number of Units	Drop Down	5	3
	Refrigerant Type	Tons	2.00	2.33
Q	Tons of Cooling	lbs	4	3
Total r Charge	pounds	lbs / ton	8	7
Rc	Normalized Refrigerant Charge	NA	2%	2%
ODPr	Ozone Depletion Potential	NA	0	0
GWPr	Global Warming Potential	%	1890	1890
Lr	Annual Leakage Rate (1)	%	10%	10%
Mr	End of Life Refrigerant Loss (2)	years	113.4	132.3
Life	Equipment Life	NA	10	10
LCODP	Lifecycle ODP	NA	0	0
LCGWP	Lifecycle GWP	ODP	113.4	132.3
Score			Non-Compliant	Non-Compliant
Compliance (Score < 100 = Compliant)			Combination	1 & 2 Combined

For Multiple System Types		
	Weighted Average Score	119.3
	Compliance (Score < 100 = Compliant	Non-Compliant
	GWP	APPLICATIONS

(1) default value is 2% (enter manufacturer's data to override)
(2) default value is 10% (enter manufacturer's data to override)

Lookup Tables			
Refrigerant	HCFC or HFC	0.020	1.780
R-123	HCFC	0.040	76
R-22	HCFC	0.000	12.240
R-23	HFC	0.000	1.320
R-32	HFC	0.000	550
R-134a	HFC	0.000	1.020
R-152a	HFC	0.000	120
R-245fa	HFC	0.000	3.900
R-404a	HFC	0.000	1.700
R-407c	HFC	0.000	1.890
R-410a	HFC	0.000	3.900
R-507a	Window AC, heat pumps	System 1	System 2

Default Equipment Life		
	Unitary, Split, and Packaged AC units & Heat pumps	10
	reciprocating compressors and reciprocalling chillers	15
	Centrifugal and absorption chillers	20
	Units	23

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EA CREDIT 6: ADVANCED REFRIGERANT MANAGEMENT

REQUIRED DOCUMENTS

Documents	Option 1	Option 2
Confirmation that refrigerants will not be used or that low-impact alternatives will be used	✓	
Equipment Type		✓
Equipment Cooling Capacity		✓
Quantity of Equipment		✓
Refrigerant Type		✓
Refrigerant Fillings (along with supporting documents)		✓
Refrigerant Filling Calculations (for VRF systems only)		✓
Equipment Lifespan (along with supporting documents)		✓
Refrigerant Equipment Table or GreenChill Certificate (for commercial refrigeration systems)		✓
Leak test results (for commercial refrigeration systems only)		✓

REFERENCE STANDARDS

- US EPA Clean Air Act, Title VI, Section 608, Compliance with the Section 608 Refrigerant Recycling Rule

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EA CREDIT 7: GREEN ENERGY AND CARBON CERTIFICATION

PURPOSE

The main aim is to support the use of self-sufficient renewable energy sources to minimize the impact of fossil fuels on the environment and the economy and to take measures to reduce carbon emissions.

Since January 1, 2005, contracts must be signed with suitable energy providers that have come online for at least 5 years.

These contracts should demonstrate that at least 50% or 100% of the project's energy needs are met from Green Energy Sources, Carbon Certificates, or Renewable Energy Certificates (REC).

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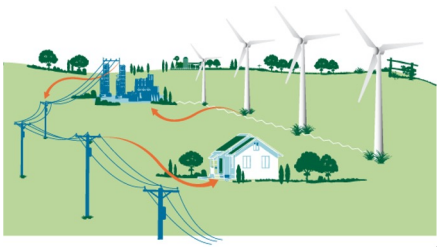
EA CREDIT 7: GREEN ENERGY AND CARBON CERTIFICATE



