

CEM[®]



Certified Energy Manager Instructions & Application CEM Exam with Live In-House Seminar Version

Note: As of July 1, 2009, all applicants must take a required approved preparatory seminar before sitting for the exam.

The following information is contained in this booklet:

Part A: Information for Applicants

- Objectives.....page 2
- Eligibility.....page 2
- Statement of Non-Discrimination...page 3
- Statement of Impartiality.....page 3
- Required Body of Knowledge.....page 3
- Procedures.....page 3-4
- Point Scoring Evaluation.....page 4
- Appeals Policy.....page 5
- Fees.....page 5
- Incomplete Applications.....page 5
- The CEM Examination.....page 5-6
- Examination Language.....page 6
- Americans with Disabilities Act.....page 6
- Rescheduling Exams.....page 6
- Inclement Weather.....page 6
- Test Admission Procedures.....page 7
- Testing Site Rules.....page 7
- Examination Irregularities.....page 8
- Handling of Tests.....page 8
- Notification of Results.....page 8
- Retesting.....page 8

- Maintaining Certification.....page 8-9
- Retired Certification Status.....page 9
- Reinstatement of CEM.....page 9
- Request for Duplicate Certificate....page 9
- Use of CEM Designation.....page 9-10
- CEM Stamp.....page 10

Part B: CEM Application

- Applicant Information Data.....page 11
- Education.....page 12
- Experience Record.....page 13
- Affidavit and checklist.....page 14
- Employment Verification.....page 15-16
- Client Verification.....page 17-18

Part C: Study Guide

- Self-Evaluation Online Exam.....page 19
- Study Guide Ref. & Topics.....page 20-24
- Sample Exam Questions.....page 25-32
- Reference Books.....page 33-34

Part A: Information for Applicants

CERTIFIED ENERGY MANAGER (CEM®)

Please read through the following important information before submitting your **CEM® Application found in part B** of this booklet.

1. CEM® OBJECTIVES

- To raise the professional standards of those engaged in energy management.
- To improve the practice of energy management by encouraging energy managers in a continuing program of professional development.
- To identify persons with acceptable knowledge of the principles and practices of energy management related disciplines and laws governing and affecting energy managers through completing an examination and fulfilling prescribed standards of performance and conduct.
- To award special recognition to those energy managers who have demonstrated a high level of competence and ethical fitness for energy management.

2. ELIGIBILITY

Energy managers with one the following prerequisites may apply to sit for exam:

A Four-Year Engineering or Architecture degree or Professional Engineer (P.E.) or Registered Architect (R.A.) with at least three years of experience in energy engineering/management

OR

A Four-Year Technology, Environmental Science, Physics, or Earth Science degree with at least four years of experience in energy engineering/management

OR

A Four-Year Business or related degree with at least five years of experience in energy engineering/management

OR

A Two-Year Energy Management Associate's degree with at least six years of experience in energy engineering/management

OR

A Two-Year Technical degree with at least eight years of experience in energy engineering/management

OR

Ten years or more verified experience in energy engineering/management

****Acceptable experience is full-time direct energy management work. Higher education, part-time internships, and research positions are not acceptable.****

3. STATEMENT OF NON-DISCRIMINATION

AEE endorses the principles of equal opportunity. Eligibility criteria for examination and certification as a Certified Energy Manager are applied equally to all individuals regardless of age, race, religion, gender, national origin, veteran status, sexual orientation, or disability.

4. STATEMENT OF IMPARTIALITY

AEE's CEM Certification Department adheres to principles of impartiality in all its dealings. The CEM Department shall act impartially towards all applicants, candidates, and certificants.

5. THE REQUIRED BODY OF KNOWLEDGE / STUDYING FOR THE EXAM

The effective practice of energy management requires an in-depth knowledge of a wide variety of subjects. All applicants must take a required approved preparatory seminar before sitting for the certification exam. For certification purposes, however, the candidate must also demonstrate to the satisfaction of the Certification Board the knowledge and ability to apply the essentials of energy management. To aid candidates in preparing for the examination, the Certification Board makes available a bibliography of suggested reference materials and a study guide (Refer to Part C of this booklet).

The most effective way to “study” for the exam is to practice – practice solving problems, practice working within the exam’s time constraints, and studying the materials covered in the exam.

There are many things you can do to help yourself prepare for the exam.

- Review the reference books and videos
- Practice the study guide in Part C of this application packet
- Take the self-evaluation exam, available for purchase on the CEM website, www.aeecenter.org/certification/CEM
- Review the body of knowledge included in Part C of this application packet
- Practice basic algebra calculations

6. PROCEDURES

The first step in the CEM certification process is to register for a required approved preparatory seminar. After seminar registration has been completed, the certification application should be completed. Since certification is based on education, experience and passing the examination, it is important that the applicant understands the eligibility requirements, and has attained the prerequisite to qualify for certification.

The application should be received by the certification department four weeks prior to the desired exam date if the applicant feels confident he/she has the necessary prerequisite for certification. Once the application is complete and the CEM exam is passed, all applications are sent to the CEM Board for final approval. Only after Board approval is certification granted. Should applicants have questions about the experience prerequisite for certification, he/she can have his/her application reviewed by the CEM Board prior to taking the exam. If this is the case, a **completed application** (including official college transcripts and employment verification and/or client verification) must be received by AEE at least eight weeks prior to desired exam date, and the applicant must request in writing that he/she would like an initial review of his/her application by the CEM Board.

It is very important that all applicants give clear and complete details concerning energy management experience so that the CEM Board can have a clear understanding of the applicant’s energy management experience. **Based on the eligibility requirement, the number of years of required experience to be verified**

will vary. Past employers may need to be complete the employment verification form. If you are self-employed or are a principal owner of a company, three client verifications are required in the place of employment verification. **All employment verification and/or client verification forms should be completed by the employers and/or clients before sending to AEE. AEE does not send requests to employers and clients. Once forms are received by AEE, we may contact employers and/or clients to confirm and verify the information on the form is correct.**

7. THE APPLICATION & POINT SCORING EVALUATION

The Application Form provides an organized method for documenting professional and educational background, achievements and community service.

The Personal Data Form is divided into the following three parts:

Division I – Education

Division II – Professional Registration (i.e. PE, Registered Architect)

Division III – Experience/Employment in Energy Management

The applicant is requested to list on the Application Form all pertinent information in these categories for evaluation by the CEM Board. All applicants must complete the application; a resume does not replace the four-page application.

