THE BEP BODY OF KNOWLEDGE AND STUDY GUIDE

Preparation for the BEP® Certification Exam

The BEP® Certification Exam is a four-hour open book exam. The examination questions are based on the Body of Knowledge listed below. Because of the diversity of background of a Certified Business Energy Professional, the examination has 11 different subject sections, all of which are included in the exam. You must bring a hand calculator to the exam as the BEP exam does not allow computers, tablets, or cell phones to be used during the test.

It is highly recommended that you review the complete Study Guide and answer the Exam Review questions included in the Study Guide to help you prepare and determine your readiness for the exam.

The BEP® Examination contains the following mandatory subjects:

Body of Knowledge 2.0	Percent of Exam
Codes and Standards and Green Buildings	3 – 5%
Energy Fundamentals	5 – 7%
Utility Rate Structures	7 – 11%
Electric and Gas Procurement	7 – 11%
Energy Accounting, Carbon Auditing, Metering and Energy Information Services (EIS)	10 – 16%
Energy Assessment and Instrumentation	7 – 11%
Energy Economics and Alternative Financing	9 – 13%
Commissioning and Measurement & Verification (M&V)	6 – 10%
Building Systems	10 – 14%
Industrial Process and Utility Equipment	7 – 11%
Combined Heat and Power and On-site Generation	7 – 11%

CERTIFIED BUILDING ENERGY PROFESSIONAL (BEP®) EXAM

This study guide is intended to help prepare candidates taking the Certified Business Energy Professional (BEP®) exam.

The exam will be open book, last four hours, and have 130 multiple choice questions to answer. There are 11 sections from which questions mainly are drawn.

The primary references include:

BEP Training Workbook (available to AEE training attendees)

Web Based Enterprise Energy and Building Automation Systems Design and Installation, by Barney L. Capehart and Lynne C. Capehart

Manual for Intelligent Energy Services, by Shirley J. Hansen

Maximizing Energy Savings and Minimizing Energy Costs, by John M. Studebaker

Megatrends for Energy Efficiency and Renewable Energy, by Michael Frank Hordeski

Green Facilities Handbook Simple and Profitable Strategies for Managers, by Eric Woodroof

Handbook of Web Based Energy Information and Control Systems, by Barney L. Capehart and Timothy Middelkoop

Energy Management Handbook, 9th Edition by Stephen A. Roosa, Steve Doty and Wayne C. Turner

Reference books are available through the AEE eLibrary, which is a great resource for accessing searchable content as well as highlighting and taking notes. *Digital books cannot be accessed during the certification exam.*

The following is a list of the subjects for the BEP® exam.

BODY OF KNOWLEDGE: STUDY GUIDE TOPICS & REFERENCES

1	**Codes and Standards and Green Buildings**
	Codes and Standards
101	Basic energy codes
102	Methods for code compliance
103	The role of DOE with building codes
104	ASHRAE standards 90.1, 90.2, & 62.1
105	Calculate minimum outdoor air requirements
106	Components needed for good indoor air quality

	Green Buildings
107	Definition of Green Buildings
108	ENERGY STAR, LEED for commercial buildings
109	Programs to benefit Green Buildings – LEED
110	Other LEED certifications
111	Green Building Certifications
112	Energy Star
113	Energy Star Portfolio Manager

2	**Energy Fundamentals**
201	Energy and power, differences
202	Energy conservation
203	Site and source energy

3	**Utility Rate Structures**
301	Knowledge of different types of costs recovered in rates (commodity, distribution, fixed vs. variable, power cost adjustments, etc.)
302	Primary vs Secondary Service
303	Power Factor Adjustments
304	Load Factor
305	Interruptible and Firm Power
306	Block rates, time of use rates, real time pricing
307	Rate analysis
308	Green power
309	PPA and VPPA
310	Transportation vs. Bundled Service
311	Rate development
312	DSM programs and their impact to rates

4	**Electric and Gas Procurement**
401	History of electric and gas
402	Risk identification in procurement
403	Natural gas procurement
404	Electric procurements
405	Understanding price discovery of fuels
406	Detailed procurement process
407	Overall procurement strategies
408	Fuel choices (hydrogen)

