

50001 CP BODY OF KNOWLEDGE AND STUDY GUIDE
Preparation for the 50001 CP Certification Exam (IP Format)



The 50001 CP 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 50001 Certified Practitioner, the examination has 6 different subject sections, 5 of which are included in the exam. You must bring a hand calculator to the exam as the 50001 CP 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 50001 CP™ Examination contains the following mandatory subjects:

Body of Knowledge	Percent of Exam
1. Personal Competencies	Pre-reg
2. General Understanding Competencies	17 – 25%
3. Management Systems Competencies	18 – 28%
4. Analysis Competencies	17 – 25%
5. Technical Analysis Competencies	17 – 25%
6. Technical Competencies	11 – 17%

50001 CERTIFIED PROFESSOPMAL (50001 CP™) EXAM

This study guide is intended to help prepare candidates taking the 50001 Certified Professional (50001 CP™) exam.

The exam will be open book, last four hours, and have 65 multiple choice questions to answer. There are 5 sections listed below from which questions mainly are drawn.

The primary references include:

50001 Certified Professional (50001 CP™) Training Workbook (available to AEE training attendees)

The following is a list of the subjects for the 50001 CP exam.

BODY OF KNOWLEDGE: STUDY GUIDE TOPICS & REFERENCES

1 Personal Competencies

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| 101 | Communicate with individuals orally |
| 102 | Communicate with individuals in writing |

- These are pre-requisite competencies and required to a level for an individual to communicate in general conversation and general writing skills
- The requirements of a certified 50001 professional in relation to these competencies are at a reasonably “generic” level. It is understood that the certified 50001 professionals engaged in some roles may require an enhanced level of communication skills (e.g., a Certification Body Lead Auditor) but this is not a requirement of all certified 50001 professionals and therefore the more basic skill level is appropriate to the certification.
- The competence of communication, both written and verbal, will be required for an individual to undergo the process of applying for and completing the certification process

2 General Understanding Competencies

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| 201 | Demonstrate their understanding of energy management systems terminology and energy management systems principles |
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- The certified 50001 professionals will be able to demonstrate understanding of the following:
 - The basic principles of operation of management systems in general
 - To plan, do, check, act cycle
 - The High-level Structure (HLS) as outlined in ISO document Annex SL

- The interaction between the “definitions” in the standard, the “requirements of the ISO 50001: 2018 Energy Management Standard” and the guidance in the annex
- The ways in which the different components of the management systems standard interact with one another
- The meaning of normative and non-normative references
- The classes of findings that arise from a certification audit and the requirements in closing out such findings
- The interaction between the ISO 50001: 2018 Energy Management Standard and the 50001 “family of standards” including ISO 50002, 50003, 50004, 50006, 50015, 19011
- The ability to form integrated management systems with other standards
- The difference between types of certification audits
- The certification audit process and the requirement for independence in relation to auditors
- The difference between internal and external audits in relation to consultancy
- All definitions outlined in the definitions section of ISO 50001 Energy principles and how to apply them including, at minimum, types of energy, energy uses, energy conversion, and conversion of energy and power, in different units (e.g., kWh to TJ)
- The law of conservation of energy
- How each type of energy applies to the energy management system scope
- How to calculate the time required for a certification audit, conforming to the requirements of ISO 50003 given a set of information about an organization
- Understanding and application of international energy nomenclature (e.g., CDD, HDD)
- The certified 50001 professional shall have knowledge of the principles of:
 - Fuel combustion
 - Energy flow
 - Energy losses
 - Energy efficiency
 - Energy balance
 - Thermal energy
 - Mechanical energy
 - Energy in transport
 - Electrical energy
 - Renewable energy (thermal and electrical)

