# ENERGY MANAGEMENT

**Syllabus:**Principles of energy management - organizing energy management program - initiating - planning - controlling - promoting - monitoring - reporting. Energy manager - qualities and functions - language - Questionnaire – check list for top management.

## Energy Management:

Energy management involves the planning and operation of energy-related production and consumption systems. While energy productivity presents a significant opportunity for the nation, it is a critical necessity for individual companies. It offers a valuable means for innovative management to reduce energy costs—one of the fastest-rising components of product cost since 1973.

Successful companies have leveraged these opportunities largely due to the clear intent and commitment from top executives. Once that leadership is established, managers at all levels can respond effectively. Without it, even the best-designed energy programs yield minimal results.

To enhance or initiate energy management efforts, there are four fundamental principles that can significantly improve program effectiveness:

## PRINCIPLES OF ENERGY MANAGEMENT:

1. ***To control the costs of the energy function or service provided, but not the energy.***
2. ***To control energy functions as a product cost, not as a part of manufacturing or general overhead.***
3. ***To control and meter only the main energy functions***
4. ***To put the major effort of an energy management program in to installing controls and achieving results***

The first principle is to ***control the costs of the energy function or service provided, but not the energy.*** As most operating people have noticed, energy is just a means of providing some service or benefit. With the possible exception of feed stocks for petrochemical production, energy is not consumed directly. It is always converted into some useful function. In most organizations it will pay to be even more specific about the function provided. For instance, evaporation, distillation, drying, and reheat are all typical of the uses to which process heat is put. In some cases it has also been useful to break down the heat in terms of temperature so that the opportunities for matching the heat source to the work requirement can be utilized.

In addition to energy costs, it is useful to measure the depreciation, maintenance, labour, and other operating costs involved in providing the conversion equipment necessary to deliver required services. These costs add as much as 50% to the fuel cost. It is the total cost of these functions that must be managed and controlled, not the Btu of energy.

Second principle of energy management is **to *control energy functions as a product cost, not as a part of manufacturing or general overhead***. It is surprising how many companies still lump all energy costs into one general or manufacturing overhead account without identifying those products with the

highest energy function cost. In most cases, energy functions must become part of the standard cost system so that each function can be assessed as to its specific impact on the product cost. The minimum theoretical energy expenditure to produce a given product can usually be determined en route to establishing a standard energy cost for that product. As in all production cost functions, the minimum standard is often difficult to meet, but it can serve as an indicator of the size of the opportunity. In comparing actual values with minimum values, four possible approaches can be taken to reduce the variance, usually in this order:

1. An hourly or daily control system can be installed to keep the function cost at the desired level.
2. Fuel requirements can be switched to a cheaper and more available form.
3. A change can be made to the process methodology to reduce the need for the function.
4. New equipment can be installed to reduce the cost of the function.

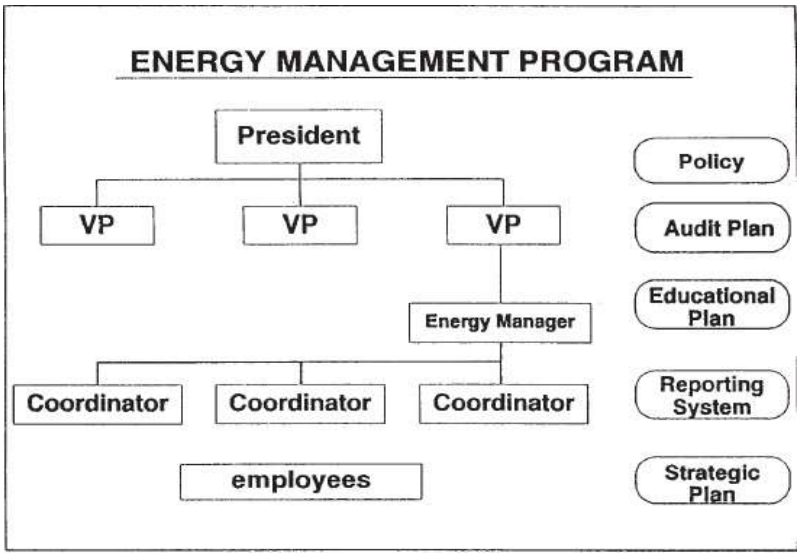
The starting point for reducing costs should be in achieving the minimum cost possible with the present equipment and processes. Installing management control systems can indicate what the lowest possible energy use is in a well-controlled situation. It is only at that point when a change in process or equipment configuration should be considered. An equipment change prior to actually minimizing the expenditure under the present system may lead to over sizing new equipment or replacing equipment for unnecessary functions

