Chapter 1.8 Energy Monitoring and Targeting

Part – I: Objective type Questions and answers

1.	Energy monitoring and targeting is built on the principle of " _____". a) "production can be reduced to achieve reduced energy consumption" b) "Consumption of energy is proportional to production rate" c) "You cannot manage what you do not measure" d) None of the above.
2.	One of the following is not the element of energy monitoring & targeting system a) Recording the energy consumption b) comparing the energy consumption C) Controlling the energy consumption d) Reducing the production
3.	Which of the variable does not contribute to energy consumption? a) Production b) Hours c) Climate d) none of the above
4.	Poor scattering on trend line of production Vs Energy consumption indicates ___. a) poor level of control b) good level of control c) both the above d) none of above.
5.	Level of production may have an effect on specific energy consumption. State True or False
6.	M & T involves a systematic, disciplines division of the facility in to energy cost centres. State True or False?
7.	The empirical relationship used to plot production Vs Energy consumption is (Y= energy consumed for the period; C = fixed energy consumption; M = energy consumption directly related to production; X= production for same period). a) X=Y+MC b) Y=Mx+C c) M=Cx+Y d) None of above
8.	The energy used by any business varies with production process, volumes and input – State True or False.
9.	1 kg LPG = _____ kcal. a) 12,000 kcal b) 8000 kCal c) 6000 kCal d) 4000 kCal
10.	The energy used by any manufacturing process varies with a) production volume b) type of process c) resource input d) All the above
11.	The best way of correlating production and energy data in any plant is..... a) Text format b) Graphical representation c) Oral communication d) None

12.	For any company, energy consumption mostly relates to..... a) Profits b) Inventory c) Production d) All the above
13.	What is CUSUM? a) Cumbersome b) Cumulative Sum c) Calculated Sum d) None
14.	A CUSUM graph follows a random fluctuation trend and oscillates around. a) 100 b) 100% c) 0 d) none of the above
15.	To draw a CUSUM chart following data is required a) Monthly energy consumption& monthly production b) Monthly specific energy consumption and turn over c) Monthly profits and production d) None
16.	What is specific energy consumption? a) energy consumption per month b) Energy consumed per unit of production c) energy consumption per year d) none of the above
17.	Data required to plot a moving annual total is ____. a) production b) energy c) both the above d) none the above
18.	Energy and production data is useful to calculate..... a) Specific Energy Consumption b) Specific Fuel consumption c) Specific Cost d) None
19.	What type of data is useful to find out the fixed energy consumption? a) SEC Vs production b) SEC Vs Energy c) Production Vs energy d) None
20.	What do you mean by “toe” a) Total oil equivalent b) Tons of effluent c) Tons of oil equivalent d) none of the above

Part – II: Short type Questions and answers

1. Define 'Energy Monitoring and targeting'?

Energy monitoring and targeting is primarily a management technique that uses energy information as a basis to eliminate waste, reduce and control current level of energy use and improve the existing operating procedures. It builds on the principle **"you can't manage what you don't measure**". It essentially combines the principles of energy use and statistics.

Monitoring is essentially aimed at preserving an established pattern. Targeting is the identification of energy consumption level, which is desirable as a management objective to work towards energy conservation

2. Briefly list Benefits that arise from an effective M&T system

Ans.

- Enhanced energy performance leading to increased profits.
- Allocation of energy costs to individual account centres.
- Improved operational and investment decision making and subsequent analysis.
- Enhanced control of operating practices which can lead to increased product quality and reduced product loss.
- Improved calculation of energy costs for projected levels of production.
- Improved identification of maintenance requirements.

3. List down the essential elements of monitoring and targeting System?

Ans.

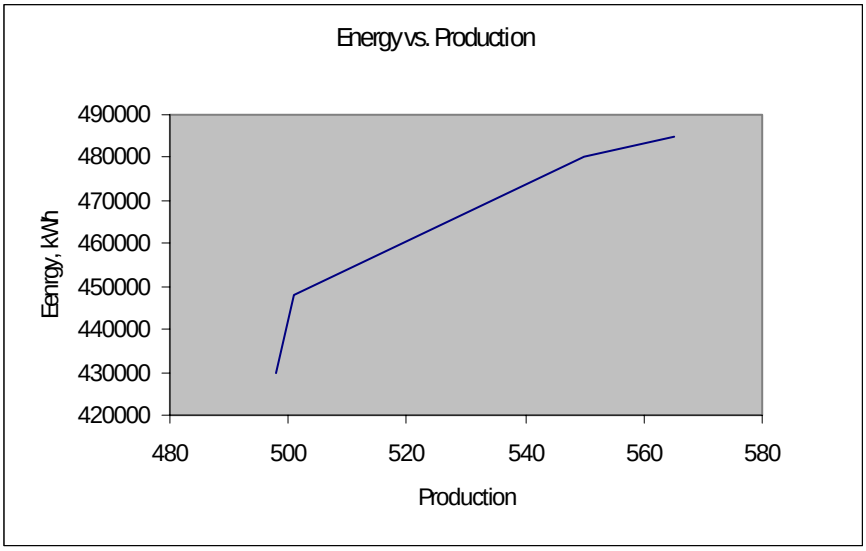
The essential elements of an M&T system are:

- Recording
- Analyzing
- Comparing
- Setting Targets
- Monitoring
- Reporting
- Controlling

4. Plot electricity consumption Vs production for the months given in table below and explain trend of Specific Energy Consumption (SEC).

