# Certified Energy Manager (CEM) qualification

Energy management is a complex discipline requiring engineering knowledge, people skills, and a sound appreciation of business financial management. It is not (as many employers might assume) just a minor branch of environmental management. Successful energy managers in medium and large organisations need to be able to develop this specific range of competences and have their education, training and experience recognised.

Certified Energy Manager, awarded by the Association of Energy Engineers (AEE), is one way to achieve these objectives. It combines an intensive five-day programme of instruction with a four-hour examination, but CEM is only awarded if the candidate has approved prior qualifications—typically an engineering degree and three years' relevant working experience, although extra experience can be substituted for academic qualifications: see the final section overleaf. So if you meet someone with CEM you can be confident that they know the principles and practical aspects of the subject. Whether you are recruiting an energy manager, appointing an energy consultant, or dealing with a solution-provider's engineer, the CEM badge is something to look out for.

*"The course and the preparation have broadened my energy management skills which I believe is reflected in my day to day work. I have been able to talk to customers confidently about areas that previously would have been outside of specialisations (now including steam and boilers). Achieving CEM itself is an excellent way for energy managers to understand various energy usage situations that they come across in their day to day work, identify an opportunity, develop a plan of action and deliver real benefits for their business"*

- *Graham Richards BEng(Hons) CEM*

All around the world you will find people with the CEM qualification. There are over ten thousand already and the number is growing continuously, not just in the front line, but in organisations from the Chilean Energy Efficiency Agency to the Chinese National Institute for Standardisation where credibility with energy users is vital. For anyone working in a multinational organisation it is the natural choice, and in terms of ISO50001 there is no question that CEM fulfils the requirements for your energy management representative to be appropriately qualified.

In the United Kingdom, CEM training and examinations are organised by VESMA.COM in association with the Irish chapter of AEE who provide the accredited instructor and a local CEM board. The board vets applications and determines candidates' eligibility against British equivalents of the American academic criteria. All training and examination materials are in SI units of measurement.

For information about forthcoming CEM training and examination sessions please visit http://vesma.com/training or contact Vilnis Vesma at the address below.

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# What does the training cover?

In the UK, the CEM training programme is delivered in two three-day instalments, the second including the examination on the final day. It has probably the most comprehensive syllabus of its type, covering the following topics:

### I. ENERGY ACCOUNTING AND ECONOMICS

Simple Payback Period
Time Value of Money
Present Worth
Net Present Value
Present Worth Method
Internal Rate of Return
Energy Accounting
Point of Use Costs
Life Cycle Cost Method
Energy Unit Conversions
Interest Formulas and Tables
Project Life
Annual Cost Method
Economic Performance Measures
Impact of Fuel Escalation Rates
GJ and kWh Reporting
Efficiency Measures

### II. ENERGY AUDITS AND INSTRUMENTATION

Role of Audits
Energy Management Measures
Combustion Analysis
Power Factor Correction
Very Basic Thermodynamics
Air Velocity Measurement
Light Level Measurement
Infrared Equipment
Fuel Choices
Energy Use Index
Level 1 Audit
Level 3 Audit
ASHRAE 90.1
ASHREA 135
IEC
Mini Data Loggers
Audit Equipment
Load Factors
Combustion Analyzers
Electric Metering Equipment
Temperature Measurement
Pressure Measurement
Humidity Measurement
Energy and Power Measurement
HHV and LHV
Energy Cost Index
Level 2 Audit
ISO 50001
ASHRAE 62.1
Energy Star Portfolio Manager
IECC
ASHRAE 55

### III. ELECTRICAL SYSTEMS

Demand and Energy
Real Power
Power Factor
Power Factor Correction
Rate Structure and Analysis
Variable Speed Drives
Power Quality
Grounding
Load Factors
Reactive Power
Three Phase Systems
Peak Demand Reduction
Motors and Motor Drives
Affinity Laws (Pump and Fan Laws)
Harmonics
IEEE PQ Standard 519

## IV.HVAC SYSTEMS

Heating, Ventilating, and Air Conditioning (HVAC)

Affinity Laws
Psychrometric Chart
HVAC Equipment Types
Degree Days
Heat Transfer
Vapor Compression Cycle
Cooling Towers
ASHRAE Ventilation Standard
ASHRAE Thermal Comfort Standard
Performance Rating (COP, EER)
HVAC Economizers
Air Distribution Systems (Reheat, Multizone, VAV)
Chillers
Energy Consumption Estimates
Absorption Cycle
Air and Water Based Heat Flow
Demand Control Ventilation
Reading Psychrometric Charts

## V. MOTORS AND DRIVES

AC Induction Motors
DC Motors
Load Factor and Slip
Motor Speed Control
Fan and Pump Laws
Motor Selection Criteria
Motor Management Software
AC Synchronous Motors
High Efficiency Motors
Power Factor and Efficiency
Variable Frequency Drives
Variable Flow Systems
New vs Rewound Motors
Power Factor Correction