- The requirements of a certified 50001 professional in relation to General Understanding Competencies is such that every certified 50001 professional needs to understand energy and understand ISO 50001 and an ability to combine the requirements of the Management System Standard with the requirements of an energy system. Whilst the application of ISO 50001 in particular applications will require specialist knowledge (e.g., Nuclear Power Station), such specific knowledge is not required of all certified 50001 professionals. Therefore, the outlined competencies are seen as competencies that will typically be required for the application of ISO 50001 in all organizations (e.g., Transport Energy may not be a large component of a nuclear power station, but the certified 50001 professional needs to know enough to make the basic analysis to know if this is the case or not, and therefore needs knowledge of the principles to make this assessment). The requirement in relation to the various standards is in relation to understanding the interaction of the standards and the associated “priorities,” what are “requirements,” what is “guidance,” etc. and their application. It does not require an in-depth knowledge of the content of each standard.
- It is intended that the assessment of these competencies would be undertaken in an assessment of practical implementation. E.g., a question in the exam could present a scenario of water heating system operating in a particular way and presenting the information in such a way that the application is asked to assess the heat lost into the room. This might therefore have assessed the knowledge of law of conservation of energy, energy balance, thermal and electric energy, and heat loss. The preference would be questions worded in a practical application as opposed to simplistic questions simply by requiring the application of a formula available in a folder.

3 Management Systems Competencies

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| 301 | Demonstrate their understanding of the context of an organization and the needs and expectations of interested parties, when determining the scope and boundaries of an organization’s EnMS |
| 302 | Demonstrate their understanding of the requirements of Top Management within an EnMS and the relevance to the EnMS roles, responsibilities and authorities within the organization and the stated energy policy |
| 303 | Demonstrate their ability to identify potential conflicts with organization context and unintended consequences with different proposed energy management system approaches and / or potential energy performance improvement opportunities |
| 304 | Demonstrate their ability to assess a given approach in relation to communication and awareness for a particular situation and assess for conformance, or otherwise, against EnMS requirements. |
| 305 | Demonstrate their ability to assess documented information against EnMS standard requirements. |
| 306 | Demonstrate their ability to review a given set of circumstances in relation to Legal Obligations & Other Obligations and determine conformance or otherwise (comparison of the facts (data) v/s legislation stated). (This does not imply that an individual has an in-depth knowledge of all legal requirements) |
| 307 | Demonstrate their ability to assess an internal audit plan for a given set of circumstances and identify shortfalls, or otherwise, in the plan, in relation to the EnMS Standard |

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| 308 | Demonstrate their ability to assess a management review set of notes and identify shortfalls, or otherwise, in EnMS standard conformance |
| 309 | Demonstrate their ability to review non-conformities and associated actions taken, and to assess for conformance, or otherwise, to the EnMS standard |
| 310 | Demonstrate their ability to identify relevant legal and other requirements related to energy and to conclude whether these have been appropriately considered in a given set of circumstances in an energy management application. |

- ISO 50001/2018 Clause 3, 4, 5, 6, 7, 8, 9, 10
- The 50001 professional will be able to apply these in the situation of a single facility management system, a management system covering multiple facilities and a management system where the work is carried out in various locations (i.e. temporary sites)
- The type of organization, that the management systems the 50001 professionals might be required to assess against, include an organization whose activities are office based in a single commercial office facility, an organization that manufactures products, an organization that provides services (such as a courier or an office cleaning firm) and a retail type organization. (Note - assessment of competencies will be at a general level – not requiring in-depth understanding of a particular industry or organization)
- The requirements of a Certified 50001 professional in relation to these competencies are that the Certified 50001 Professional needs to have the knowledge to assess the most appropriate approach to implement an EnMS within an organization and therefore needs all the competencies required associated with the implementation. That said, a Certified 50001 professional should not need to have a detailed understanding of the operation of every type of industry where ISO 50001 can be applied, but every Certified Professional will require the competence to assess the conformity of a given set of circumstances against a given set of requirements (from the standard) and make the required judgement; or given a set of requirements (clauses of the standard), and the knowledge of an organization (context of the organization), and a set of options as to how to meet the requirements, make a judgement as to which approach is more appropriate. To allow for a consistent assessment of competence in this regard, and to allow for most applications where ISO 50001 will be applied, assessment of competence may be against applications in the given areas of manufacturing/services/ retail and should not require a specialist knowledge of the operations of these types of organization above that commonly understood by individuals or provided in the details given to allow the assessment of competence to be made.