The third principle is **to *control and meter only the main energy functions***—the roughly 20% that make up 80% of the costs. A few functions usually account for a majority of the costs. It is important to focus controls on those that represent the meaningful costs and aggregate the remaining items in a general category. Many manufacturing plants have only one meter, that leading from the gas main or electric main into the plant from the outside source. Regardless of the reasonableness of the standard cost established, the inability to measure actual consumption against that standard will render such a system useless. Sub-metering the main functions can provide the information not only to measure but to control costs in a short time interval. The cost of metering and sub-metering is usually incidental to the potential for realizing significant cost improvements in the main energy functions of a production system.

The fourth principle is to put ***the major effort of an energy management program in to installing controls and achieving results***. It is common to find general knowledge about how large amounts of energy could be saved in a plant. The missing ingredient is the discipline necessary to achieve these potential savings. Each step in saving energy needs to be monitored frequently enough by the manager or first-line supervisor to see noticeable changes. Logging of important fuel usage or behavioural observations are almost always necessary before any particular savings results can be realized. Therefore, it is critical that an energy director or committee have the authority from the chief executive to install controls, not just advise line management. Those energy managers who have achieved the largest cost reductions actually install systems and controls; they do not just provide good advice.

## ORGANISATION STRUCTURE OF ENERGY MANAGEMENT PROGRAM:

The organizational chart for energy management program is shown in figure. It must be adapted to fit into an existing structure for each organization. For example, the presidential block may be the general manager, and VP blocks may be division managers, but the fundamental principles are the same. The main feature of the chart is the location of the energy manager. This position should be high enough in the organizational structure to have access to key players in management, and to have knowledge of current events within the company. For example, the timing for presenting energy projects can be critical. Funding availability and other management priorities should be known and understood. The organizational level of the energy manager is also indicative of the support management is willing to give to the position.




### Energy manager:

One very important part of an energy management program is to have top management support. More important, however, is the selection of the energy manager, who can among other things secure this support. The person selected for this position should be one with a vision of what managing energy can do for the company.

Every successful program has had this one thing in common—one person who is a shaker and mover that makes things happen. The program is then built around this person. There is a great tendency for the energy manager to become an energy engineer. Developing a working organizational structure may be the most important thing an energy manager can do.

### Energy coordinators:

Energy Coordinators shall be appointed to represent a specific department or division. The Energy Manager shall establish minimum qualification standards for Coordinators, and shall have joint approval authority for each Coordinator appointed. Coordinators shall be responsible for maintaining an ongoing awareness of energy consumption and expenditures in their assigned areas. They shall recommend and

implement energy conservation projects and energy management practices. Coordinators shall provide necessary information for reporting from their specific areas. They may be assigned on a full-time or part-time basis; as required to implement programs in their areas.

**Employees:**

Employees are shown as a part of the organizational structure, and are perhaps the greatest untapped resource in an energy management program. A structured method of soliciting their ideas for more efficient use of energy will prove to be the most productive effort of the energy management program. A good energy manager will devote 20% of total time working with employees. Too many times employee involvement is limited to posters that say "Save Energy." Employees in manufacturing plants generally know more about the equipment than anyone else in the facility because they operate it. They know how to make it run more efficiently, but because there is no mechanism in place for them to have an input, their ideas go unsolicited. An understanding of the psychology of motivation is necessary before an employee involvement program can be successfully conducted.

Organizing an energy management program involves a systematic approach with key phases like initiating, planning, controlling, promoting, monitoring, and reporting. These steps ensure a structured and effective strategy for optimizing energy consumption and achieving energy efficiency goals.

1) **Initiating:**

A well written energy policy authorized by the management provides the energy manager with the authority of being involved in business planning, new facility location and planning. Selection of production equipment, purchase of measuring equipment and energy reporting.