The two areas of evaluation shall receive points as follows:

Application Form Data	Maximum Score 1400 points	Minimum Score Required 700
CEM Examination	Maximum Score 1152 points	Minimum Score Required 700
Total Required:	Maximum Score 2552 points	Minimum Score Required 1400

To be awarded the CEM designation, candidates must achieve the minimum total of 700 points on the CEM Application Data and the minimum score of 700 points on the CEM examination individually for a minimum total of 1400 points.

If a candidate has failed to acquire sufficient points to be recommended for CEM, the candidate may be re-examined at a subsequent examination period and/or resubmit an updated Application Form. Examination scores will be kept on file by the Certification Director for a period of 3 years. Applicants have 3 years to follow up and complete his/her CEM file; after 3 years, applicants must resubmit the application and retake the CEM exam.

It is essential that candidates devote considerable time and effort to completing the Application Form since certification by the CEM Board can be based only on the information provided. Inaccurate and/or incomplete data will only be a liability for the applicant. Documentation should be attached to the Application to substantiate the information presented.

8. APPEALS POLICY

An appeal is a formal request for reconsideration of an adverse decision made by the CEM Board or its representatives related to an individual's achievement of a certification. Candidates may appeal the results of eligibility determination or the examinations within 60 days of the date of the results. The appeals process and an application for submitting an appeal is as follows:

- If a candidate has a problem with AEE's determination of their eligibility or with the examination, they should first send an email to the CEM Director to request reconsideration of an adverse decision.
- If the candidate is unsatisfied with the CEM Director's reconsideration of the adverse decision, they must request an appeal form from the CEM Director. Once the Appeals Form has been completed, it must be forwarded to the CEM Director, who will forward the appeal to the Appeals Board
- Upon receiving the appeal, the Appeals Board has forty-five (45) days in which to consider the appeal. Candidates will be notified of the Appeals Board's decision after forty-five (45) days.

9. FEES:

RETESTING FEE

For each re-examination held with live seminar in USA/Canada, a fee of \$100.00 will be required. For each re-examination held at a Remote Testing Center location in USA/Canada, a fee of \$150.00 will be required.
No refunds allowed.

RENEWAL FEE

Three-year renewal fee: \$300.00

Reinstatement fee: \$350.00

No refunds allowed.

10. INCOMPLETE APPLICATIONS

Incomplete applications will remain on file with the Certified Energy Manager Certification Department for a period of three (3) years. After three years, application materials will be destroyed.

11. THE CEM EXAMINATION

The applicant must complete a four-hour exam. Live Seminar dates and locations are available on our website at www.aeecenter.org/certification/cem. Applicants must register separately to attend the associated live seminar. An Examination Administrator will proctor the examination. This Administrator may be an Association associate, an educator, an approved testing expert or agency, or whomever the Certification Director deems appropriate based on pre-approval. The examination questions are based on the body of knowledge accessible in Part C of this application. Because of the diversity of background and experience of Energy Managers, the examination has 17 different subject sections, all of which are mandatory. The exam consists of multiple choice and true/false questions. This is an open book/open notes exam. In addition, stand-alone, scientific, business/financial, or graphing calculators (i.e. Texas Instruments, Casio, Sharp, etc.) may be used on the exam. The following items are strictly prohibited during the exam: calculator with internet capability, cell phones including use of cell phone calculator, laptop computers, tablets, camera devices, any use of internet/email and AEE reference CDs. Only printed reference materials organized in a binder may be allowed in the exam room. Grading is accomplished by members of the Certification Department and the CEM Board. Candidates are notified of exam results by email within 30 days of the exam date.

The CEM Examination contains the following mandatory subjects:

Body of Knowledge	Percent of Exam
Codes and Standards	4 – 6 %
Energy Accounting and Economics	11 – 14 %
Energy Audits and Instrumentation	11 – 15 %
Electrical Systems	5 – 7 %
HVAC Systems	5 – 7 %
Motors and Drives	5 – 6 %
Industrial Systems	4 – 6 %
Building Envelope	4 – 5 %
CHP Systems and Renewable Energy	4 – 5 %
Fuel Supply and Pricing	4 – 5 %
Building Automation and Control Systems	4 – 6 %
High Performance Buildings	4 – 5 %
Thermal Energy Storage Systems	3 – 4 %
Lighting Systems	5 – 7 %
Boiler and Steam Systems	4 – 6 %
Maintenance and Commissioning	4 – 6 %
Energy Savings Performance Contracting and Measurement & Verification	4 – 5 %

12. LANGUAGE

The Certified Energy Manager Exam when administered in the United States is only offered in English.

13. AMERICANS WITH DISABILITIES ACT

Special arrangements may be provided to candidates with a disability (as defined by Title III of the Americans with Disabilities Act) who submit with their certification application, a written explanation of their needs along with appropriate medical documentation. An ADA request form is available on the CEM website – www.aeecenter.org/certification/CEM.

14. RESCHEDULING EXAMS

While application and exam fees are nonrefundable, a candidate may reschedule taking a live exam at any time for any reason. Candidates taking the exam at a Remote Testing Center, if you need to reschedule your confirmed exam date or location, please contact AEE prior to rescheduling. **A \$50 rescheduling fee payable to AEE will be assessed for each reschedule of your Remote Testing Center exam.**

15. INCLEMENT WEATHER

If any candidate is unable to arrive at a designated exam site because of inclement weather, terrorist acts, a natural disaster, or other unforeseen emergencies beyond control of the candidate as determined by AEE, the candidate will be allowed to take a future examination without being charged a re-examination fee.

If for any reason the exam is unable to be administered, then the examination will be rescheduled within a reasonable period of time. Candidates may take the exam at a future administration without being charged a re-examination fee. Candidates will be responsible for their own associated expenses for future testing.

16. TEST ADMISSION PROCEDURES

Candidates must report to the test location on time. Sign-in begins 30 minutes to one hour before the posted exam time. Candidates must present a government-issue photo ID when checking in to take the exam. Candidates who arrive more than thirty minutes late or without a photo ID will NOT be permitted to enter the test center, and their examination fees will be forfeited. Distribution of test materials, and testing instructions will begin within five minutes of the posted start time of the exam. The total testing time is four hours. Additional time has been allotted for instructions. You can expect to leave the testing center at approximately 4.5 hours after the posted start time for the exam. There are no scheduled breaks.

17. TESTING SITE RULES

The following are rules enforced at all test administrations. Candidates found not to be in compliance with these standards will immediately be removed from the exam and their test papers collected. The incident will be reported to the CEM Certification Director.