## VI. INDUSTRIAL SYSTEMS

Waste Heat Recovery
Industrial Energy Management
Steam Systems
Heat Exchangers
Turbines
Compressed Air Systems
Air Compressor Controls
Boilers and Thermal Systems
Fuel Choices
Steam Tables
Compressors
Pumps
Air Compressors
Air Leaks

## VII. BUILDING ENVELOPE

Thermal Resistance
Insulation
Solar Heat Gain
Thermally Light Facilities
Conduction Heat Loads
Air Heat Transfer
Heat Transfer Coefficients
Vapour Barriers
Solar Shading
Thermally Heavy Facilities
Psychrometric Chart Calculations
Water Heat Transfer

## VIII. BUILDING AUTOMATION SYSTEMS

Energy Management Strategies
Distributed Control
Optimization Controls
Building Control Strategies
Expert Systems
Self-Tuning Control Loops
TCP/IP
BAS Systems
Artificial Intelligence
Energy Information Systems
Internet, Intranets and WWW
Web Based Systems

## IX. CONTROL SYSTEMS

Basic Controls
BACnet & LON
Power Line Carriers
Terminology
Signal Carriers
Electric Controls
PID Controls
Direct Digital Control
Central Control
Reset Controls
Communication Protocols
Pneumatic Controls
Basic Control Definitions

## X. COMBINED HEAT AND POWER SYSTEMS; RENEWABLE ENERGY

Topping Cycles
Combined Cycles
Prime Movers
Regulations
Combined Heat and Power
Bottoming Cycles
Fuel Selection
Operating Strategies
Distributed Generation
Thermal Efficiencies
Solar, Wind, Biomass, and Hydropower
Solar Thermal and Solar Photovoltaic Systems

## XI. LIGHTING SYSTEMS

Light Sources
Lamp Life
Lighting Retrofits
Zonal Cavity Design Method
LED Lighting
Coefficient of Utilization
Lamp Lumen Depreciation
Dimming
Color Temperature
Visual Comfort Factor
Ballasts
Efficiency and Efficacy
Strike and Restrike
Lux
Inverse Square Law
Room Cavity Ratios
Light Loss Factors
Lighting Controls
Color Rendering Index
Reflectors
Ballast Factor
IES Lighting Standards

## XII. MAINTENANCE

Combustion Control
Steam Leaks
Insulation
Group Relamping
Preventive Maintenance
Boiler Scale
Compressed Air Leaks
Steam Traps
Outside Air Ventilation
Scheduled Maintenance
Proactive Maintenance
Water Treatment

## XIII. BOILER AND STEAM SYSTEMS

Combustion Efficiency
Excess Air
Steam Traps
Condensate Return
Waste Heat Recovery
Scaling and Fouling
Condensing Boilers
Air to Fuel Ratio
Boiler Economizers
Steam Leaks
Boiler Blowdown
Flash Steam
Turbulators

### XIV. THERMAL ENERGY STORAGE SYSTEMS

Design Strategies
Storage Media
Chilled Water Storage
Sizing
Full Storage Systems
Operating Strategies
Advantages and Limitations
Ice Storage
Volume Requirements
Partial Storage Systems

### XV. COMMISSIONING

Purpose of Commissioning
Need for Commissioning
Measurement & Verification
Phases of Commissioning
Commissioning Documentation
Benefits of Commissioning
Commissioning New Buildings
Real Time and Continuous Commissioning
Commissioning Agent
Facility Design Intent
Re-commissioning

### XV. MEASUREMENT AND VERIFICATION (M&V)

Baseline Energy Use
Post Retrofit Energy Use
Utility Bill Comparison
Measurement & Verification Protocols
ASHREA M&V Protocol
Spot Measurement
Goals of M&V
Calibrated Simulation Modeling
IPMVP/EVO
M&V Baseline for Savings
Continuous Measurement

## Prior qualification requirements

The CEM training is inherently extremely useful and can be taken on its own without the examination. However, for those seeking CEM qualification the “yardstick” requirement for the award is as follows:

- A first degree in engineering
- Three years working in energy management
- Attendance at a recognised CEM training course
- Passing a four-hour open-book examination subsequently

**Candidates who do not have a first degree in engineering** can still be awarded CEM if they have more working experience in energy. As a rough guide, a science degree rather than engineering would need four years of experience; a business or related degree needs five; sub-degree qualifications (recognised college diplomas or certificates) can require up to eight years and a candidate with no relevant academic qualification would need to have worked in energy management for at least ten years. Part-time energy duties can be aggregated up to meet the requirement. The local CEM board evaluates candidates’ prior qualifications, and in order to arrive at a fair assessment the instructor observes how marginal candidates perform during the training and board members may interview candidates for clarification. Candidates with insufficient experience who pass the examination can subsequently apply for CEM when the deficit has been made good. There is no time limit.