5	**Energy Accounting, Carbon Auditing, Metering and Energy Information Services (EIS)**
	Energy Accounting
501	Fuels / Selections
502	Point of use
503	Break point price
504	Facility energy accounting
505	Collecting and organizing utility data
506	Sources of data
507	Limitations of data
508	Independent variable
509	Energy interval data
510	Intro to spreadsheet tools
511	Benchmarking
512	Calculating the Energy Use Index
513	Comparison of facilities
514	Heating and cooling degree days
515	End use analysis
516	Forecasting energy usage
517	Advanced benchmarking with “Big Data”
	Carbon Accounting
518	Carbon flows
519	Emission classification
520	Emission tracking
521	Carbon trading
522	Steps to achieving carbon neutrality
523	Reduction
524	Sequestration
525	Electric vehicles
526	Electrification
527	Future fuels
528	Life carbon cycle – [cradle to grave]
	Metering
529	Self-contained meters versus CT rated metering installations
530	Revenue meters – gas & electric meters
531	Meter reading systems, Manual, MV90, Cellnet, MetraTek
532	Energy flows metering (electric, gas, oil, steam, Btu, water, sewer, etc.)
533	High level understanding of meter components – index, AMR module, electronic correctors, etc.
534	Components metered (kWh, kW, kVARh; turnup vs. therms vs. CCF)
535	Pressure and temperature correction – (high pressure gas meters)
536	Read terminology (estimate, actual, pro-rate)

537	Issues that arise from incorrect installation
538	Interval Data Systems and Analysis
539	Sub-metering
540	Cost center metering, reporting and budgeting
	Energy Information Services (EIS)
541	EIS definition
542	EIS backbone
543	Purpose of an EIS
544	Meter data flow
545	IT and web based systems
546	Data collection and devices
547	Data processing and systems
548	Server and client side programs

6	**Energy Assessment and Instrumentation**
601	Process of energy assessments
602	Types of energy assessments
603	Common energy assessment deficiencies
604	Analysis of operations and maintenance
605	Assessment equipment
606	Assessment report
607	Incorporating the goals

7	**Energy Economics and Alternative Financing**
	Energy Economics
701	Importance of knowing finance
702	Economic evaluation
703	Life Cycle Costing, Simple Payback, Net Present Value, Annual Worth, Savings to Investment Ratio, Internal Rate of Return
704	Energy efficiency vs. renewable economic evaluations
705	Levelized cost of energy
	Alternative Financing
706	Methods of finance
707	Direct purchase methods
708	Leasing methods
709	Performance contracting
710	Guidance for choosing method

8	**Commissioning and Measurement & Verification (M&V)**
	Commissioning
801	Commission definitions
802	Retro, Real-time, Re and Season commissioning
803	Is commissioning necessary and cost effective?
804	Associated costs
805	Benefits of commissioning
806	Phases of commissioning
807	Guidance of the commissioning Request for Proposal (RFP)
808	Documentation
	Measurement & Verification (M&V)
809	Reasons for M&V
810	M&V targets
811	Minimizing risk
812	Determining independent variables
813	M&V options
814	Adjusting baselines
815	International Performance Measurement and Verification Protocol (IPMVP®)

9	**Building Systems**
	Lighting
901	Terminology
902	Types of lamps
903	Factors in lighting application (lumens, footcandles, efficacy, CRI, Color Temp, LLD, LLF)
904	Effective and energy efficiency lighting designs
905	Lighting – local code requirements
906	Lighting Energy Metrics (e.g. LPD)
907	Relamping
	HVAC
908	Purposes
909	Temperature, relative humidity and CO_2 controls
910	Filtration / indoor air quality
911	Power, energy and air-conditioning
912	HVAC performance measures (EER, SEER, COP, IEER, IPLV)
913	Air based systems
914	Water based systems
915	Energy Recovery Ventilation (ERV)
916	System and technology improvements
	Controls
917	Purposes

918	Types of controls
919	Close and open loop
920	PID controls
921	Newer control systems & Strategies
922	Control technologies
923	Specific control operations/tasks