4 Analysis Competencies

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| 401 | Demonstrate their ability to use and interpret basic statistics. This shall include the use of control charts and similar approaches to display and analyze data (e.g., Sankey, Pie, Poisson Distribution, Heatmaps, etc.) |
| 402 | Demonstrate their ability to predict potential improvements or assess the level of proposed energy improvements, when presented with a set of different states opportunities and associated savings potentials. This would include the context of where the savings will be delivered (i.e, identification and recognition of interactive effects) |
| 403 | Demonstrate their ability to assess provided data and other relevant information, along with stated objectives and targets, and to assess the level of energy performance improvements delivered or not delivered |
| 404 | Demonstrate their ability to review provided energy data from monitoring and measurement against stated EnPI' and Baseline and to identify potential anomalies between actual and expected energy data and possible causes |
| 405 | Demonstrate their ability to identify alignment or misalignment with different sets of opportunities for improvements and a given set of objectives, targets, and action plans and EnMS requirements |
| 406 | Demonstrate their ability to assess data collection plans for robustness, related to a particular set of organization circumstances and to assess against EnMS standard requirements |

- The management system can come from any type of organization outlined for management system competencies above (single site, multi-site, temporary site, office, manufacturing, services, and retail).
- The 50001 professionals shall be required to demonstrate an understanding of and the application of statistical terms such as mean, mode, variance, standard deviation, error, regression analysis (single variable and 2- variable), Coefficient of Variance, in analysis of energy consumption and energy performance.
- The 50001 professionals may be asked to undertake the analysis where data is given to them in written form (report) or requested to assess the data outlined in tables, graphs, and control charts. This analysis may require an individual to assess information from multiple charts, or graphs and to form conclusions.
- All analysis will be undertaken on processes limited to the process activities outlined in the technical competencies below. Alternatively, this could be accompanied by a written description of the process in sufficient detail for an individual to understand what represents efficient or inefficient operation and which does not require an in-depth understanding of the process involved.

5 Technical Analysis Competencies

- 501 Demonstrate their ability to assess and energy review (or part thereof) against the requirements of the EnMS standard
- 502 Demonstrate their ability to assess EnPI's and baselines given a set of circumstances and determine if they are appropriate for assessing the existence of energy performance improvement
- 503 Demonstrate their ability to analyze energy data and other relevant information; to identify potential variables and static factors; and to determine relevant variables
- 504 Demonstrate their ability to identify different appropriate energy performance indicators and baselines, given the objectives and targets of an organizations EnMS and / or assess the relevance or appropriateness of a set of EnPI's and baselines for a set of given circumstances.
- 505 Demonstrate their ability to use different basic energy analysis approaches to identify potential improvements for a standard set of energy systems. This will include the ability to interpret potential energy improvement opportunities, and/ or estimate energy improvement potential from stated opportunities, when presented with relevant data and applying basic energy and engineering principles
- 506 Demonstrate their ability to assess the relevance of selected competences criteria for a given set of circumstances related to energy management
- 507 Demonstrate their ability to assess operation criteria related to typical SEUs (as outlined in competency 7) under a given set of circumstances and to identify weaknesses or strengths in the operational control approach undertaken
- 508 Demonstrate their ability to review a given set of circumstances related to design and/or procurement and identify weaknesses and/ or conformance with the EnMS Standard

- The management system can come from any type of organization outlined for management system competencies above (single site, multi-site, temporary site, office, manufacturing, service and retail).
- The 50001 professionals shall demonstrate their understanding and ability to apply analysis as outlined in ISO 50006 against a range of processes and systems as outlined below in "technical competencies."

6 Technical Competencies

- 601 Demonstrate their ability to assess proposed opportunities for improvement and form a judgement as to whether they will deliver energy performance improvement under a given set of circumstances. This ability is fundamental to an individual operating as an ISO 50001 Certified Professional, whether
- A) Operating as a consultant in delivering an Energy review to the client in accordance with ISP 50001 requirements
 - B) Reviewing an SEU in terms of Current Energy Performance and able to correlate energy performance values (e.g. EnPI's) with the existence of significant opportunities for energy performance improvement
 - C) When acting in a position of an auditor
 - D) Assessing the work of others to assess the appropriate nature of an action plan, its alignment with the projected energy improvement targets and the general reasonable nature of the energy calculations that support the projected improvement target
- 602 Demonstrate their ability to review proposed Measurement & Verification approaches against proposed opportunities for improvement, objectives, and targets; and determine if improvement in performance has been demonstrated and / or the level of improvement demonstrated
- 901 Control Systems (terminology & functions)
- 902 BAS functions
- 903 Potential costs savings opportunities