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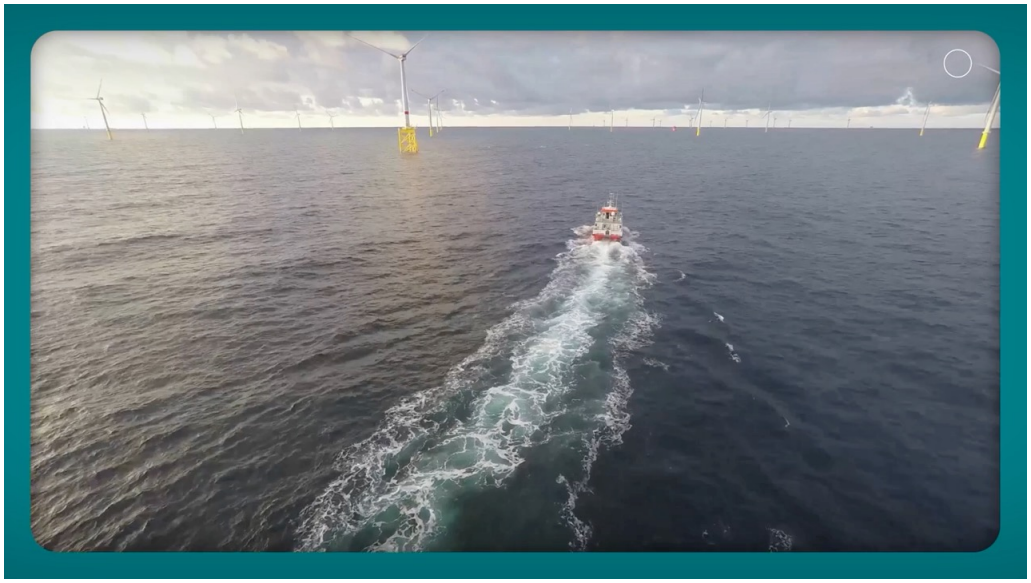
RENEWABLE ENERGY SYSTEMS ALSO HAVE ENVIRONMENTAL IMPACTS



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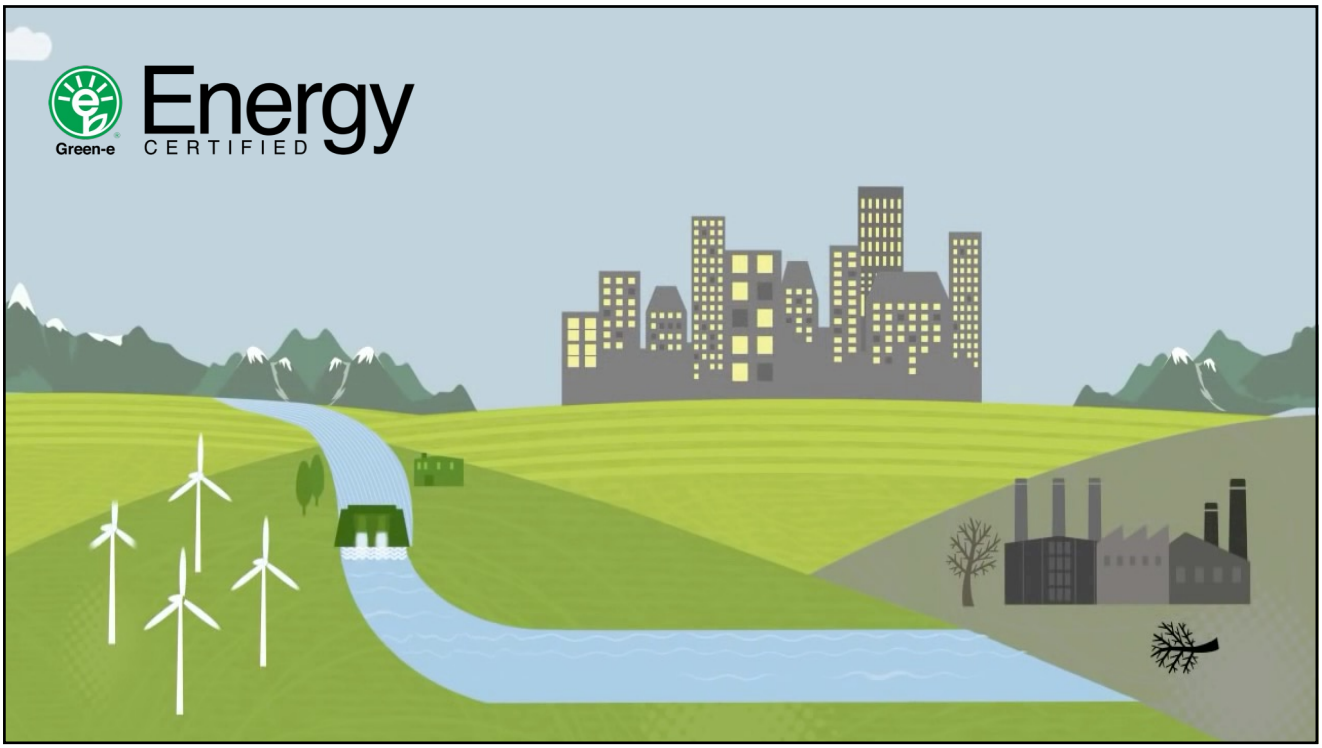

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REC - WHAT IS A RENEWABLE ENERGY CERTIFICATE?