10	**Industrial Process and Utility Equipment**
	Industrial and Utility Processes
1001	Equipment types & uses overview, heating, & colling systems
1002	Boilers, chillers, cooling towers
1003	Ventilation air
1004	Vapor compression system / heat pumps
1005	System maintenance
1006	Energy & costs savings opportunities
1007	Transmission
1008	Local distribution company
1009	Gas main distribution
1010	Electric utility system
1011	Generation
1012	Distribution
1013	Power quality and reliability
	Motor Systems Management
1015	Motor basics
1016	Motor types
1017	Importance of motor management
1018	Energy savings
1019	Selecting / replacing motors
1020	Variable frequency drives (fans and pumps)
	Steam and Hot Water Systems
1021	Boiler types
1022	Condensing boiler operation
1023	Boiler metrics
1024	Turbines and expander
1025	Heat exchangers
	Compressed Air Systems
1026	Components of air systems
1027	Metrics
1028	System efficiency improvements

11	**Combined Heat and Power and On-site Generation**
1101	Combined heat and power efficiency
1102	Facilities attractive to combined heat and power
1103	Smart grid
1104	Rate offerings (green, premium)
1105	Distributed generation characteristics
	Distributed Generation; and on-site combined heat and power systems
1106	Diesel, natural gas, hydrogen
1107	Steam turbines
1108	Combustion turbines
1109	Microturbines
1110	Fuel cells
1111	Solar concentrating
1112	Solar photovoltaic
1113	Wind turbines
1114	Geothermal, organic rankine cycle
1115	Ocean and tidal
	Energy Storage
1116	Batteries
1117	Ratings
1118	Pros and cons
1119	Types for use in facilities
1120	Costs
1121	Discharge duration (power and energy)
1122	**Flywheel, capacitors, compressed air, water/hydraulic**
1123	Ratings
1124	Pros and cons
1125	Types for use in facilities
1126	Barriers to CHP and DG

EXAM REVIEW QUESTIONS (Sample Only)

1. Which of the following is the INCORRECT conversion factor?

   A. 1 HP = 3,412 W
   B. 1 therm = 100,000 Btu
   C. 1 MBtu = 1,000 Btu
   D. 1 MMBtu= 1,000,000 Btu

2. A: (US Version) Calculate the point of use cost in MMBtu for natural gas at $0.78/therm and at 72% combustion efficiency.

   A. $6.83 per MMBtu
   B. $7.80 per MMBtu
   C. $10.83 per MMBtu
   D. $11.80 per MMBtu

   B: (SI Version) Calculate the point of use cost in MJ for fuel oil at $2.12/liter and at 75% combustion efficiency.

   A. $0.081 per MJ
   B. $0.096 per MJ
   C. $0.107 per MJ
   D. $0.116 per MJ

3. What percentage of building failures will have major consequences and occur INFREQUENTLY?

   A. 5%
   B. 10%
   C. 15%
   D. 25%

4. When connecting a CT to a panel to measure current flow, it is important to connect the CT on the correct phase and to ensure the polarity of the CT is correct. To assist with this connection, an arrow is labeled on the CT. When the CT is installed correctly, the arrow should point in which direction?

    A. Upward
    B. Downward
    C. Toward the supplying energy
    D. Toward the load
    E. It doesn't matter

5. LEED awards energy efficiency points based upon:

    A. Reduction of energy costs
    B. Reduction of energy use
    C. Reduction of environmental emissions
    D. All of the above

6. A: (US Version) What is the EUI of a facility which has 113,000 square feet of conditioned floor space and used the following fuel amounts in 2023?

Electricity	824,000 kWh
Natural Gas	46,987 therms
Light heating oil	26,000 gallons

    A. 91,256.22 Btu/ft^2/yr
    B. 98,674.23 Btu/ft^2/yr
    C. 112,989.84 Btu/ft^2/yr
    D. 126,983.34 Btu/ft^2/yr
    E. 142,532.32 Btu/ft^2/yr

B: (SI Version) What is the EUI of a facility which has 10,500 square meter of conditioned floor space and used the following fuel amounts in 2023?

