

BEYOND

SMART CITIES

ENERGY MANAGEMENT AND AUDIT - CEM

REFRESHER TRAINING COURSE

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP

CEM REFRESHER TRAINING COURSE

ENERGY MANAGEMENT SPECIALIST

BEYOND SMART CITIES

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HIGH PERFORMANCE GREEN BUILDINGS

FOR ENERGY PROFESSIONALS

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ENERGY SPECIALIST CURRICULUM COURSE

ENERGY MANAGEMENT SPECIALIST

BEYOND SMART CITIES

LEARNING OBJECTIVES

LEED PROGRAM AND BENEFITS

LEED CERTIFICATION & SYSTEMS VERIFICATION

BENEFITS OF LEED COMMISSIONING

GLOBAL SUSTAINABILITY ASSESSMENT SYSTEM (GSAS) PROGRAM

SYSTEMS COMMISSIONING ,GUIDELINES FOR SYSTEMS COMMISSIONING

ENERGY MANAGEMENT SPECIALIST

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SUSTAINABILITY DEFINED

Design Ecology Project: Sustainability is a state or process that can be maintained indefinitely. The principles of sustainability integrate three closely intertwined elements - the environment, the economy, and the social system - into a system that can be maintained in a healthy state indefinitely.

Brundtland Commission of the UN: Development is sustainable "if it meets the needs of the present without compromising the ability of future generations to meet their own needs."

ASHRAE defines Sustainability: "Providing for the needs of the present without detracting from the ability to fulfill the needs of the future."

Sustainable Design - Green Buildings Are designed & constructed in accordance with practices that significantly reduce or eliminate the cradle to grave negative impacts of buildings on the environment and occupants in five broad areas:



LEED PROGRAM AND BENEFITS

LEED provides a framework for healthy, efficient, carbon and cost-saving green buildings. LEED certification is a globally recognized symbol of sustainability achievement and leadership.

LEED certified buildings save money, improve efficiency, lower carbon emissions and create healthier places for people. They are a critical part of addressing climate change and meeting ESG goals, enhancing resilience, and supporting more equitable communities.

To achieve LEED certification, a project earns points by adhering to prerequisites and credits that address carbon, energy, water, waste, transportation, materials, health and indoor environmental quality.

Projects go through a verification and review process by GBCI and are awarded points that correspond to a level of LEED certification: Certified (40-49 points), Silver (50-59 points), Gold (60-79 points) and Platinum (80+ points).



LEED RATING SYSTEM GOALS

LEED is a holistic system that doesn't simply focus on one element of a building such as energy, water or health, rather it looks at the big picture factoring in all of the critical elements that work together to create the best building possible.

In fact, 35% of the credits in LEED are related to climate change, 20% of the credits directly impact human health, 15% of the credits impact water resources, 10% of the credits affect biodiversity, 10% of the credits relate to the green economy, 5% of the credits impact community and 5% of the credits impact natural resources. In LEED v4.1, a majority of the LEED credits are related to operational and embodied carbon.



LEED RATING SYSTEM GOALS +

Reduce contribution to global climate change

Enhance individual human health

Protect and restore water resources

Protect and enhance biodiversity and ecosystem

Promote sustainable and regenerative material cycles

Enhance community quality of life





ENERGY AND ATMOSPHERE



The Energy and Atmosphere (EA) category approaches energy from a holistic perspective, addressing energy use reduction, energy-efficient design strategies, and renewable energy sources

CRITERIA IN THIS CATEGORY

EA PR FUNDAMENTAL COMMISSIONING AND VERIFICATION

EA PR MINIMUM ENERGY PERFORMANCE

EA PR BUILDING-LEVEL ENERGY METERING

EA PR FUNDAMENTAL REFRIGERANT MANAGEMENT

EA CR ENHANCED COMMISSIONING/EA CR OPTIMIZE ENERGY PERFORMANCE

EA CR ADVANCED ENERGY METERING / EA CR DEMAND RESPONSE

EA CR RENEWABLE ENERGY PRODUCTION / ENHANCED REFRIGERANT MANAGEMENT

MAXIMUM POSSIBLE CREDITS : 4 P / 33 C

EA - PR- CONSTRUCTION

FUNDAMENTAL COMMISSIONING AND VERIFICATION

INTENT

To support the design, construction, and eventual operation of a project that meets the owner's project requirements for energy, water, indoor environmental quality, and durability.

POTENTIAL TECHNOLOGIES & STRATEGIES

☒The qualified commissioning authority (CA) chosen to represent the owner's needs should be brought in early in the design process. As a third party, the CXA can verify early on that the architect's and engineers' designs meet the owner's project requirements. During the construction phase, the commissioning team, led by the CXA, will verify that contractors install and program the systems correctly according to the design.