- All candidates must have proper photo ID in order to be admitted to the test center.
- Candidates are admitted only to their assigned test site at their assigned time
- Candidates arriving more than 30 minutes after the posted test time will not be allowed to take the exam. Extended time will not be provided to those who begin the exam after the posted start time. Those taking the exam at a live testing site will have to reschedule. Those taking the exam at a remote testing center will have to reschedule and pay a \$70 rescheduling fee before they will be able to reschedule to take the exam, if it is rescheduled more than 48 hours prior to the exam date.
- No guests are permitted in the examination rooms
- **The exam is open book and calculators are REQUIRED.**
- Use of cell phones, recording devices, PDAs, or other wireless capable devices is not permitted during the exam.
- No unauthorized material is allowed in the exam room.
- No device capable of taking images is allowed in the exam room.
- Talking, comparing answers, or exchanging reference materials during the exam is not permitted.
- While testing, it is the candidate's responsibility to keep their testing materials in their own space and out of sight of fellow examinees. An examinee that is found looking at another examinee's answer sheet will be automatically disqualified, dismissed, and reported. A retake of the exam will not be permitted for six months
- Absolute silence must be maintained in the exam room
- Upon request, students will be excused for bathroom breaks, but only one person at a time may leave the room during the exam. The exam booklet must be left in the testing room in the closed position, with the answer sheet turned over so that the answers are not visible.
- The exam booklet, answer sheets, and blue book may not be taken from the exam room and must be turned in to the proctor immediately upon completion of the exam.
- If taking the exam at a live testing site, use a number 2 pencil when filling in your answer sheet. If you erase an answer, please do so completely.
- Scoring is based on the number of correct answers. Because there is no penalty for wrong answers, it is to your advantage to answer every question in each section. If a question is difficult, you may decide to come back to the question after you have completed all of the questions with which you are familiar.
- The exam will be 4.0 hours. An announcement will be made every hour, when 30 minutes remain, and a ten minute warning will also be provided.

18. EXAMINATION IRREGULARITIES

Any problems, suspected incidences of cheating, alleged inappropriate examination administration, environmental testing conditions severe enough to cause disruption of the process, or other irregularities related to test administration should be addressed to the onsite proctor or to the CEM Director. All such matters will be reported, investigated, and subject to further action based upon policies and procedures adopted by AEE.

19. HANDLING OF TESTS

AEE will take all available precautions to ensure the appropriate and secure handling of completed tests. In the rare and extreme case in which the tests become lost or unreadable, candidates will be required to undergo retesting, without being charged a re-examination fee. Candidates will be responsible for their own travel-associated expenses for future testing.

20. NOTIFICATION OF RESULTS

Candidates are notified via email of their examination results within 30 days of the test administration. Candidates who successfully complete the examination and whose credentials and application entitle them to certification will be notified by letter and be granted an AEE Certified Energy Manager certification. Candidates who did not successfully complete the examination will be notified via email and given a diagnostic report on the reason for their failing.

21. RETESTING

In the event that a candidate fails his or her first attempt to pass the CEM exam, AEE requires a waiting period of at least 60 days between the first and second attempt to pass that same exam. Additionally, before any candidate's third attempt or any subsequent attempt to pass the exam, the candidate is required to wait for a period of at least 60 days from his or her last attempt to pass the exam. Candidates must submit a retesting form, which is provided at <http://www.aeecenter.org/certification/CEM>. In the event that the candidate passes the CEM exam, the candidate is prohibited from retaking the same certification exam.

22. MAINTAINING CERTIFICATION

The continuing education of Energy Managers is essential to cope with the rapidly changing field of energy management. A CEM must accumulate ten professional credits every three years and submit a completed Renewal Form to the Certification Renewal Director to remain certified. CEM renewal notices are mailed in the 3rd year of certification six months prior to the expiration date, which falls on December 31 of that year.

Professional credits for recertification can be accumulated at any time within the three year period. For example, Energy Managers receiving a CEM certification in 2015 must file a record of ten professional credits with the Certification Renewal Director by December 31, 2018 in order to receive a CEM certificate for another 3-year period. ***Credits are not maintained by AEE during the three year period. It is the responsibility of the individual to maintain a record of credits accrued and submit this information at the time of renewal.***

Activities for CEM Renewal Credits

- Continued employment in energy management/energy engineering activities:
1 credit per year
- Membership in a professional engineering society:
1 credit per year (3 max)
- Continuing education (CEU's) / professional activities (seminars or conferences):
2 credits per CEU, college credit hour or 10 contract hours for seminar
- Awards presented and/or papers published involving energy engineering/management:
2 credits each
- Offices held in a professional engineering society:
1 credit per year

23. RETIRED CERTIFICATION STATUS

A CEM, upon retiring and reaching the age of sixty-five, will 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 CEMs. No further reporting is necessary except to notify the Certification Renewal Director of meeting the age requirement by sending a copy of the retired CEM's Driver's License.

24. REINSTATEMENT OF CEM

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 has the following options to reinstate:

1. Resubmit to the certification process and successfully meet the criteria for certification by personal data information and examination or,
2. 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.

25. REQUEST FOR DUPLICATE CERTIFICATE

Any certified professional may request additional copies of his or her certification document. Requests must be made in writing to AEE and may be made at any time. The fee of \$20 must be included with the request. The request for a duplicate certificate form can be found at <http://www.aeecenter.org/certification/CEM>.

26. USE OF CEM DESIGNATION

The certificate mark and logo are the property of AEE. Permission to use the certification mark or logo is granted to certified persons at the discretion of the AEE's CEM Board, for permissible uses only. As a Certified Energy Manager (CEM[®]), the Energy Manager may use the designation with his/her name on organization letterheads, business cards, certain internet listings and forms of address. The Energy Manager may be required to surrender the certificate in the event that it is revoked or suspended. An official CEM[®] Stamp which authenticates your Certification and Certification validation is available for purchase. The official stamp is useful for proposals and official documents (see below).

Certification is for individuals only. The CEM designation may not be used to imply that an organization, company or firm is certified. AEE does not endorse or recommend any individual CEM, product or service.

Improper usage of CEM or AEE logo may result in suspension. If you have questions about usage of the CEM designation, please contact AEE.

Sample Correct Usage (Signature or Business Card):

John A. Smith, P.E., C.E.M. / Mary Jones, B.E.P., C.E.M.

Web Usage:

John A. Smith is an individual member of the Association of Energy Engineers (AEE) and is a [Certified Energy Manager](#) (CEM®).

