CEM®

Certified Energy Manager

A Certification for Energy Professionals that spearheads the optimization of energy performance across facilities, campuses, buildings, or industrial plants with a keen focus on sustainability and energy efficiency.

CERTIFICATION SCHEME **2.0**

Version No: 1.0
Effective Date: 5/1/2024

Association of Energy Engineers®

Scope

The Certified Energy Manager (CEM®) is an individual who optimizes the energy performance of a facility, building, industrial plant or campus. The CEM® is a systems integrator for electrical, mechanical, process and building infrastructure, analyzing the optimum solutions to reduce energy consumption in a cost-effective approach.

Certified Energy Managers® demonstrate competency in the following areas that are included in the CEM® Body of Knowledge to gain certification: energy and sustainability policies, codes and standards, energy rates, tariffs and supply options, energy audits and instrumentation, energy accounting and economics, electrical power systems and motors, lighting systems, HVAC systems and building envelope, building automation, controls and artificial intelligence systems, energy storage systems, boiler and steam systems, distributed generation and renewable energy systems, industrial systems, operations, maintenance and commissioning, energy savings performance contracting, and measurement & verification.

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Eligibility Requirements for Competence

Individuals applying for the CEM Certification Examination must attend an approved preparatory training course, meet the following education, and experience requirements, and complete a certification application.

Education and Experience Requirements

Education		Work Experience
4-year or Level 6 European Qualifying Framework (EQF) engineering/architectural degree* OR Professional Engineer (PE) OR Registered Architect (RA) OR Current status of Certified Energy Manager (CEM®)	and	3+ years related experience
4-year or Level 6 European Qualifying Framework (EQF) degree* in technology, environmental science, physics, or earth science*	and	4+ years related experience
4-year or Level 6 EQF degree* in any major or 3-year diploma	and	5+ years related experience
2-year or Level 5 EQF degree* in Energy Management	and	6+ years related experience
2-year or Level 5 EQF degree* Technical	and	8+ years related experience
NONE		10+ years related experience

*or equivalent degree
Related experience in energy engineering or energy management.

Competencies

1. Know the techniques of energy optimization and its application to buildings and industrial plants, detecting and evaluating the opportunities for saving and improving energy efficiency.

2. Apply the principles of efficient use of energy.

3. Know the methods of analysis and management for the implementation of energy saving and efficiency measures to buildings and industrial plants.

4. Be able to perform an energy audit of buildings or industrial plants, obtaining a reliable knowledge of energy consumption to identify where and how energy is consumed and the factors that affect the different processes.

5. Apply the knowledge of generation and distribution of compress air and electric technologies applicable to the building or industrial sector.

6. Ability to perform energy analysis in buildings or industrial plants facilities (calculation of yields, primary energy consumption, demands, etc.).

7. Ability to provide solutions and technological proposals to improve the efficiency in the energy consumption of a facility.

8. Apply knowledge of generation and distribution of heat or cold to facilities and know the different configurations of cogeneration – multigeneration applicable to the building and the industrial sector.

9. Know and apply knowledge of basic sciences and technologies to the practice of Energy Engineering.

10. To have the ability to analyze available data in an appropriate manner to determine the potential opportunities that might exist across products, systems and processes and determine reasonable estimates of levels of energy improvement/ reduction that can be achieved.

11. Ability to plan and manage time with given constraints.

12. Calculate an economic evaluation of the proposed improvement opportunities.

Examination Requirements for Competence

To earn the CEM® Certification, candidates must pass the certification examination. The competency requirements assessed are the following:

Certified Energy Manager® - Examination Blueprint

Body of Knowledge / Duties and Tasks (% Exam)	
1	**Energy and Sustainability Policies, Codes and Standards (6% - 8%)** *20XX stands for current year of standard
101	Climate Change & Decarbonization Policies
102	Sustainable Development Goals & Policies
103	United Nations Sustainable Development Goals (SDGs)
104	Electrification Policies
105	Nuclear Policies & Approaches
106	Local and National Tax Incentives
107	GHG Accounting & Reporting (including Carbon Footprint Calculations)
108	ESG (Environmental, social and governance), CSR (Corporate Social Responsibility) Reporting
109	Net Zero Buildings
110	Smart Cities
111	Transition to Clean Energy
112	Climate Change Risk, Resiliency and Adaptation
113	Green Hydrogen Approaches
114	Circular Economy in Energy
115	ASHRAE/IESNA Standard 90.1-20XX
116	ASHRAE Standard 90.2-20XX
117	ASHRAE Standard 62.1 -20XX
118	Indoor Environmental Quality
119	ASHRAE Standard 135-20XX
120	ASHRAE Standard 189.1- 20XX

Certified Energy Manager - Examination Blueprint

1	**Energy and Sustainability Policies, Codes and Standards (6% - 8%)** *20XX stands for current year of standard
121	ASHRAE Guideline 14-20XX
122	ASHRAE Standard 211-20XX
123	IEEE PQ Standard 519
124	International Energy Conservation Code (IECC)
125	ISO 50001
126	Sustainable Design
127	International Green Building Rating Systems
128	LEED Certifications & Accreditations
129	ENERGY STAR Ratings & Tools
130	Cyber-Security Issues

2	**Energy Rates, Tariffs and Supply Options (5% - 7%)**
201	Basic Energy Units and Conversions
202	Fuel & Electricity Procurement
203	Point of Use Costs
204	Supply and Demand Impact on Pricing
205	Fuel Price Risks
206	Rate Structure & Analysis (energy, water and sewer)
207	Ratchet and Contract Clauses
208	Peak Demand Reduction
209	Evaluating Supply Options
210	Trends in Deregulation
211	Selection of Energy Supplier in a Deregulated Market
212	Primary and Secondary Power
213	Demand Side Management
214	Energy Efficiency in Transportation

3	Energy Audits and Instrumentation (7% - 11%)
301	Role of Audits
302	ASHRAE Level 1, 2, 3 Audit
303	Audit Equipment
304	Energy and Power Measurement
305	Power Factor Measurement
306	Flow Measurement
307	Air Velocity Measurement
308	Temperature Measurement
309	Humidity Measurement
310	Pressure Measurement
311	Combustion Analysis
312	Light Level Measurement
313	Heat Measurement
314	Infrared Equipment
315	Fuel Choices
316	Key Performance Indicators, Energy Use Index & Energy Cost Index
317	Facility Load Factor
318	HHV and LHV
319	ASHRAE Standard 211-20XX
320	Energy Management Measures
321	Energy Simulation / Models
322	Digital Tools / Apps

4	Energy Accounting and Economics (6% - 10%)
401	Time Value of Money
402	Impact of Escalation Rates
403	Financial Evaluation Methods: Present Worth, Net Present Value, Annual Worth, Savings to Investment Ratio, Internal Rate of Return, Life Cycle Cost, Simple Payback
404	Interest Formulas and Tables
405	Depreciation Methods

5	Electrical Power Systems and Motors (7% - 11%)
501	Demand and Energy
502	Power Factor
503	Real Power and Reactive Power
504	Three Phase Systems
505	Power Quality, Harmonics and Grounding
506	Motor Types
507	Motor Selection Criteria
508	High Efficiency Motors
509	Motor Load Factor
510	Motor Slip
511	New vs. Rewound Motors
512	Affinity Laws (Pump and Fan Laws)
513	Motor Speed Control
514	Variable Frequency Drives / Variable Speed Drives
515	Variable Flow Systems