Month	kWh Consumption	kVAh consumption	Production-MT	kVA demand
April	4,85,000	5,30,000	565	1285
May	4,30,000	4,80,000	498	1000
June	4,48,000	4,90,000	501	960
July	4,80,000	5,30,000	550	1300

Ans



The SEC is varying in the range of 858 to 894 kWh/MT. The SEC has shown a reduction in trend with higher production during April 2004.

Month	kWh Consumption	Production-MT	SEC(kWh/MT)
April	4,85,000	565	858.4
May	4,30,000	498	863.5
June	4,48,000	501	894.2
July	4,80,000	550	872.7

5. What are the steps involved in CUSUM analysis?

1. Plot the Energy – Production graph
2. Draw the best fit straight line
3. Derive the equation of the line
4. Calculate the expected energy consumption based on the equation
5. Calculate the difference between calculated and actual energy use
6. Compute CUSUM
7. Plot the CUSUM graph
8. Estimate the savings

6. What is the significance of calculating specific energy consumption?

The energy should directly relate production and in-turn deriving specific energy consumption (also known as SEC). This can also be represented by graphical method for easy comparison of variation in SEC to gain more understanding on this issue.

7.	What is advantage of presenting plant data in graphical form? Graphs generally provide an effective means of developing the energy-production relationships, which explain what is going on in the plant. The main advantage being quick understanding of the energy consumption scenario.
8.	What is the benefit of using moving average total technique when plotting a monthly energy and production data? This technique is useful for drawing the trend over a period of time. It also smoothes out errors in the timing of meter readings & also covers a full range of seasons, holidays etc.
9.	Write a formula relating production and energy consumption. Energy consumed for the period = M x production for same period + C Where M is the energy consumption directly related to production and C is the 'fixed' energy consumption.
10.	Why CUSUM technique is most useful? CUSUM technique is a simple but remarkably powerful statistical method which highlights small differences in energy efficiency performances. Regular use of the procedure allows energy manger to follow his plant performance and to spot any trends at an early date.
11.	Name the various sources in the plant from where information related to energy use data can be obtained? • Plant level information can be derived from financial accounting Systems—the utilities cost centre • Plant Department level information can be found in comparative energy consumption data for a group of similar facilities, service entrance meter readings etc. • System level (for example, boiler plant) performance data can be determined from sub-metering data • Equipment level information can be obtained from nameplate data, run-time and schedule information, sub-metered data on specific energy consuming equipment.
12.	What do you understand by CUSUM? CUSUM represents the difference between the base line (expected or "standard" consumption) and the actual consumption data points over the base line period of time. A CUSUM graph therefore follows a trend, which represents the random fluctuations of energy consumption and should oscillate about zero. This trend will continue until something happens to alter the pattern of consumption such as the effect of an energy saving measure or, conversely, a worsening in energy efficiency (poor control, housekeeping or maintenance).
13.	Name the plant utility systems that require Monitoring and Targeting? Plant and building utilities such as fuel, steam, refrigeration, compressed air, water, effluent, and electricity are areas which require Monitoring and Targeting.
14.	What is the primary aim of "energy monitoring' in the plant? Monitoring is essentially aimed at establishing the existing pattern of energy consumption, targeting is the identification of energy consumption level which is desirable as a management goal to work towards energy conservation.

15.	How the savings can be achieved with the help of Monitoring & targeting? The savings can be achieved in the following three ways: o Reduction in energy usage, by eliminating energy wastages o Changes in usage patterns by controlling maximum demand and consuming energy at different times of the day (when the cost is lower)
	o Improved monitoring of energy expenditure, which ensures that you pay the correct amount based on how much energy the site uses.
16.	What is the conversion factor to convert 1 kg of HSD, furnace oil and LPG into kcal? 1 kg HSD = 10500 kcal 1 kg Furnace oil = 10200 kcal 1 kg LPG = 12000 kcal
17.	What are the advantages of plotting a moving annual total to relate energy consumption and production in a plant? Having more than twelve months of production and energy data, it is possible to plot a *moving annual total*. For this chart, each point represents the sum of the previous twelve months of data. In this way, each point covers a full range of the seasons, holidays, etc. This technique also smoothens out errors in the timing of meter readings. It also tells the deviation of the energy line to pick up early warning of waste or to confirm whether energy efficiency measures are making an impact.
18.	What are the advantages of adding production data to the specific energy consumption chart? The level of production may have an effect on the specific consumption. If the production data is added to the SEC chart, it helps to explain some of the features. For example, the very low SEC occurred when there was a record level of production. This indicates that there might be fixed energy consumption – i.e. consumption that occurs regardless of production levels.
19.	How do we better envisage the plain energy data of a plant entered in spread sheet form? It is hard to envisage from the plain energy data entered in the spread sheet, so there is a need to present the data using bar chart. The starting point is to collect and collate 24/12 months of energy bills. The most common bar chart application used in energy management is one showing the energy per month for this year and last year. However, it does not tell the full story about what is happening. One will also need production data for the same 24/12-month period.
20.	What are the advantages of benchmarking process parameters in a plant? Benchmarking process parameters will provide valuable indications of effectiveness of plant operation as well as energy use.