REQUIREMENTS

Complete the following commissioning (Cx) process activities for mechanical, electrical, plumbing, and renewable energy systems and assemblies, in accordance with ASHRAE Guideline 0-2013 and ASHRAE Guideline 1.1-2007 for HVAC&R Systems, as they relate to energy, water, indoor environmental quality, and durability. Develop the OPR. Develop a BOD.

IMPLEMENTATION

REQUIRED DOCUMENTATION

Documentation	All projects
Commissioning plan	X
Commissioning report	X
List of systems to be commissioned	X
Verification of Cx activities and results	X
Cx plan	X
Documentation of testing and verification	X
OPR, OPRN	X
Cx report	X

Documentation	All equipment	Phase-out required
Equipment type		X
Refrigerant type		X
CFC conversion or replacement plan		X
Refrigerant leakage info, quantity		X
Phase-out completion date		X
Confirmation that no new or existing equipment contains CFCs	X	

EA- CR(6) - DESIGN

ENHANCED COMMISSIONING

INTENT

To further support the design, construction, and eventual operation of a project that meets the owner's project requirements for energy, water, indoor environmental quality, and durability.

POTENTIAL TECHNOLOGIES & STRATEGIES

Enhanced commissioning is a natural extension of the fundamental commissioning (Cx) process. It provides owners, via the commissioning authority (CxA), further oversight and verification that the building will meet their expectations and requirements beyond the first day of occupancy. Enhanced commissioning gives the CxA the power to act as the owner's advocate by conducting in-depth reviews of the basis of design, design documents, and construction submittals. Training and a postconstruction verification visit are some of the enhancements that contribute to ongoing quality building control and operations.

REQUIREMENTS

Implement, or have in place a contract to implement, the following commissioning process activities in addition to those required under EA Prerequisite Fundamental Commissioning and Verification.

The commissioning authority must do the following:

- ✓ Review contractor submittals.
- ✓ Verify inclusion of systems manual requirements in construction documents.
- ✓ Verify inclusion of operator and occupant training requirements in construction documents.
- ✓ Verify systems manual updates and delivery.
- ✓ Verify operator and occupant training delivery and effectiveness.
- ✓ Verify seasonal testing.
- ✓ Review building operations 10 months after substantial completion.
- ✓ Develop an on-going commissioning plan. Include all enhanced commissioning tasks in the OPR and BOD.

IMPLEMENTATION

REQUIRED DOCUMENTATION

Documentation	Option 1_Path 1	Option 1_Path 2	Option 2
List of all tasks completed as part of Co activities	X	X	X
Training outline and participation list	X	X	X
Confirmation of systems manual delivery	X	X	X
Ongoing Co plan	X	X	X
Inclusion of monitoring and tracking in Co plan		X	
Inclusion of evaluation in Co plan			X
Verification of additional reviews per Data Center requirements (data centers only)	X	X	

EA- CR(18) - DESIGN

OPTIMIZE ENERGY PERFORMANCE

INTENT

To achieve increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic harms associated with excessive energy use that disproportionately impact frontline communities.

POTENTIAL TECHNOLOGIES & STRATEGIES

Create an energy model of the proposed design, or expand the scope of the preliminary model, to analyze HVAC system alternatives early in the design process (see EA Prerequisite Minimum Energy Performance, Further Explanation, Modeling Potential HVAC Systems).

REQUIREMENTS

Analyze efficiency measures during the design process and account for the results in design decision making. Use energy simulation of efficiency opportunities, past energy simulation analyses for similar buildings, or published data (e.g., Advanced Energy Design Guides) from analyses for similar buildings. Analyze efficiency measures, focusing on load reduction and HVAC-related strategies (passive measures are acceptable) appropriate for the facility. Project potential energy savings and holistic project cost implications related to all affected systems.

IMPLEMENTATION

REQUIRED DOCUMENTATION

Documentation	Option 1	Option 2
Appendix G energy modeling inputs	X	
Input and output reports from modeling software	X	
Renewable energy (if applicable)		X
Exceptional calculations (if applicable)	X	
Target Pexco results and summary	X	X
Energy consumption and demand for each building and use and fuel type	X	
Fuel rates	X	
AEQG compliance tables		X
List of process equipment efficiencies (detail only)		X

EA- CR(1) - DESIGN

ADVANCED ENERGY METERING

INTENT

To support energy management and identify opportunities for additional energy savings by tracking building-level and system-level energy use.

POTENTIAL TECHNOLOGIES & STRATEGIES

- Design and install an advanced metering system.
- Refer to the credit requirements for types of equipment, measurement frequency, communication protocols, and data storage requirements (see Further Explanation, Meter Selection).
- Locate the meters to capture the usage of major end users (see Further Explanation, Electricity Metering Strategies).
- Install and calibrate the meters according to the manufacturers' recommendations

REQUIREMENTS

Install advanced energy metering for the following:

- ☒ all whole-building energy sources used by the building; and
- ☒ any individual energy end uses that represent 10% or more of the total annual consumption of the building.