- Technical competence ability will be limited to the following list of processes and systems unless sufficient detailed explanation is given meaning that knowledge and experience of that type of system is not required to complete the task.
 - internal lighting
 - external lighting
 - HVAC (including temperature control as well as temperature and humidity control)
 - boilers (oil & gas)
 - chillers (air and water cooled)
 - building envelope
 - electrical distribution
 - electric motors
 - Electric motor drives
 - pumping
 - fans
 - compressed air (basic level)
 - transport (basic level - cars, light commercial, truck)
 - basic plug loads (e.g., computers, printers, etc.)
 - steam systems (basic)
 - heat loss and its components and drivers
 - heat exchangers
 - Cooling towers

- Waste heat recovery
 - Controls
 - Financial analysis
- The 50001 professionals shall be able to understand and use the following: steam tables, pump curve, refrigerant table, psychrometric chart and shall be able to determine the potential savings from opportunities given the necessary information.
- The focus here is to ensure that the Certified 50001 Professional has the competencies to assess systems based on sound engineering principles so that in the event of encountering a user of energy that they have not come across before would be able to apply sound engineering judgement to allow a reasonable assessment of current energy performance to be carried out. Therefore, the assessment of competence should be focused on assessment of competence in these areas as opposed to areas where an in-depth knowledge or extensive experience of particular systems would be required. As an example it could be appropriate to provide a sample scenario of a cooling tower system in operation (e.g. as displayed on a BMS screenshot) and an individual applying general knowledge where supplied with all the necessary data (temperatures, set points, basis of control, air temperature and relative humidity, psychrometric chart etc.) should be able to form an opinion that the tower is being operated inefficiently because the set point of the cooling tower is below the wet bulb temperature of the external air and fans are therefore at 100% speed irrespective of cooling load. The Certified 50001 professional should not need an in-depth experience of cooling towers to spot this because the relevant information to allow the judgement to be formed would be provided.

EXAM REVIEW QUESTIONS (Sample Only)

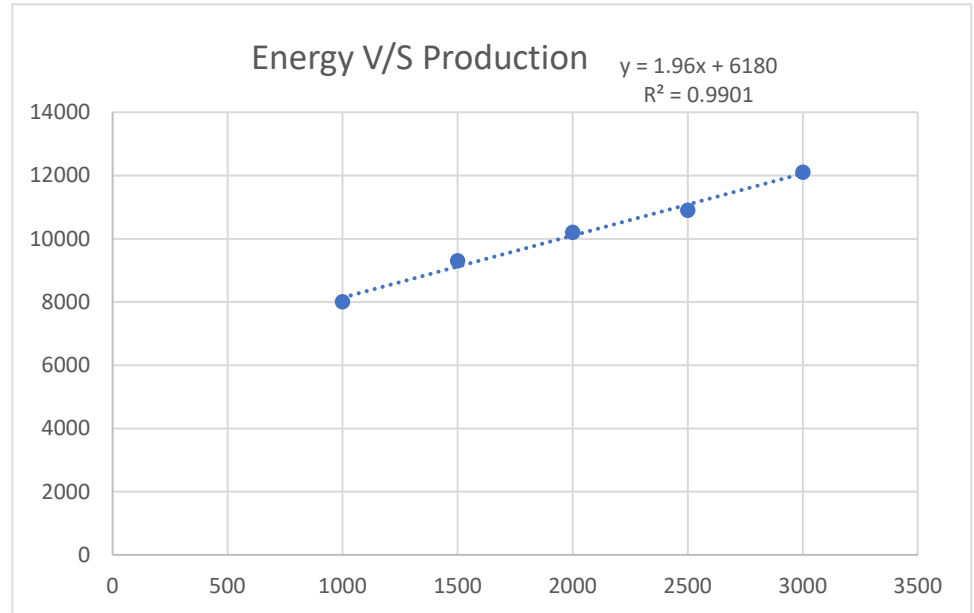
1. You are consulting with an industrial facility that is going through its ISO 50001 Stage 2 initial certification audit. The scope of certification is “management of electrical and thermal energy associated with the manufacturing activities carried out on the site”. You have observed the energy review by the certification auditor and have seen that the organization has set a criterion for selection of significance as being an energy use that accounts for 12% or more of overall energy use. The SEUs selected are pumping, lighting, boilers (hot water), heating distribution system and IT. Cumulatively, this accounts for 82% of the energy of the organization (100% of the gas and 68% of electricity).