Incorrect Usage:

ABC Company is Certified by AEE.

Correct Usage:

- ABC Company has many Certified Energy Managers -CEMs® on its staff.
- ABC Company is looking for a Certified Energy Manager candidate for a position.
- John Smith, President of ABC Company, is an individual member of the Association of Energy Engineers and is a Certified Energy Manager (CEM), Certified Carbon Reduction Professional (CRM) and Certified Sustainable Development Professional (CSDP).
- ABC Company is a Corporate Member of the Association of Energy Engineers (AEE) and has five current Certified Energy Managers (CEM) on staff including.....

John Smith is an individual:



Link to www.aeecenter.org/certification

Corporate Member of:



Link to www.aeecenter.org

27. CEM STAMP

As the CEM designation becomes a requirement for more jobs and projects, AEE is pleased to announce the availability of an official stamp that will authenticate your status as a CEM in good standing. The stamp will include your name, your CEM ID number, and the expiration date of your CEM. Stamp is self-inking with dark blue ink. Download the order form at www.aeecenter.org/cemstamp.

Price: \$50 (includes shipping) / Electronic Version: \$15 (only available as an add-on to \$50 stamp)



Part B: CEM[®] APPLICATION

CEM Exam with Live In-House Seminar Version & Study Guide

Please use this form only if you plan on taking the CEM Certification Exam held in-conjunction with one of the Live AEE Seminars

1) Seminar Name / Date / Location (REQUIRED): _____

NOTE: The following information is to be filled out as completely as possible. Please read the "Information for Applicants" very carefully, and follow instructions for completing and forwarding forms. It is important that the AEE Certification Board have substantiating data for each criteria indicated in the application.

Mail application and payment to:

AEE – CEM Certification Dept.
3168 Mercer University Drive and/or client verification
Atlanta, GA 30341
OR fax to: 770-447-4354
Email: Helen@aeecenter.org

Personal Data (Please print or type)

File Number: _____ (AEE Internal Use Only)

Full legal name as it will appear on certificate:

Mr. Ms. Last Name: _____ Legal First Name: _____ Middle Initial: _____

Job Title: _____

Firm Name: _____

Address: _____

City: _____ State: _____ ZIP code: _____ Country: _____

Phone: _____ Fax: _____ Business E-mail: _____

Residence Address: _____

City: _____ State: _____ ZIP code: _____ Country: _____

Mobile Phone: _____ Personal E-mail: _____

Address Requested for Correspondence: Business Residence

E-mail Address Requested for Correspondence: Business Personal

**DIVISION I – EDUCATION
(MAXIMUM 350 POINTS FOR DIVISION I)**

List in chronological order the name and location of each college or university from which you have earned a degree.

Points are based on degree obtained and substantiating documentation submitted. **Please arrange for Official College Transcripts where degree was issued to be forwarded to AEE, but do not delay filing of application for this reason.**

Note: If there is a possibility that the name that appears on your transcript may be different from the name that you currently use (ie. your maiden name), please provide that name here: _____

Name & Location Of Institution	Years From - To	Date Graduated	Degree Received	Field In Which Degree Was Issued

**DIVISION II – PROFESSIONAL REGISTRATION
(MAXIMUM 350 POINTS FOR DIVISION II)**

I am a Professional Engineer: yes no
 I am a Registered Architect: yes no
 I am an Engineer in Training (E.I.T.): yes no
 I am a Certified Plant Engineer: yes no
 I am an Energy Auditor: yes no

If you answered yes to any of the above, complete the following and **enclose a copy of your registration. Registration must indicate that license is currently in force.** Points are based on substantiating documentation submitted.

State	Registration No.	Date	Now in Force
			<input type="checkbox"/> yes <input type="checkbox"/> no
			<input type="checkbox"/> yes <input type="checkbox"/> no
			<input type="checkbox"/> yes <input type="checkbox"/> no
			<input type="checkbox"/> yes <input type="checkbox"/> no
			<input type="checkbox"/> yes <input type="checkbox"/> no

Have any states revoked or suspended your registration? yes no
 If yes, please explain:

DIVISION III – EXPERIENCE RECORD

(MAXIMUM 700 POINTS - 350 points for 3 years of full-time energy experience; 50 points per year thereafter)
Applicant should forward one copy of the Employment Verification Form to each employer for those periods which apply to Certification Eligibility. *Forms may be completed by immediate superiors or personnel officers and must be returned directly to AEE.* Please complete the following in chronological order and list the most recent employer first. Include a description of job functions held for those periods of employment, which qualify you for specific category of certification as applied for. This form may be copied if additional space is needed.

Date: From-To (mm/yy – mm/yy)	Employer Name & Address	CONCISE STATEMENT OF ENERGY-RELATED WORK PERFORMED
TITLE OF POSITION		
Date: From-To (mm/yy – mm/yy)	Employer Name & Address	CONCISE STATEMENT OF ENERGY-RELATED WORK PERFORMED
TITLE OF POSITION		
Date: From-To (mm/yy – mm/yy)	Employer Name & Address	CONCISE STATEMENT OF ENERGY-RELATED WORK PERFORMED
TITLE OF POSITION		
Date: From-To (mm/yy – mm/yy)	Employer Name & Address	CONCISE STATEMENT OF ENERGY-RELATED WORK PERFORMED
TITLE OF POSITION		

AFFIDAVIT

I _____ (Name), having completed the aforementioned to the best of my ability, do hereby apply for AEE Certified Energy Manager Certification and wish to take the CEM Examination.

I hereby agree (a) to be bound by terms and provisions of the Certificate of Incorporation of the Association of Energy Engineers, its by-laws and such other regulation as may from time to time be in force, so far as they may affect me; (b) to indemnify and hold harmless each and all of your members, Board of Directors, Certification Board, officers, examiners and agents from and against any liability whatsoever in respect to any act or omission by you or them or any of them in connection with this application, the examination, the grades given upon such examination, and/or the granting or issuance of or failure to grant or issue a certificate to me; (c) that any prescribed fee paid by me is not refundable; and (d) that any certificate granted or issued me shall remain the property of the Association. I certify that all the information contained in this application is correct to the best of my knowledge.

I further pledge myself hereby to the highest ethical standards in the practice of energy engineering/management and hereby agree to abide by the Code of Ethics for Certified Energy Managers (www.aeecenter.org/CEMCodeOfEthics).