Renewable Energy Certificates (RECs); are an extensively used system in Europe and America aimed at promoting renewable energy investments and consumption.

This system allows for the tracking of each unit of electricity from its source to the final consumer, with the goal of creating a reliable market. For every 1 MWh of electricity produced from renewable energy facilities, a certificate is generated.

There are two main types of renewable energy certificate systems in the world; I-REC and EKOenergy.

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EA CREDIT 7: GREEN ENERGY AND CARBON CERTIFICATE

REQUIREMENTS

Green energy and REC certificates must be certified by Green-e Energy or documented as green by an equivalent organization. REC certificates can be used to offset the effects of electricity consumption in Option 2.

Carbon certificates can be used to offset carbon emissions from CO2 measurements in Options 1 and 2 – an equal or equivalent standard would also be the Green-e Climate Certificate or a similar equivalent.

For US Projects, the carbon certificates used must come from projects that reduce greenhouse gas emissions made within America.

The percentage of green energy or carbon certificates to be used should be based on the amount of energy consumed, not on costs.

Table 1. Energy Points from Green Energy or Carbon Certificates

Percentage of Total Energy from Green Energy, RECs, and/or Carbon Certificates	Points
%50	1
%100	2

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EA CREDIT 7: GREEN ENERGY AND CARBON CERTIFICATION

REQUIRED DOCUMENTS

Documents	All Projects
Calculation of Annual Electricity and Non-Electric Energy Uses	✓
Calculations Indicating How Much REC, Green Energy, and Carbon Certification Is Required to Reach the Target Score Threshold	✓
Purchase Contract or Letter of Intent for REC, Green Energy, and Carbon Certification Required to Be Purchased to Reach the Target Score Threshold	✓
Green-e Equivalence Report, If Not Green-e Certified	✓

REFERENCE STANDARDS

- Green-e Energy and Green-e Climate
- Commercial Building Energy Consumption Survey (CBECS)
- Building Owners and Managers Association (BOMA)
- ENERGY STAR Portfolio Manager: Methodology for Greenhouse Gas Inventory and Tracking Calculations
- Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2010. Annex 2 Methodology and Data for Estimating CO2 Emissions from Fossil Fuel Combustion:
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories
- eGRID2012 Version 1.0—U.S. Environmental Protection Agency
- WRI-WBCSD Greenhouse Gas Protocol

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EA CREDIT 7: GREEN ENERGY AND CARBON CERTIFICATE

DIFFERENCES OF LEED v3

- In addition to electricity, credit now also considers the use of energy sources other than electricity in the carbon certificate acquisition calculations.
- It has been defined as a requirement to have a 5-year agreement for the source to be purchased, and the source must be available online since January 1, 2005, and distribute profit at least once a year.
- Point thresholds:
- Increased to 50% for 1 point,
- Increased to 100% for 2 points.

Green-e Energy CERTIFIED

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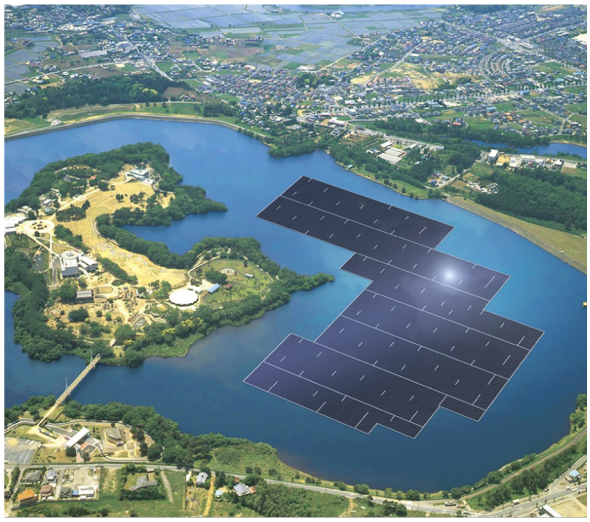
EA CREDIT 5: RENEWABLE ENERGY PRODUCTION

LEED v4.1 CHANGES

This credit title has been placed under the renewable energy credit title in V4.1 and has been removed as a separate credit title.



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