6	Lighting Systems (5% - 7%)
601	Color Rendering Index
602	Color Temperature
603	Visual Comfort Factor
604	Human Centric Lighting, Pupil Lumens
605	Spectral Power Distribution
606	Efficiency and Efficacy
607	Light Sources
608	Ballasts, Ballast Factors and Lighting Drivers
609	Strike and Restrike
610	Lamp Life
611	Lumens
612	Dimming
613	Glare Control with Reflectors, Diffusers and Uplighting
614	Footcandles
615	Inverse Square Law
616	Zonal Cavity Design Method
617	IES Lighting Standard
618	Coefficient of Utilization
619	Lamp Lumen Depreciation
620	Light Loss Factors
621	Lighting Retrofits
622	Lighting Controls
623	Luminaire Specific Lighting Controls
624	Natural Lighting (Skylights, Solar Tubes, Light Shelfs, etc.)

7	HVAC Systems and Building Envelope (10% - 16%)
701	Vapor Compression Cycle
702	HVAC Equipment Types
703	Refrigerants and Global Warming Potential Factors
704	Performance Ratings (COP, EER, kW/ton)
705	Cooling Towers
706	Variable Refrigerant Flow
707	HVAC Economizers
708	Air Distribution Systems (Reheat, Multizone, VAV)
709	Chillers
710	Absorption Cycle
711	Chilled Beam Systems
712	Heat Pumps
713	Energy Consumption Estimates
714	Enthalpy
715	Heat Transfer Equations
716	Psychrometric Chart
717	Building Envelope
718	Thermally Light and Heavy Facilities
719	Thermal Resistance, Conductance and Conductivity
720	Insulation
721	Degree Days
722	Seasonal Heat Transfer Estimation
723	Instantaneous Heat Transfer Estimation
724	Solar Heat Gain
725	Solar Shading
726	Passive Design

8	Building Automation, Controls and Artificial Intelligence Systems (6% - 10%)
801	Basic Controls
802	Terminology
803	Signal Communication Options (Analog vs Digital)
804	Power Line Carriers
805	Self-Tuning Control Loops
806	P, PI, and PID Controls
807	Hardware: Pneumatic, Electric and Direct Digital Control
808	Central and Distributed Control
809	Communication Protocols and Integrating Systems
810	Open Protocol Systems
811	Energy Information Systems
812	Control Strategies (Set-Back, Reset, Optimized Start/Stop, and others)
813	Building Automation & Energy Management Systems
814	Energy Management Strategies, Optimization and Sequencing
815	Internet Of Things (IOT)
816	Web or Cloud Based Systems
817	Artificial Intelligence
818	Expert Systems
819	Cyber-Security and Information Technology Issues

9	Energy Storage Systems (3% - 5%)
901	Design Strategies
902	Chilled Water Storage
903	Partial Storage Systems
904	Full Storage Systems
905	Operating Strategies
906	Advantages and Limitations
907	Storage Media
908	Sizing
909	Ice Storage
910	Phase Change Materials (PCM)
911	Thermal Storage for Heating
912	Electric Energy Storage

10	Boiler and Steam Systems (4% - 6%)
1001	Combustion Efficiency (as it relates to: Oxygen to Fuel Ratio, Fouling and Heat Recovery)
1002	HHV and LHV
1003	Boiler Economizers & Waste Heat Recovery
1004	Condensing Boilers
1005	Enthalpy from Saturated and Superheated Steam Tables
1006	Steam Traps
1007	Condensate Return
1008	Boiler Blowdown
1009	Flash Steam
1010	Turbulators

11	Distributed Generation & Renewable Energy Systems (4% - 6%)
1101	CHP Regulations, Enablers and Barriers to Entry
1102	District Energy Systems
1103	Prime Movers
1104	Fuel Selection
1105	Operating Strategies
1106	Thermal Efficiencies
1107	Heat Recovery Steam Generators
1108	Topping, Bottoming, and Combined Cycle Generation
1109	Wind, Biomass, Geothermal and Hydropower
1110	Solar Photovoltaic Systems & Batteries
1111	Solar Thermal Systems
1112	Micro-Grids
1113	Building to Grid Integration
1114	Waste to Energy