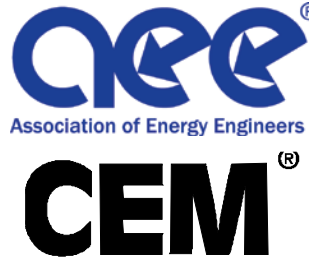
Signature in Full _____

Date: _____

CERTIFICATION DOCUMENTS CHECKLIST

The following items need to be submitted to complete your application:

- Application – pages 11-14
- Letter of Employment and Job Duties Verification - pages 15-16 (years of experience needed vary with education)
- Letter of Client Verification – pages 17-18 (three needed to verify self-employment)
- Official college transcripts
- Professional Registration (PE or RA registration may be submitted in lieu of transcripts)



**REQUEST FOR EMPLOYMENT AND
JOB DUTIES VERIFICATION**
Certified Energy Manager

From: _____

To:

Dear _____:

I am applying to the Association of Energy Engineers for Certification as an Energy Manager. In this regard, I hereby authorize your release of the requested information enclosed which verifies my employment and duties from the period _____ to _____.

Please furnish the requested information as completely as possible, and **return to AEE Certification Board.**

The receipt of replies will be reported by AEE, but under no circumstances will the information be divulged to me, or used for any purpose except to validate my application for Energy Manager Certification.

Applicant Signature

NOTE: If self-employed, complete letter of client verification.

APPLICANT COMPLETE / Attach to Cover Letter

Name: _____

Address: _____

City: _____ State: _____ ZIP code: _____

LETTER OF EMPLOYMENT and JOB DUTIES VERIFICATION

The following information verifies the employment and duties of the above applicant for AEE Certification.

Company: _____ Telephone: _____

Address: _____

City: _____ State: _____ ZIP code: _____

The above named applicant was (has been) employed by our company from
_____ to _____ and has held the following positions:

_____	Dates: _____
_____	Dates: _____
_____	Dates: _____
_____	Dates: _____

Please fully describe the energy-related responsibilities of the applicant **(REQUIRED)**. Attach descriptions if necessary to answer fully. **Forms with incomplete details will not be processed.**

To the best of my knowledge, and our employment records, I hereby attest that the above information is true and correct.

Name of person supplying information: _____
(Please type or print)

Official Title of Respondent: _____

Signature: _____ Date: _____

You may be contacted by AEE as a random sample to confirm and verify information provided.

**Return to: AEE CERTIFICATION BOARD – CEM
3168 MERCER UNIVERSITY DRIVE
ATLANTA, GEORGIA 30341**



REQUEST FOR CLIENT VERIFICATION Certified Energy Manager

From: _____

To:

Dear _____:

I am applying to the Association of Energy Engineers for Certification as an Energy Manager. In this regard, I hereby authorize your release of the requested information enclosed which verifies my employment and duties from the period _____ to _____.

Please furnish the requested information as completely as possible, and ***return to the AEE Certification Board.***

The receipt of replies will be reported by AEE, but under no circumstances will the information be divulged to me, or used for any purpose except to validate my application for Energy Manager Certification.

Applicant Signature

NOTE: Complete this form only if self-employed – furnish three (3) client verification letters.

APPLICANT COMPLETE / Attach to Cover Letter

Name: _____

Address: _____

City: _____ State: _____ ZIP code: _____

CLIENT COMPLETE / LETTER OF CLIENT VERIFICATION

The following information verifies the Contractor/Consultant and duties of the above applicant for AEE Certification.

Company: _____ Telephone: _____

Address: _____

City: _____ State: _____ ZIP code: _____

The above contractor/consultant has provided service(s) to our company from:

_____ to _____

*****Please fully describe the energy-related responsibilities of the applicant (REQUIRED). Attach descriptions if necessary to answer fully. Forms with incomplete details will not be processed.*****

To the best of my knowledge, I hereby attest that the above information is true and correct.

Name of person supplying information: _____
(Please type or print)

Official Title of Respondent: _____

Signature: _____ Date: _____

You may be contacted by AEE as a random sample to confirm and verify information provided.

**Return to: AEE CERTIFICATION BOARD – CEM
3168 MERCER UNIVERSITY DRIVE
ATLANTA, GEORGIA 30341**

Part C: STUDY GUIDE

CERTIFIED ENERGY MANAGERS (CEM® EXAM)

Online Self-Evaluation Exam Also Available

CEM Applicants have access to an online version self-evaluation CEM exam. The 65-question multiple choice self-evaluation exam simulates half the certification test, contains a two hour time limit, and covers seventeen sections. There is an **\$80 fee** to take this online test and you may access the full details at:

Direct Link: www.aeecenter.org/cem/selfevaluation

Get a sense of how to time questions. The actual exam time allotted is 4 hours for 130 questions. You will need to complete the 65-question self-evaluation exam in 2 hours. At the end of the exam, you will receive a sections report that lets you know what sections you passed and failed. You will not be able to see the specific questions that you answered wrong/right or the answers.

The following is a list of the subjects for the CEM exam. Each subject covers a number of topics. Following the list of topics are suggested references with chapter numbers. The primary references are the Handbook of Energy Engineering, 7th by D. Paul Mehta and Albert Thumann, the Energy Management Handbook, 8th Edition by Steve Doty and Wayne C. Turner, and Guide to Energy Management, 8th Edition by Barney L. Capehart, Wayne C. Turner and William J. Kennedy. However, some other books are also referenced as appropriate.

The study guide will not lead you to answers to all of the questions, but it will certainly lead you to a very large number of correct answers. A person with the necessary experience who reviews the study guide should not have any problem passing the exam.

The exam will: be open book, last four hours, and have 130 questions to answer. Of the 130 questions, 120 are scored and 10 randomly located questions are trial questions being prepared for possible use on future exams. The 10 trial questions do not count toward the examinee's score. The trial questions are randomly located and are not identified. Therefore, all 130 questions should be answered. There are 17 sections listed below from which questions mainly are drawn.

BODY OF KNOWLEDGE: STUDY GUIDE TOPICS & REFERENCES

I. CODES AND STANDARDS

ISO 50001
ASHRAE/IESNA Standard 90.1-2012
IEC and IEEC Codes
ASHRAE Standard 90.2
ASHRAE Standard 62.1-2010
Model Energy Code
ASHRAE Standard 135-2008
ASHRAE Standard 189.1-2009

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 1.
REF: Turner, **Energy Management Handbook**, 8th, Chapter 20.
REF: **ASHRAE 62.1 2004 and 2007 Standard**

II. ENERGY ACCOUNTING AND ECONOMICS

Simple Payback Period	Life Cycle Cost Method
Time Value of Money	Interest Formulas and Tables
Present Worth	Project Life
Net Present Value	Annual Cost Method
Present Worth Method	Economic Performance Measures
After Tax Cash Flow Analysis	Depreciation Methods
Internal Rate of Return	Impact of Fuel Escalation Rates
Energy Accounting	Btu Reporting
Point of Use Costs	Efficiency Measures

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 2.