The above mentioned policy confuses with a procedures manual,in order to have an effective policy it should contain the planning

a) Objectives:

In this statements relating to energy and most importantly that the organization will incorporate energy efficiency into facilities with an equipment must be emphasised along with life cost analysis.

b) Accountability:

In this segment it should define the organization structure and authority held by energy manager,coordinators etc.

c) Reporting:

For a smooth flow of an organization,metering the energy use with skilled labour and instrumentation is must.Hence reporting provides a legitimate reason for cancelling funds from

top management

**2) Planning:**

Planning is the most important part of energy management program,and for most technical people is the least desirable.From a good plan one can shield from disruption and also the scheduling of events puts continuous emphasis on the energy management programme

a) Problem Definition

The problem is clearly defined all the members of energy management program

b) Grouping:

Divede large groups into smaller groups of seven to ten, then have group elected recording secretary

c) Generation of Ideas:

Each person writes as many answers to a problem as can be generated within a specifies time.

d) Round-Robin Listing:

Secretary lists each idea individually on a caset until all have been recorded.

Caset is a frame displaying charts,promotional materials etc.

e) Discussion:

Ideas are discussed for clarification,elaboration,evaluation and combiing

f) Ranking:

Each person ranks the five most important items.The total number of points receive for eah idea will determine the first choice of group.

**3) Educational or Audit Planning:**

Individual definitions of the audit contribute to the events that will keep energy management programme active.For this to happen an audit team must be departed such that

a) The team can be selected to match equioment to be audited, and thus can made as in-house personnel
b) Energy team can identify all potential energy conservation projects, in terms of capital investment the audit can be an excellent training tool by involving others in process, and by adding a training component as a part of the audit

**3. Controlling:**

Controlling is one of the managerial functions like planning, organizing, staffing and directing. It is an important function because it helps to check the errors and to take the corrective action so that deviation from standards are minimized and stated goals of the organization are achieved in a desired manner.

According to modern concepts, control is a foreseeing action whereas earlier concept of control was used only when errors were detected. Control in management means setting standards, measuring actual performance and taking corrective action.

**Purpose:**

Ensure energy use stays within planned limits

Detect deviations or inefficiencies early

Facilitate timely corrective actions

Support continuous improvement in energy performance

**Tools & Technologies:**

Smart meters and submeters

Energy management software and dashboards

SCADA (Supervisory Control and Data Acquisition) systems

Automated control systems for HVAC, lighting, etc.

- **Purpose:** Raise awareness and motivate participation in energy-saving efforts.
- **Key Actions:**
  - Secure **management support** and allocate resources.
  - Conduct **training** and educate employees on energy efficiency.
  - Communicate via **newsletters, posters, and meetings**.
  - Encourage **employee involvement** through teams and feedback.
  - Use **visual tools** like dashboards to show energy data.
  - Integrate energy goals into daily work and performance reviews.
- **Benefits:** Increased energy savings, improved staff engagement, faster adoption of energy measures.

**4. Promoting:**

- Raise Awareness: Promote energy conservation practices throughout the organization.
- Incentivize Efficiency: Encourage employees to participate in energy-saving initiatives through rewards or recognition.
- Share Success Stories: Highlight successful energy-saving initiatives to motivate others.
- External Communication: Communicate the organization's commitment to energy efficiency to external stakeholders.
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## 5. Monitoring:

- **Monitoring** involves collecting detailed data on energy use and related factors (e.g., production, weather) to establish a baseline consumption pattern and detect deviations.
- Its primary goal is to maintain energy consumption within this established pattern by providing accurate, timely data.
- **Targeting** sets desirable energy consumption levels as management goals based on monitoring data.
- Together, Monitoring and Targeting (M&T) is a management technique that treats energy utilities (fuel, electricity, steam, etc.) as controllable resources, similar to raw materials or labor.
- Facilities are divided into **Energy Cost Centers** where energy use is tracked against production or other operational metrics.
- Regular data enables setting targets, spotting variances, and implementing corrective actions.
- M&T typically achieves energy cost reductions of **5-20% annually** in industrial sectors.
- The principle behind M&T: **"You can't manage what you don't measure."**

**The essential elements of M&T system are:**

i) **Recording** -Measuring and recording energy consumption

ii) **Analyzing** -Correlating energy consumption to a measured output, such as production quantity

iii) **Comparing** -Comparing energy consumption to an appropriate standard or benchmark

iv) **Setting Targets** -Setting targets to reduce or control energy consumption

v) **Monitoring** -Comparing energy consumption to the set target on a regular basis

vi) **Reporting** -Reporting the results including any variances from the targets which have been set.

vii) **Controlling** -Implementing management measures to correct any variances, this may have occurred.