IMPLEMENTATION

REQUIRED DOCUMENTATION

Documentation	All projects
List of all advanced meters to be installed, including type, energy source metered	X
Manufacturers' cutsheets	X

HOW DO CXA AGENTS USE LEED

Reviewing design plans to ensure they meet owner's objectives and LEED Certification requirements

Providing commissioning services required by LEED Certification requirements

Ensuring that equipment and systems are functioning at the efficiency level for which they were designed

Scheduling site visits and tests throughout the construction cycle to ensure on-going efficiency

Modifying control programs to enhance occupant comfort while reducing energy consumption and increasing operational efficiency



BENEFITS OF LEED COMMISSIONING

Identifying Energy Conservation Measures (ECMs)

Evaluating potential rebates

Tenant/Occupant Comfort

Identifying possible future operational issues

Promote sustainable and regenerative material cycles

Enhance community quality of life



BENEFITS OF GREEN BUILDINGS

Environmental Benefits - reduced impacts on natural resource consumption

Economic Benefits - improves the bottom line - savings through efficiency and productivity

Health and Safety Benefits - enhanced occupant comfort/health

Community Benefits - minimize strain on local infrastructures and improve the quality of life

Reduced Operating Costs - primarily through energy savings - lower energy bills by 20% to 50%

Optimized Life - cycle economic performance vs. minimum first cost emphasis.

Increased Building Valuation - use the formula: asset value increases at ten times the reduction in operating cost on an annual cost per sq. ft basis, Decreased vacancies /Reduced liability - improves risk management.



GSAS PROGRAM AND BENEFITS



The primary objective of GSAS is to create a sustainable built environment, considering the specific needs and context of the region.

GSAS certifications aim to evaluate the sustainability of the built environment through providing a performance-based approach for assessment, considering the reduction of the environmental impacts of the built environment by adopting the best practices.

GSAS aims to promote the adoption of sustainability into regulatory requirements and building codes, hence making sustainability business as usual (QCS 2014 Qatar Construction Specifications (Section 7) -Green Constructions) .



ENERGY



The Energy category is concerned with improving the design and energy performance of the development having a direct and positive impact on both the consumption of resources and environmental quality including climate change, fossil fuel depletion, air pollution and human comfort, health and well-being.

CRITERIA IN THIS CATEGORY

E.1 THERMAL ENERGY DEMAND PERFORMANCE

E.2 ENERGY USE PERFORMANCE

E.3 PRIMARY ENERGY PERFORMANCE

E.4 CO2 EMISSIONS

E.5 ENERGY SUB-METERING

E.6 RENEWABLE ENERGY

MAXIMUM POSSIBLE SCORE POINT: 18 [24%]

QCS- MANDATORY

INTENT

To minimize the building energy demand through the establishment of GSAS thermal energy demand performance.

POTENTIAL TECHNOLOGIES & STRATEGIES

The criterion requires assessing the annual thermal energy demand of the building by calculating the EPC value using GSAS Energia Suite™. The assessment considers the thermal energy demand associated with the external and internal heat gains of the building.

E.1 THERMAL ENERGY DEMAND PERFORMANCE

REQUIREMENTS

- 1.The Project will assess GSAS energy performance coefficient of the thermal energy demand (EPCdem) in relation to applicable GSAS benchmark.
- 2.The Project will complete GSAS Energia Suite™ for E1 Thermal Energy Demand Performance to establish the criterion development based on the evidence obtained from the infrastructure providers.

GSAS ONLINE SUBMITTALS

Provisional Certification Stage (LOC)	
Types	Descriptions
Documents	A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions.
	Relevant HVAC design drawings, specifications, cooling load and other supplementary calculations.
	Relevant architectural design drawings and specifications of the window and wall glazing.
Tool	GSAS Energia Suite™.

QCS- MANDATORY

INTENT
To reduce the dependence on fossil-based primary energy supply and delivery network through the establishment of GSAS primary energy performance.

POTENTIAL TECHNOLOGIES & STRATEGIES
Determine the cooling system information,the ventilation and pump system information,the renewable energy system design information ,he system of controls for the HVAC system ,hot water generation system,renewable energy system. Input the data into GSAS Energia Suite™ to determine the EPC value for E.2 Energy Use Performance.

E.2 ENERGY USE PERFORMANCE

REQUIREMENTS
1.The Project will assess CSAS energy performance coefficient of the primary energy (EPCpri) in relation to applicable CSAS benchmark.
2.The Project will complete GSAS Energia Suite™ for E.3 Primary Energy Performance to establish the criterion level.