REF: Turner, **Energy Management Handbook**, Chapter 4.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 4.

III. ENERGY AUDITS AND INSTRUMENTATION

Role of Audits	Audit Equipment
ASHRAE Type 1 Audit	ASHRAE Type 2 Audit
Energy Management Measures	Load Factors
Combustion Analysis	Combustion Analyzers
Power Factor Correction	Electric Metering Equipment
Very Basic Thermodynamics	Temperature Measurement
Air Velocity Measurement	Pressure Measurement
Light Level Measurement	Humidity Measurement
Infrared Equipment	Energy and Power Measurement
Fuel Choices	HHV and LHV
Energy Use Index	Energy Cost Index

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 3.

REF: Turner, **Energy Management Handbook**, Chapter 3.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 2.

IV. ELECTRICAL SYSTEMS

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

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 4.

REF: Turner, **Energy Management Handbook**, Chapter 11.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 5.

V. 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

Performance Rating (COP, EER, kW/ton)

HVAC Economizers

Air Distribution Systems (Reheat, Multizone, VAV)

Chillers

Energy Consumption Estimates

Absorption Cycle

Air and Water Based Heat Flow

Demand Control Ventilation

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 7 & 8.

REF: Turner, **Energy Management Handbook**, Chapter 10.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 8.

VI. 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

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 4.

REF: Turner, **Energy Management Handbook**, Chapter 11.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 7.

VII. 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 and Pumping Systems

Air Compressors

Air Leaks

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 5, 6 & 12.

REF: Turner, **Energy Management Handbook**, Chapter 5, 6 & 8.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 14.

VIII. BUILDING ENVELOPE

Thermal Resistance

Insulation

Solar Heat Gain

Thermally Light Facilities

Conduction Heat Loads

Air Heat Transfer

Heat Transfer Coefficients

Vapor Barriers

Solar Shading

Thermally Heavy Facilities

Psychrometric Chart

Water Heat Transfer

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 7.
REF: Turner, **Energy Management Handbook**, Chapter 9 & 15.
REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 6 & 11.

IX. CHP SYSTEMS and RENEWABLE ENERGY

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

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 9.
REF: Turner, **Energy Management Handbook**, Chapter 7.
REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 16

X. FUEL SUPPLY AND PRICING

Procurement of Natural Gas	Procurement of Oil
Supply and Demand Impact on Pricing	Evaluating Supply Options
Fuel Price Risks	Trends in Deregulation around the World
Electricity as a Commodity	Selection of Energy Supplier in a Deregulated Market

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 1.
REF: Turner, **Energy Management Handbook**, Chapter 21 & 24.

XI. BUILDING AUTOMATION AND CONTROL SYSTEMS

Energy Management Strategies	Terminology
Basic Controls	PID Controls
BACnet & LON	Signal Carriers
Power Line Carriers	Direct Digital Control
Distributed Control	Central Control
Optimization Controls	Reset Controls
Building Control Strategies	Communication Protocols
Expert Systems	Artificial Intelligence
Self-Tuning Control Loops	Energy Information Systems
TCP/IP	Internet, Intranets and WWW
BAS Systems	Web Based Systems

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 4 & 10. REF:
Turner, **Energy Management Handbook**, Chapter 12 & 22.
REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 11 & 17.

XII. HIGH PERFORMANCE BUILDINGS

Green Buildings	USGBC
Sustainable Design	LEED Certification
ASHRAE 90.1 Energy Cost Budget Method	LEED O&M
Certified, Silver, Gold, and Platinum	LEED NC
LEED CI	LEED CS
Water Efficiency	Energy and Atmosphere
Materials and Resources	Indoor Environmental Quality
ENERGY STAR Rating	Portfolio Manager
Energy Star Label	Green Globes
ASHRAE Standard 189	ASHRAE Green Guide

REF: United States Green Building Council, website with LEED v3 and LEED Rating Systems presentations, www.usgbc.org

REF: ENERGY STAR Building & Plants, ENERGY STAR website, www.energystar.gov

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 18

XIII. THERMAL ENERGY STORAGE SYSTEMS

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

REF: Turner, **Energy Management Handbook**, Chapter 19.

XIV. LIGHTING SYSTEMS

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

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 4.

REF: Turner, **Energy Management Handbook**, Chapter 13.

REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 6.

XV. BOILER AND STEAM SYSTEMS

Combustion Efficiency	Air to Fuel Ratio
Excess Air	Boiler Economizers
Steam Traps	Steam Leaks

Condensate Return
Waste Heat Recovery
Scaling and Fouling
HHV and LHV

Boiler Blowdown
Flash Steam
Turbulators
Condensing Boilers

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 6.
REF: Turner, **Energy Management Handbook**, Chapter 5 & 6.
REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 9 and 10.

XVI. MAINTENANCE AND COMMISSIONING

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

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 11.
REF: Turner, **Energy Management Handbook**, Chapter 14.
REF: Capehart, Turner and Kennedy, **Guide to Energy Management**, Chapter 12 and 20.

COMMISSIONING

Purpose of Commissioning
Need for Commissioning
Retro-Commissioning
Measurement and Verification
Phases of Commissioning
Commissioning Documentation

Benefits of Commissioning
Commissioning New Buildings
Real Time and Continuous Commissioning
Commissioning Agent
Facility Design Intent
Re-commissioning

REF: Turner, **Energy Management Handbook**, Chapter 26

XVII. ENERGY SAVINGS PERFORMANCE CONTRACTING and MEASUREMENT AND VERIFICATION

Measurement and Verification Protocols
Energy Savings Performance Contracting
Shared Savings Contracts
Contracting and Leasing
Risk Assessment

Energy Service Companies
Utility Financing
Demand Side Management
Savings Determination
Loans, Stocks and Bonds

REF: Mehta and Thumann, **Handbook of Energy Engineering**, Chapter 13.
REF: Turner, **Energy Management Handbook**, Chapter 25.

EXAM REVIEW QUESTIONS (Sample Only)

Some of these review questions may be more complex or difficult than the exam but will be good practice problems.