Part – III: Long type Questions and Answers

1. How does it help one for the determination of the relationship of energy use to key performance indicators in the plant?

Determining the relationship of energy use to key performance indicators will allow you to determine:

- Whether your current energy is better or worse than before
- Trends in energy consumption that reflects seasonal, weekly, and other operational parameters
- How much your future energy use is likely to vary if you change aspects of your business
- Specific areas of wasted energy
- Comparison with other business with similar characteristics - This "benchmarking" process will provide valuable indications of effectiveness of your operations as well as energy use
- How much your business has reacted to changes in the past
- How to develop performance targets for an energy management program

2. Use CUSUM technique and calculate energy savings for 6 months period of 2003. For calculating total energy savings, average production can be taken as 4000MT/Month. Refer data given in table below.

2003-Month	Actual –SEC, kWh/MT	Predicted SEC-kWh/MT
Jan	242	265
Feb	238	265
Mar	287	265
Apr	237	265
May	295	265
Jun	246	265

It may also be noted that energy saving measures were implemented prior to Jan-2003. It may also be noted that retrofits were not functioning during March & May 2003.

The table above gives values of Specific energy consumption monitored Vs predicted for each month. The variations are calculated and the Cumulative sum of differences is calculated from Jan-June-2003.

2003-Month	Actual - SEC, kWh/MT	Predicted SEC-kWh/MT	Difference= Actual-Predicted	CUSUM
Jan	242	265	- 23	-23
Feb	238	265	- 27	-50
Mar	287	265	+ 22	-28
Apr	237	265	- 28	-56
May	295	265	+ 30	-26
Jun	246	265	- 19	-45

= 47 kWh/MT x 4000 MT x 6 months

Energy Savings for six months = 10.80 lakh kWh

3.	Write Ten key steps in " Monitoring and targeting" that you will undertake as an energy manager in your plant . As an energy manager following are the steps I prefer to undertake in my plant. M&T is a comprehensive approach to utility management and efficiency through ongoing monitoring and target setting.
	Ten Key Steps 1. Conduct Scoping Study to understand the major consumption areas. 2. Get Senior Management approval 3. Improve Metering 4. Configure Software 5. Measure Utility Consumption and Production Variables 6. Develop Targets 7. Develop Opportunities Database 8. Conduct Energy Team Meetings 9. Actions 10. Training for Culture Shift
4.	What are the various ways to relate the plant's energy consumption with production? A critical feature of M&T is understanding the parameter that drives energy consumption, like production, hours of operation, weather, etc. Knowing this one can then start to analyze the data to see how well is energy management. After collection of energy consumption, energy cost and production data, the next stage of the monitoring process is to study and analyze the data to understand what is happening in the plant. It is strongly recommended that the data be presented graphically. A better appreciation of variations is almost always obtained from a visual presentation, rather than from a table of numbers. Graphs generally provide an effective means of developing the energy-production relationships, which explain what is going on in the plant. The energy data is then entered into a spreadsheet. It is hard to envisage what is happening from plain data, so you need to produce bar chart. The starting point is to collect and collate 24/12 months of energy bills. You will also need production data for the same 24/12-month period. Probably the most common bar chart application used in energy management is one showing the energy per month for this year and last year.– however, it does not tell us a lot about what is happening.
	Having more than twelve months of data one can plot a moving annual total. For this chart, each point represents the sum of the previous twelve months of data. In this way each point has a full range of the seasons, holidays, etc. This technique also smoothes out errors in the timing of meter readings. If we just plot energy we are only seeing part of the story – so we plot both energy and production on the same chart – most likely using two y-axes. Looking

	at this chart both energy and production seem to be "tracking" each other – this suggests there is no major cause for concern. But one need to watch for a deviation of the energy line to pick up early warning of waste or to confirm that energy efficiency measures are making an effect.
5.	Briefly explain the essential elements of monitoring and targeting System? The essential elements of a M&T system are:
	• Recording -Measuring and recording energy consumption • Analyzing -Correlating energy consumption to a measured output, such as production quantity • Comparing -Comparing energy consumption to an appropriate standard or benchmark • Setting Targets -Setting targets to reduce or control energy consumption • Monitoring -Comparing energy consumption to the set target on a regular basis • Reporting -Reporting the results including any variances from the targets which have been set • Controlling -Implementing management measures to correct any variances which may have occurred.