## 6. Reporting:

The bottom line is that any reporting system has to be customized to suit individual circumstances and while reporting is not always the most crucial part of managing energy, it can make a contribution to programme by providing bottom-line on it's effectiveness. By making report of requirement of energy policy, it simply require combining production data and energy data to develop an energy index.

With all the above considered, the best way to report is to do it against an audit than has been performed at facility.

- **Internal Reporting:** Provide regular reports to management and stakeholders on program progress, achievements, and challenges.

- **External Reporting:** Prepare reports for external stakeholders, such as regulatory bodies or investors.
- **Documentation:** Maintain comprehensive documentation of all aspects of the energy management program.

**Requirements for an Energy Managemnt Program:**

Shirley Hansen give the following requirements for an energy management:

i) Set up an Energy Management Plan

ii) Establish energy records

iii) Identify outside assistance

iv) Assess future energy needs

v) Identify financing sources

vi) Make energy recommendations

vii) Implement recommendations

viii) Provide liaison for the energy committee

ix) Plan communication strategies

x) Evaluate program effectiveness

## QUALITIES AND FUNCTIONS OF AN ENERGY MANAGER:

Energy managers come from diverse backgrounds due to the multi-disciplinary nature of energy management. Typically drawn from the existing workforce, they need a thorough understanding of the organization's processes and finances. They must stay updated on the latest energy efficiency technologies with an open mind. Alternatively, an external expert may be appointed based on relevant experience.

**Qualities:**

- Typically from diverse backgrounds; must understand the organization's processes and finances.
- Stay updated on energy efficiency technologies with an open mind.
- High visibility within the organization but often with responsibility greater than authority.
- Strong technical knowledge of company processes, products, and maintenance.
- Excellent communication skills to engage lawyers, engineers, accountants, officials, etc.
- Ability to present programs with clear, predictable returns to secure management support.
- Strong leadership to coordinate and control energy conservation efforts.
- Analytical skills to evaluate investments and cost-effectiveness.
- Questioning mindset with the ability to gain colleagues’ support.

**Functions:**

- Generate and sustain interest in energy conservation; organize training and awareness.
- Maintain consistent records and uniform accounting systems for energy data.
- Provide technical advice on energy-saving methods and equipment.
- Identify sources of technical guidance and coordinate energy users.
- Set realistic energy targets and monitor consumption trends.
- Identify and quantify energy wastage; recommend practical reductions.
- Oversee detailed studies and progress on energy projects.
- Provide best practice materials tailored to organizational needs.
- Advise departments on energy conservation while ensuring safety and health.
- Keep updated with global energy conservation developments; liaise with research bodies.
- Advise senior management with latest energy trends and policies.

**Role:**

- Must have direct access to senior management and clear terms of reference.
- Role varies from advisory to authority-based, depending on organization size and structure.

**For a successful energy manager, the following points may be considered as guidelines:**

1. Based on factual data prepared, think ahead, anticipating questions; the request for approval of expenditure is to be made sufficiently in advance.

2. Learn how to say 'NO' in a diplomatic way and be aggressive.

3. Stick your neck out as energy is not a safe sell.

4. Be creative; put the action plan tasks on priority after identifying the needs.

5. Be a good and patient listener and establish a free thinking environment.

6. Prepare and develop implementation strategies.

7. Establish credibility through an accurate energy accounting system.

8. Be patient but demanding as efficient use of energy is an evolutionary process.

## LANGUAGE OF THE ENERGY MANAGER:

It is essential to understand the language of the energy manager and how it is applied to facilitate easy communication of energy conservation goals and to analyze the literature in the field. For the better comparison of efficiencies of various fuels and the cost per unit heating value, it is essential that the heating value of each fuel is expressed in proper units, i.e., Btu, Kcal, KJ. The method of reducing the energy cost of the plant can be easily understood and analyzed only when the energy contents of the plants processes is

known. If the energy is utilized efficiently, definitely there will be reduction in product costs and increase in profits. This requires the preparation of the energy balance for the plant during a given period. Energy managers need to make forecasts as to the availability of supplies, fuel pricing and the future energy use of their building companies. Only after knowing all the facts, engineering judgment can be made and conclusions drawn. Unfortunately, with energy forecasting, not all the facts are known and many times conflicting data exist. For the development of a good forecasting model, the energy manager should know past and present consumption of energy and the pricing pattern.