1. What is the basis for Commercial Building Codes by most states?
 - A. ASHRAE 90.2
 - B. ASHRAE 90.1
 - C. ASHRAE 62.2
 - D. ASHRAE 60.1

2. ASHRAE Standard 55 has rules for:
 - A. Ventilation for acceptable indoor air quality
 - B. Energy standard for buildings except low rise residential buildings
 - C. Thermal environmental conditions for human occupancy
 - D. All the above

3. If electricity is selling for \$0.06 per kilowatt-hour and is used for electric heating with an efficiency of 90%, what is the equivalent price of natural gas per therm if it can be burned with an efficiency of 80%?
 - A. \$1.33/therm
 - B. \$1.47/therm
 - C. \$1.56/therm
 - D. \$1.65/therm
 - E. \$1.780/therm

4. An energy saving device will save \$25,000 per year for 8 years. How much can a company pay for this device if the interest rate (discount rate) is 15%?
 - A. \$10,000
 - B. \$77,000
 - C. \$112,000
 - D. \$173,000

5. What would be used to find hot spots or phase imbalances in an AC circuit?
 - A. Ohmmeter
 - B. Infrared Camera
 - C. Wattmeter
 - D. All of the above

6. An audit for one firm showed that the power factor is almost always 70% and that the demand is 1000kW. What capacitor size is needed to correct power factor to 90%?
 - A. 266 kVAR
 - B. 536 kVAR
 - C. 618 kVAR
 - D. 1000 kVAR

7. The amount of reactive power that must be supplied by capacitors to correct a power factor of 84% to 95% in a 400 HP motor at 75% load and 98% efficiency is
- A. 72.4 kVAR
 - B. 82.5 kVAR
 - C. 90.04 kVAR
 - D. 92.4 kVAR
 - E. 123.5 kVAR
8. Power factor correcting capacitors may be located
- A. At the inductive load
 - B. At load control centers
 - C. At the customer side of the service transformer
 - D. All of the above
9. You find that you can replace a 50 HP motor with a 5 HP motor by cutting the total air flow requirements. Both motors operate at full load. Calculate the total dollar savings, given the information below: {Hint: savings of 45 HP }
- | | |
|-----------------------|-------------------|
| Runtime: | 8,760 hours/year |
| Motor Efficiency: | 90% (both motors) |
| Electrical Rate: | \$9.00/kW/mo |
| | \$0.05/kWh |
| Fuel Cost Adjustment: | \$0.005/kWh |
- A. \$22,000
 - B. \$18,798
 - C. \$15,650
 - D. \$12,710
 - E. \$9,874
10. An absorption system with a COP of 0.8 is powered by hot water that enters at 200 F and exits at 180 F at a rate of 25 gpm. The chilled water operates on a 10 F temperature difference. Calculate the Chilled water flow. You do not need to know how an absorption chiller works to solve this problem.
Use $COP = q_{out}/q_{in}$.
- A. 10 gpm
 - B. 20 gpm
 - C. 40 gpm
 - D. 45 gpm
 - E. 50 gpm
11. 10,000 cfm of air leaves an air handler at 50 F; it is delivered to a room at 65 F. No air was lost in the duct. No water was added or taken away from the air in the duct. How many BTU/hr was lost in the ductwork due to conduction?
- A. 162,000 BTU/hr
 - B. 126,550 BTU/hr
 - C. 75,000 BTU/hr
 - D. 42,550 BTU/hr
 - E. 10,000 BTU/hr

12. An investment tax credit of 10% for a **single project** (Not the company) at a large company:
- A. Reduces the company's overall taxes by 10%
 - B. Increases depreciation rate by 10%
 - C. Effectively reduces first cost of the project by 10%
 - D. A and C
13. Air at 69 F dry bulb and 50% relative humidity flows at 6750 cubic feet per minute and is heated to 90 F dry bulb. How many BTU/hr is required in this process?
- A. 50,000 BTU/hr
 - B. 75,000 BTU/hr
 - C. 152,000 BTU/hr
 - D. 310,000 BTU/hr
14. Estimate the seasonal energy consumption for a building if its design-heating load has been determined to be 350,000 BTU/hr for a design temperature difference of 70 F. This means that the Building Load Coefficient, $U \times A$, equals 5000. The heating season has 3,500-degree days. The heating unit efficiency is 80%. Assume 1 MCF = 10^6 BTU.
- A. 625 MCF/year
 - B. 525 MCF/year
 - C. 420 MCF/year
 - D. 356 MCF/year
 - E. 225 MCF/year
15. A wall has a total R-value of 15. Determine the annual cost of the heat loss per square foot in a climate having 5,000 heating degree-days. The heating unit efficiency is 70% and the fuel cost is \$5.00/million BTUs.
- A. \$0.057/yr/ft²
 - B. \$0.040/yr/ft²
 - C. \$0.0312/yr/ft²
 - D. \$0.0201/yr/ft²
16. A 10,000 square foot building consumed the following amounts of energy last year. What is the Energy Use Index of the building in BTU per square foot per year?
- Natural Gas 5,000 therms/year
 - Electricity 60,000 kWh/year
- A. 7,500 BTU/square foot/yr
 - B. 18,000 BTU/square foot/yr
 - C. 31,500 BTU/square foot/yr
 - D. 70,500 BTU/square foot/yr
 - E. 700,000 BTU/square foot/yr

17. Assuming that adding 2 inches of fiberglass insulation drops the U-value of a building from 0.24 to 0.098, calculate the annual cooling savings per square foot from the data given below:
- 2,000 cooling degree days; Cooling COP = 2.5; Electrical cost \$0.05/kWh
- A. \$0.010/ft²-yr
 - B. \$0.025/ft²-yr
 - C. \$0.040/ft²-yr
 - D. \$0.195/ft²-yr
 - E. \$0.202/ft²-yr
18. How much fuel is wasted if 100 pounds per hour of condensate at 30 psia saturated liquid is drained to the sewer and is made up with water at 60 F. Assume the boiler is 80% efficient and ignore blowdown effects.
- A. 12,090 BTU/hr
 - B. 15,200 BTU/hr
 - C. 18,000 BTU/hr
 - D. 23,850 BTU/hr
 - E. 29,800 BTU/hr
19. Select the equipment best suited to efficient **air-to-air heat exchange and humidity** control in the HVAC system of a large office building:
- A. Heat pipe
 - B. Radiation recuperator
 - C. Rotary sensible heat wheel
 - D. Shell and tube heat exchanger
 - E. Run around heat exchanger loop
20. Chilled water reset increases chiller efficiency and succeeds because it _____ .
- A. Restarts the system.
 - B. Raises the water temperature leaving the chiller.
 - C. Lowers the water flowrate through the chiller.
 - D. Stops water flow to zones with no occupancy.
21. The difference between the setting at which the controller operates to one position and the setting at which it changes to the other is known as the:
- A. Throttling range
 - B. Offset
 - C. Differential
 - D. Control Point
22. An all-electric facility pays \$100,000 annually for energy. The compressed air system has energy costs of \$20,000 per year. The system air pressure can be lowered by 10 psi. Approximately how much will be saved annually?
- A. \$20,000
 - B. \$10,000
 - C. \$5,000
 - D. \$2,000
 - E. \$1,000