You also remember that in your previous operational control review of the facility, there were two large energy uses that had not been determined to be significant. These were compressed air and conveyer belts. The compressed air accounts for 14% of electrical energy. The compressors are fixed speed, with multiple compressors operating at part load, and there are numerous incidences of audible leaks from the system. The compressors appear to operate continually. For the conveyers, these appear to operate continually unloaded for about 30% of time and the temperatures on the belts indicate that there are multiple bearings that appear partially seized. When the certification auditor questioned the site about air compressors and conveyors, the organization responded that neither are significant as per their definition of significance and that they intend to get to these issues in the following quarter. Both issues are identified on their opportunities register. What level of finding should the auditor assign to this situation, if any?

- A. Recommend Certification on the basis that the identified issues are not significant in accordance with the organization definition, and they are aware of the issues. No nonconformity. No opportunity for improvement (OFI)
- B. Recommend Certification, with minor nonconformities related to the Compressed air system and Conveyer system.
- C. Not recommend certification and raise major non-conformity against the Compressed air and conveyer systems.
- D. Recommend Certification with an OFI identifying these as areas for future improvement.

2. You are reviewing the overall energy performance indicator and energy baseline for a manufacturing facility as they prepare for a certification audit. The following information has been presented to you to assess their gas consumption.

Production [Units]	Energy [MMBTU]
1000	8000
1500	9300
2000	10200
2500	10900
3000	12100



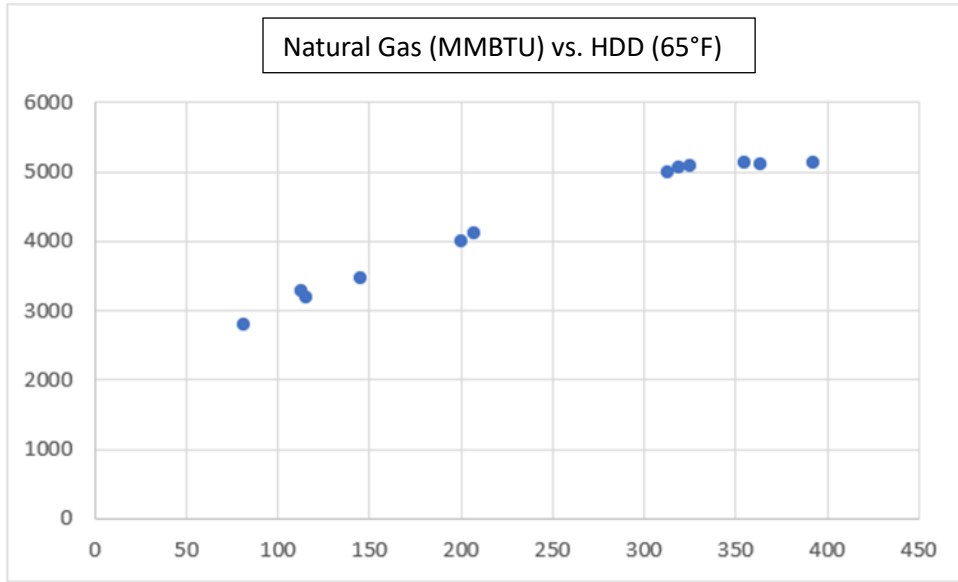
The organization has chosen to be simplistic with its Energy Performance indicator that is assessed daily. Their process is as follows.