12	Industrial Systems (6% - 8%)
1201	Industrial Energy Management
1202	Pumps, System and Performance Curves
1203	Compressed Air Systems
1204	Compressed Air Equipment, Supply, Control, Treatment and Distribution
1205	Compressed Air Demand
1206	Industrial Process Steam Systems
1207	Turbines
1208	Industrial Fan Types and Applications
1209	Industrial Refrigeration
1210	Waste Heat Recovery
1211	Heat Exchanger Types

13	Operations, Maintenance and Commissioning (7% - 11%)
1301	Maintenance Strategies: Reactive, Preventive and Predictive
1302	Computerized Maintenance Management System
1303	Quantifying Losses from Compressed Air Leaks
1304	Quantifying Losses from Uninsulated Pipes
1305	Quantifying Steam Leaks
1306	Quantifying Losses from Steam Trap Malfunction
1307	Quantifying Losses from Boiler Scale or Soot
1308	Water Treatment
1309	Group Relamping
1310	Human Behavior in Energy Management
1311	Purpose and Benefits of Commissioning
1312	Commissioning New Buildings
1313	Re-Commissioning
1314	Retro-Commissioning
1315	Real Time and Continuous Commissioning
1316	Phases of Commissioning
1317	Commissioning Agent/Authority
1318	Need for Commissioning
1319	Facility Design Intent
1320	Commissioning Documentation
1321	Measurement in Support of Commissioning

14	Energy Savings Performance Contracting and Measurement & Verification (3% - 5%)
1401	Loans, Stocks and Bonds
1402	Capital and Operating Leases
1403	Utility Financing
1404	Energy Service Companies
1405	Energy Savings Performance Contracting (ESPC)
1406	Project Development Agreements
1407	Shared Savings as well as Guaranteed Savings Contracts
1408	Utility Energy Services Contract (UESC)
1409	Measurement and Verification Protocols
1410	Savings and/or Avoided Cost Calculations and/or Verification
1411	Risk Assessment

Examination Specifications

The examination will be 4-hours, open book and follow the specifications outlined in the examination blueprint and will include 120 multiple-choice graded questions in accordance with the percent of exam range for each task and 10 additional multiple-choice non-graded test questions.

Code of Ethics

Codes of Practice are found in the Code of Ethics for Certified Energy Managers V1.1 dated September 17, 2015, available at **http://www.aeecenter.org/CEMCodeofEthics.**

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Recertification Requirements

A CEM® must accumulate ten professional credits every three years and submit a completed Renewal Form to AEE to remain certified. Professional credits for recertification can be accumulated at any time within the three-year period. Detailed explanation of activities applicable as credits for certification renewal available at **www.aeecenter.org/certification/renewal.**

Activities for CEM® Renewal Credits

Continued employment in energy auditing activities:
- **1 credit per year**

Membership in a professional engineering society
- **1 credit per year**

Continuing education (CEU's) / professional activities (seminars or conferences):
- **2 credits** per CEU, college credit hour or 10 contract hours for training

Awards presented and/or papers published involving energy auditing:
- **2 credits each**

Certified Professionals who do not acquire sufficient CEM® maintenance points to be recertified on the recertification date will be dropped from active certifications and notified in writing of suspension from using the CEM® designation. They will also no longer be listed as a CEM® in any AEE® publication. A lapsed CEM® must resubmit to the certification process and successfully meet the criteria for certification by personal data information and examination. Another option for certified professionals with the exception to ENAC recognized is to acquire make-up points at a cumulative total equal to 3.5 per year for every year since date of expiration. This option is available one-time only. Certifications that have lapsed more than three renewal cycles must retake the CEM® exam.

A CEM®, upon retiring can be designated as "CEM® – Retired," will no longer be required to pay renewal fees, and will no longer be listed in our directory of actively practicing CEM®s. No further reporting is necessary except to notify AEE of retirement status.

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