Electricity	824,000 kWh
Natural Gas	4,958,000 MJ
Light heating oil	99,000 liters

A. 256.2 MJ/m^2/yr
B. 774.6 MJ/m^2/yr
C. 1,122.4 MJ/m^2/yr
D. 1,269.6 MJ/m^2/yr
E. 2,222.8 MJ/m^2/yr

7. An energy audit of an industrial complex is in progress. One of the energy analysts has just reported to you that there is a compressed air system that has several leaks. One of the leaks is on an air supply hose. The leak on the hose was caused by a forklift that drove over it and crimped it making a hole that is approximately ¼ inch in diameter. The hose is 100 feet long and will cost $250 to replace it. If the compressed air system operates at 110 psi and the blended cost of energy is $0.11/kWh. What is the simple payback in years to replace this hose?

   A. 0.023 years
   B. 0.46 years
   C. 1.21 years
   D. 2.23 years

8. Which of the following would cause the NPV of a project to become more positive?

   A. Increasing MARR
   B. Increasing purchase price
   C. Increasing electricity rates
   D. Decreasing the project life
   E. None of the above, all of these would cause NPV to become less positive

9. An energy manager is performing an inspection of a large boiler. Looking through the viewing glass on the boiler, they can see the flame as it heats the gases before flowing through the tubes. The boiler operates for approximately 7,000 hours per year and operates for heating domestic hot water. Which of the following types would this boiler be categorized by?

    A. Fire tube boiler
    B. Power boiler
    C. Power coupled boiler
    D. Water tube
    E. Water lancing

10. A facility has the following information. Calculate the utility bill for the given month (ignore taxes).

Billing period	30 days
Monthly energy	421,900 kWh
Monthly demand	900 kW
Monthly kVA	1,008 kVA
Customer charge	$1,200.00
Energy charge	$0.038/kWh
Fuel charge	$0.032/kWh
Demand charge	$11.50/kW-Month

    A. $19,422
    B. $25,698
    C. $27,582
    D. $30,116
    E. $41,083

11. From the facility in questions 10, what is the facility's Load Factor?

    A. 39.3
    B. 49.4
    C. 65.1
    D. 89.3
    E. Cannot determine, inadequate information

12. What is the minimum criteria that must be met to obtain a LEED-NC certification level of Gold?

    A. 40 points
    B. 50 points
    C. 60 points
    D. 80 points

13. A facility has a FLF of 60%. Which of the following items would need to be looked at further to determine if the facility had potential for demand savings?

    A. Facility operating hours
    B. Billed demand KW
    C. Billing kWh
    D. Current utility rate

14. A: (US Version) How many therms of energy are in a 20 gallon tank of propane? (use a propane Btu content of 95,000 per gallon)

    A. 9.5 therms
    B. 19 therms
    C. 21 therms
    D. 42 therms

    B: (SI Version) How many MJ of energy are in a 15 cubic meter tank of propane?

    A. 165.5 MJ
    B. 188.5 MJ
    C. 208.5 MJ
    D. 382.5 MJ

15. An energy audit that includes obtaining equipment operating and maintenance procedures is:

    A. Type I
    B. Type II
    C. Type III
    D. Investment grade
    E. Master audit

16. This type of motor has the best torque properties.

    A. Direct current
    B. Induction
    C. Synchronous
    D. Squirrel cage
    E. None of the above, it solely depends on voltage and the AC frequency

17. What is the efficacy of a 150 Watt induction lamp?

    A. 40 L/W
    B. 50 L/W
    C. 60 L/W
    D. 70 L/W
    E. 80 L/W

18. Which of the following is considered a non-routine adjustment in an M&V plan?

    A. An adjustment made when energy usage changes by more than 10%
    B. An adjustment made annually due to degree day changes
    C. An adjustment made when energy usage changes dramatically but predicted
    D. An adjustment made when energy usage changes dramatically but was unpredicted
    E. All of the above

19. Which PPA does an energy manager need to be careful about making up a difference in charges between the contract price and the locational price considered a true-up cost?

    A. Physical purchase power agreement
    B. Virtual purchase power agreement
    C. All of the above

20. An HVAC system in a large office complex automatically adjusts the temperature setting of the chiller water supply to match the needs of the facility based upon the occupancy of the facility. This automatic adjustment in chill water temperature is called?