- Get the gas meter consumption for the previous day from the SCADA system [be sure to read in MMBTU value]
- Subtract 6,180 MMBTU from the value
- Get the corresponding production output from the previous day from the SCADA system
- Divide the kWh value from the previous calculation by the daily production value
- Expected value to be between 1.82 and 2.08 MMBTU/unit and if higher, investigation is required.

What would you anticipate as the most likely finding from an audit to be:

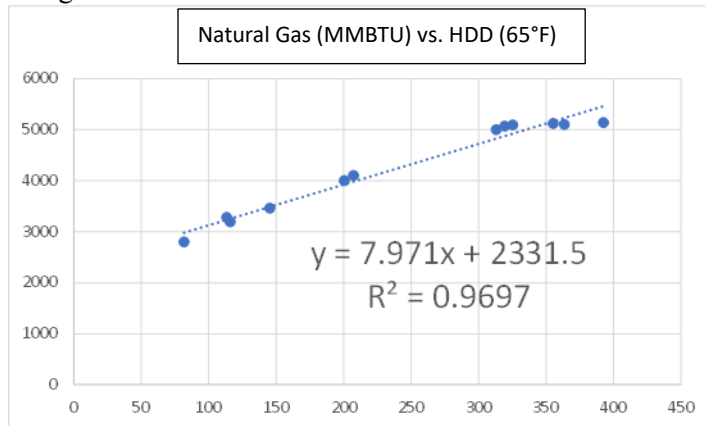
- A. Minor nonconformity on the basis that this is essentially “Specific Energy Consumption” which is not regarded as an appropriate way to assess performance.
- B. Opportunity for Improvement (OFI) noting that as gas is the energy source being assessed, the organization should have assessed the impact of external temperature on the output.
- C. OFI stating that the organization might consider programming the energy per unit assessment into the SCADA system using the formula Expected Gas (daily) = 1.96 x daily production value + 6,180 and setting an automatic alarm at +/- 4% difference between actual and expected
- D. Major nonconformity as the outlined approach does not properly provide for normalization of the baseline.
- E. Conformity with no issues.

3. When undertaking an assessment to determine the appropriate EnPIs for a facility, the profile of natural gas versus heating degree days is as follows:

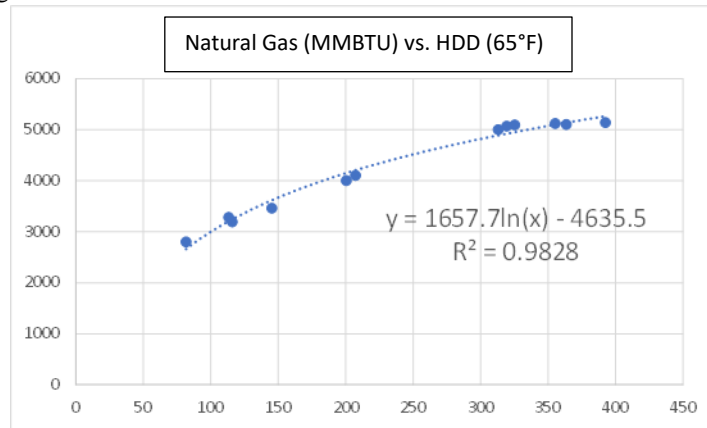


Which of the following EnPIs will best allow comparison of actual versus expected energy consumption and identification of when improvement or deterioration of energy performance occurs?