23. With a load leveling TES strategy, a building manager will
- A. Not operate the chiller during peak hours
 - B. Essentially base load the chiller (i.e., operate at high load most of the time)
 - C. Operate only during the peaking times
 - D. Operate in the “off” season
24. In retrofitting a large commercial building with a TES, which of these considerations would be least important?
- A. System efficiency
 - B. Space issues
 - C. Demand cost
 - D. Equipment cost
25. A building presently has the following lighting system:
- Present System*
- Type: 196 mercury vapor light fixtures
Size: 250 watt/lamp (285 watt/fixture, including ballast)
- You have chosen to replace the existing system with the following:
- Proposed System*
- Type: 140 high pressure sodium fixtures
Size: 150 watt/lamp (185 watt/fixture)
- The facility operates 24 hours/day. Approximate the **heating effect** if the heating system efficiency is 80%, fuel costs \$5.00 per million BTUs and there are 200 heating days (not heating degree days) per year. That is, find the increased heating cost for the heating system when the lights are more efficient, and produce less heat.
- A. \$6,986/year
 - B. \$5,289/year
 - C. \$4,485/year
 - D. \$3,070/year
 - E. \$2,548/year
26. A program available at no-cost from a US Department of Energy website that displays cost and efficiency data on electric motors is:
- A. Freeware
 - B. Building Life Cycle Cost
 - C. MotorMaster
 - D. 3EPlus
 - E. QuickPEP
27. Given the same amount of excess air and the same flue gas stack temperature rise (look at 50% excess air and 500 degrees F stack temperature rise, for example), which fuel provides the highest boiler combustion efficiency?
- A. Natural Gas
 - B. No. 2 Fuel Oil
 - C. No. 6 Fuel Oil

28. A boiler is rated at 30 boiler horsepower and 80% efficient. What is the input rating?
- A. 1,255,000 BTU/hr
 - B. 1,005,000 BTU/hr
 - C. 2,502, 500 BTU/hr
 - D. 3,628,750 BTU/hr
 - E. 13,400,000 BTU/hr
29. In a steam system, several things can happen to the condensate. Which of these is the best from the standpoint of energy expense?
- A. Drain condensate to sewer
 - B. Recover condensate in an insulated system at atmospheric pressure
 - C. Recover condensate in an un-insulated system at boiler pressure
 - D. Recover condensate in an insulated system at or near boiler pressure
30. Which of the following projects, or ECOs, would likely reduce boiler and steam system costs?
- A. Adding boiler endplate insulation
 - B. Installing condensate return system
 - C. Repairing steam leaks
 - D. Installing combustion air preheater
 - E. All the above
31. Estimate the waste heat available in Btu/minute from a refinery flare gas leaving a process unit at 800 deg F if it is flowing at 1,000 cfm and weighs 0.08 lb/cubic foot. Its specific heat or heat content over the temperature range is 0.3 Btu/lb·°F and you should assume the waste gas could be reduced in temperature to 250 deg F.
- A. 178,000 Btu/min
 - B. 165,000 Btu/min
 - C. 44,000 Btu/min
 - D. 19,200 Btu/min
 - E. 13,200 Btu/min
32. Water at 70 deg F is supplied to a 100 psia boiler. 1000 lb/hr of steam from the boiler is supplied to a process. How much heat was required to be added in the boiler to create the 1000 lb/hr of steam?
- A. 1000 Btu/hr
 - B. 234,500 Btu/hr
 - C. 729,250 Btu/hr
 - D. 1,150,000 Btu/hr
 - E. 3,759,000 Btu/hr
33. A 100 HP rotary screw air-compressor generates heat equivalent to about:
- A. 1000 Btu/hr
 - B. 12,000 Btu/hr
 - C. 100,000 Btu/hr
 - D. 250,000 Btu/hr

34. An optimum start is a control function that:
- A. shuts off the outside ventilation air during start up of the building
 - B. shuts off equipment for duty cycling purpose
 - C. senses outdoor and indoor temperatures to determine the start time needed to heat or cool down a building to desired temperatures
 - D. starts randomly
35. Which of the following could be used to detect failed steam traps?
- A. Ultrasonic equipment to listen to the steam trap operation
 - B. Infrared camera to detect the change in temperature
 - C. Real time MMS using conductance probes
 - D. All of the above
36. Calculate the group re-lamping interval for T8 lamp fixtures with instant start ballasts that annually operate for 4,160 hrs with rated life of 15,000 hrs (assuming replacements at 70% of rated life)
- A. 1.0 year
 - B. 2.5 years
 - C. 3.5 years
 - D. 4.5 years

CEM Exam questions Key

Questions	Answers
1	(B)
2	(C)
3	(C)
4	(C)
5	(B)
6	(B)
7	(A)
8	(D)
9	(A)
10	(C)
11	(A)
12	(C)
13	(C)
14	(B)
15	(A)
16	(D)
17	(C)
18	(D)

Questions	Answers
19	(A)
20	(B)
21	(C)
22	(E)
23	(B)
24	(A)
25	(D)
26	(C)
27	(C)
28	(A)
29	(D)
30	(E)
31	(E)
32	(D)
33	(D)
34	(C)
35	(D)
36	(B)

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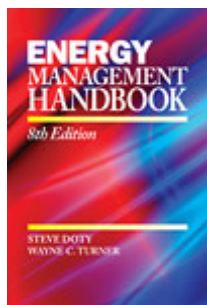
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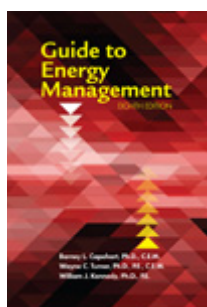


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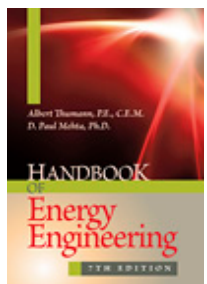


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