    A. Chill water temperature reset
    B. Chiller optimization
    C. Reheat coil reset
    D. Economizer

21. Which of the following is NOT one of the items needed to be controlled to have good indoor air quality?

    A. Relative humidity
    B. Good filtration of MERV <6
    C. Good moisture control
    D. HEPA filters on cleaning devices
    E. None of the above – they are all needed

22. A: (US Version) A lighting survey of a 15,000 square foot facility identified the below fixtures. What is the lighting watt density of this facility?

160 – T8 – 4 tube troffers @ 108 watts/fixture
120 – 8 watt LED directional lamps
80 – 23 watt induction task lamps

    A. 1.339
    B. 2.211
    C. 2.403
    D. 3.303
    E. 3.411

    B: (SI Version) A lighting survey of a 1,400 square meter facility identified the below fixtures. What is the lighting watt density of this facility?

160 – T8 – 4 tube troffers @ 108 watts/fixture
120 – 8 watt LED directional lamps
80 – 23 watt induction task lamps

    A. 11.113 W/m^2
    B. 12.213 W/m^2
    C. 13.543 W/m^2
    D. 14.343 W/m^2
    E. 23.413 W/m^2

23. Tracking the occupancy of a facility for benchmarking is considered:

    A. Tracking a dependent variable
    B. Tracking occupancy for cost allocation
    C. Tracking occupancy for growth forecasting
    D. Tracking an independent variable
    E. Tracking occupancy for cost assignment

24. During an energy assessment, a project is identified to replace a specific system. The replacement system has a calculated simple payback of two years. When comparing only the current system's annual energy usage with the new proposed system, what should be the expected range of energy savings?

    A. 5 to 15%
    B. 15+ to 30%
    C. 30+ to 45%
    D. 45+ to 60%

25. A 100 HP motor was slowed down by 15%. What is the new HP required by the motor?

    A. 100.00 HP
    B. 85.00 HP
    C. 75.00 HP
    D. 61.41 HP
    E. 50.00 HP

26. A facility just installed a large HVAC unit and they believe the unit is over-sized. The facility has a maximum daily heat load each hour for 4 hours of 875,000 Btu/hr. The facility installed a 100-ton HVAC system. By how much is the installed unit oversized?

    A. 21.0 tons
    B. 24.8 tons
    C. 27.1 tons
    D. 30.3 tons
    E. 32.5 tons

27. The efficacy of a lighting system is measured in:

    A. Lumens
    B. Footcandles
    C. Lux
    D. Lumens per Watt
    E. Footcandles per Watt

28. An energy manager is reviewing their electrical bill for Facility "A". They notice that the demand listed on the bill is 250 kW, the load factor is 74%, and the power factor is 80%. What is the average demand over the entire billing period she is reviewing?

    A. 185 kW
    B. 250 kW
    C. 338 kW
    D. 385 kW
    E. 450 kW

29. Why are evaporative heat exchangers more energy efficient than other heat exchangers?

    A. They utilize sensible heat change
    B. They utilize phase change
    C. They utilize multiple baffle heat exchange coil arrangements
    D. They do not have heat exchanger coils
    E. They have a higher area for heat transfer

30. A: (US Version) In August, the average temperature during the week was 81°F. How many cooling degree days were added during this time frame?

    A. 6
    B. 16
    C. 32
    D. 48
    E. 112

    B: (SI Version) In August, the average temperature during the week was 27 C. How many cooling degree days were added during this time frame?

    A. 60.9
    B. 76.4
    C. 88.7
    D. 112.5
    E. 124.3

ANSWER KEY

US	
Question	Answer
1	A
2A	C
3	B
4	D
5	A
6A	B
7	A
8	C
9	A
10	E
11	C
12	C
13	A
14A	B
15	E
16	A
17	C
18	D
19	B
20	A
21	B
22A	A
23	D
24	A
25	D
26	C
27	D
28	A
29	B
30A	E

International	
Question	Answer
1	A
2B	A
3	B
4	D
5	A
6B	B
7	A
8	C
9	A
10	E
11	C
12	C
13	A
14B	D
15	E
16	A
17	C
18	D
19	B
20	A
21	B
22B	D
23	D
24	A
25	D
26	C
27	D
28	A
29	B
30B	A