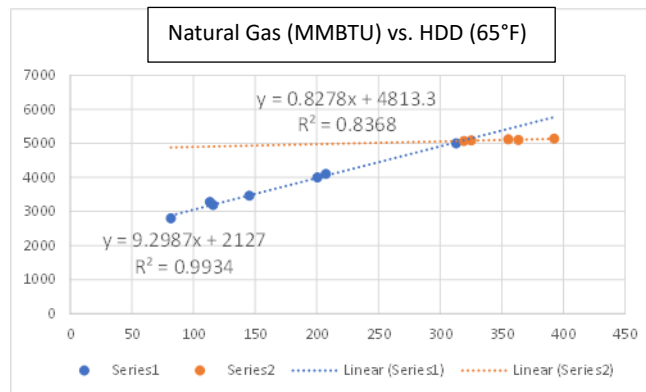
- A. Linear regression as shown



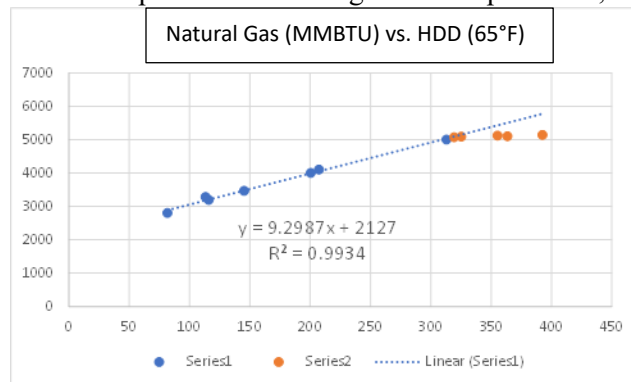
B. Logarithmic as shown



C. Split the data into two sets. Use regression line 1 (Blue) when HDD (65°F) less than 315 and regression line 2 (Red) when HDD (65°F) greater than 315



D. Use regression line 1 (Blue) when HDD (65°F) less than 315 and when HDD (65°F) is greater than 315 set expected maximum gas consumption at 5,140 (maximum value seen)



E. Either C or D

4. A steam system shows saturated steam flow to a heat exchanger at 75 psia at a flow rate of 18,250 lb_m/hour. The condensate is rejected to the condensate return system at an average temperature of 140°F. The steam is used to heat water flowing in at 300 gpm with an average supply temperature of 77°F. The heat exchanger has a heat transfer efficiency of 82.3%. To what approximate temperature is the water heated?
- A. 105°F
 - B. 131°F
 - C. 182°F
 - D. 205°F
5. You are reviewing an opportunity on the opportunity register for replacement of existing T8 fluorescent lighting with LED lighting. The expectation is that lighting quality parameters (color temperature and color rendering index) and lighting level (Lux level) will remain unchanged. What is the percentage improvement in energy intensity in terms of Lumens per Watt for this energy improvement project?

Existing lamp	40 W, 3,200 Lumens, and a 2 W electronic ballast
Replacement lamp	32 W, 3,200 Lumens

- A. 9%
 - B. 16%
 - C. 24%
 - D. 31%
6. Regarding the ISO 50001:2018 standard's requirement to establish energy targets, which of the following is true?
- A. There shall be an energy target for every significant energy user
 - B. Energy targets shall take into account opportunities for energy performance improvement
 - C. Each energy target shall have an associated energy improvement project with a documented action plan
 - D. Establishing energy targets is optional and only required as determined by the organization

7. What is the heat gain rate for 7,500 cfm of outside air at 28°F (dry bulb temperature) that is warmed by an air makeup unit to 78°F (dry bulb temperature)?
 - A. 162,000 BTU/hr.
 - B. 216,000 BTU/hr.
 - C. 350,000 BTU/hr.
 - D. 405,000 BTU/hr.

8. When establishing the energy baseline per ISO 50001: 2018, and the organization has data indicating that relevant variables significantly affect energy performance, the organization shall:
 - A. Only use energy intensity as an EnPI
 - B. Carry out normalization of the related EnPI value(s)
 - C. Conduct energy reviews quarterly
 - D. Set your significant deviation value at +/- 5% for all energy data collection items

9. Your client is considering adding a variable speed drive to a 100 HP fan motor. An evaluation of the system indicates that the speed of the fan could be reduced to one half of its current speed for most of its operational time. What would be the associated motor HP needed for the fan to run at one half speed?
 - A. 12.5 HP
 - B. 25 HP
 - C. 37.5 HP
 - D. 50 HP

10. ISO 50001: 2018 requires that organizations determine the competence that is needed for key energy related personnel. For the purposes of ISO 50001, “competence” is defined as:
 - A. Having a professional engineer’s license in the organization’s state
 - B. Having the ability to apply knowledge and skills to achieve intended results
 - C. Getting the job done ASAP without regard for safety or environmental impacts
 - D. Having a four-year degree in an applicable field of study

ANSWER KEY

Question	Answer
1	D
2	C
3	E
4	C
5	D
6	B
7	D
8	B
9	A
10	B