GSAS ONLINE SUBMITTALS

Provisional Certification Stage (LOC)	
Types	Descriptions
Documents	A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions.
	Relevant HVAC design drawings, specifications, cooling load and other supplementary calculations.
	Relevant architectural design drawings and specifications of the window and wall glazing.
Tool	GSAS Energia Suite™.

QCS- MANDATORY

INTENT
To reduce the dependence on fossil-based primary energy supply and delivery network through the establishment of GSAS primary energy performance.

POTENTIAL TECHNOLOGIES & STRATEGIES
Determine the primary energy sources of the delivered energy to the site. Input the data into GSAS Energia Suite™ to determine the EPC value for E.3 Primary Energy Performance. Prepare all applicable documentation.

E.3 PRIMARY ENERGY PERFORMANCE

REQUIREMENTS
1.The Project will assess GSAS energy performance coefficient of the primary energy (EPCpri) in relation to applicable GSAS benchmark.
2.The Project will complete GSAS Energia Suite™ for E.3 Primary Energy Performance to establish the criterion level.

GSAS ONLINE SUBMITTALS

Provisional Certification Stage (LOC)	
Types	Descriptions
Documents	A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions.
	Relevant HVAC design drawings, specifications, cooling load and other supplementary calculations.
	Relevant architectural design drawings and specifications of the window and wall glazing.
Tool	GSAS Energia Suite™.

QCS- MANDATORY

INTENT
To establish CO2 emissions performance associated with the primary energy supply and delivery network.

POTENTIAL TECHNOLOGIES & STRATEGIES
1.Determine the mix of primary energy supply.
2.Input the data into GSAS Energia Suite™ to determine the EPC value for E.4 CO2 Emissions.
3.Prepare all applicable documentation.

E.4 CO2 EMISSIONS

REQUIREMENTS
1. The Project will assess GSAS energy performance coefficient of the CO2 emissions (EPCCO2) in relation to applicable GSAS benchmark.
2.The Project will complete GSAS Energia Suite™ for E.4 CO2 Emissions to establish the criterion level.

GSAS ONLINE SUBMITTALS

Provisional Certification Stage (LOC)	
Types	Descriptions
Documents	A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions.
	Relevant HVAC design drawings, specifications, cooling load and other supplementary calculations.
	Relevant architectural design drawings and specifications of the window and wall glazing.
Tool	GSAS Energia Suite™.

QCS- MANDATORY

INTENT
To install sub-meters for monitoring the major energy consuming systems.

POTENTIAL TECHNOLOGIES & STRATEGIES
1.Partial compliance for this criterion demonstrates the installation of sub-meters for HVAC, lighting, and fan-motors. •
2.Full compliance for this criterion demonstrates the installation of sub-meters for all major energy-consuming systems.

E.5 ENERGY SUB-METERING

REQUIREMENTS
1.The Project will assess the installation of energy sub-meters for monitoring the major energy consuming systems.
2.The Project will prepare the Energy Sub-Metering plan to establish the criterion level.

GSAS ONLINE SUBMITTALS

Provisional Certification Stage (LOC)	
Types	Descriptions
Documents	A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions.
	Relevant design drawings, diagrams, and specifications.
	Where applicable, the BMS schedule of points and control system showing the energy sub-metering system integration with the BMS.
Plan	Energy Sub-Metering Plan.

QCS- MANDATORY

INTENT
To install on-site renewable energy generation systems.

POTENTIAL TECHNOLOGIES & STRATEGIES
1.Determine the provision of a renewable energy system for generating and distributing power generated from renewable sources.
2.Determine the testing and commissioning report of the renewable energy system. •
3.Determine the training program for the proper calibration, use, care, & upkeep of the renewable energy system.

E.6 RENEWABLE ENERGY

REQUIREMENTS
1.The Project will assess the installation of on-site renewable energy generating systems with the capacity to contribute to the total annual energy need of the development.
2.The Project will prepare the Renewable Energy plan to establish the criterion level.

GSAS ONLINE SUBMITTALS

Provisional Certification Stage (LOC)	
Types	Descriptions
Documents	A narrative explaining the approach undertaken for the criterion assessment and highlighting the basis of any assumptions.
	Relevant design drawings, diagrams, and specifications.
	Where applicable, the BMS schedule of points and control system showing the renewable energy system integration with the BMS.
Plan	Renewable Energy Plan.

GUIDELINES FOR SYSTEMS CXA

Consider introducing a commissioning program at the commencement of the project.

Appoint a qualified commissioning party to be responsible for leading the commissioning process, coordinating with the development team throughout the design and construction phases to ensure proper

Develop the OPR in conjunction with the project owner and ensure the requirements are quantifiable and measurable to verify that the development objectives will be achieved.

Review and verify that the commissioning requirements have been included within the construction documents and development specifications.