## QUESTIONNAIRE-CHECK LIST FOR TOP MANAGEMENT

Control of Energy

a) Name, Status and Qualification of person responsible for energy management
b) Energy consumption should be reviewed regularly and a detailed energy consumption analysis undertaken.
c) Units of measurement and possible rationalization of energy data into one unit other than money.
d) Metering facilities should be available for motoring fuels, keeping records and budgeting
e) Fuel consumption should be compared with previous figures and management should set targets.
f) Energy Education, information, energy recycling schemes, planned maintenance and regular testing of energy plant
g) List of Energy Saving Projects in order of priority with costs and pay back calculation.
h) Energy flow diagram

Sources of Energy:

a) Energy Sources used by the company i.e. solid fuels, gas, electricity, liquid fuels others
b) List of Tariffs use

Use of energy:

a) Buildings should be considered with respect to insulation, Heating periods, manuals or automatic Heating control of temperature and ventilation.
b) Storage Tanks: Heating, Insulation
c) Ares of High energy Consumption
d) Process: lagging of pipes and tanks, boiler and furnace efficiency testing, condensate recovery, process temperature levels.

**Example for check list**

| | |
|---|---|
| Date of energy audit | |
| Department/building/area covered | |
| Person(s) conducting the audit | |
| Normal occupancy hours of the building | |
| Cleaning times | |
| **Lighting** | |
| Are there areas of over-lighting or under-lighting? | |
| Are there any unused areas being lit? | |
| Are any external lights on during daylight hours? | |
| Are there any areas that have fluorescent/incandescent/halogen lightbulbs? | |
| Can lights be switched off to make use of daylight? (e.g. lights parallel to windows or in corridors) | |
| If space is intermittently occupied (e.g. store rooms, toilets, kitchen areas, copying rooms, corridors) is there scope for automatic lighting controls? | |
| Are windows and skylights regularly cleaned and maintained? | |
| **Equipment** | |
| Is your equipment as new and energy efficient as possible? | |
| Does all IT equipment have energy saving features enabled? | |
| Are computers, printers, photocopiers and other equipment switched off at the end of the day? | |
| Can any equipment be switched on later and switched off earlier? | |
| Can screens and other equipment be switched off during the day? | |
| Is the office fridge/freezer defrosted regularly? | |
| **Water** | |
| Is there any evidence of water leaks? (e.g. wet pathways on a dry day). | |
| Are taps left running? Are there any dripping taps? | |
| Are hot water heater timers set correctly? | |

| Heating | |
|---|---|
| Do occupants complain it is too hot or too cold? | |
| What is the actual temperature in the space? | |
| If there are Thermostatic Radiator Valves (TRVs), are they set correctly? | |
| Are radiators effective and giving consistent heat? | |
| If there is a room thermostat, is it correctly set? | |
| Is there any bare pipework? | |
| Are radiators blocked by boxes and furniture restricting air circulation? | |
| If there are permanent electric heaters with individual temperature and time control, are they set correctly? | |
| Are external doors and windows closed when heating is on? | |
| Are any window panes cracked or broken? | |
| Is there adequate draught proofing on windows and external doors? | |
| Are any unused areas e.g. cupboards being heated? | |
| Do you have loading areas with doors left open for vehicle access? | |
| **Building Insulation** | |
| Is there roof insulation? | |
| Are there any uninsulated cavity walls present? | |
| Are there any signs of dampness? | |
| Are windows double-glazed or secondary glazed? | |
| Are there any air leaks at windows, doors or other openings? | |
| **Employee Awareness** | |
| Is there prominent guidance in place that reminds<br>employees of best practice? | |
| Is equipment clearly labelled so that employees know how to operate energy saving features in the<br>appropriate manner? | |
| Do you have any Green Champions? | |

# Sample Checklist for Top Management EMS Audits

## Function: TOP MANAGEMENT

| 1. Environmental Policy | |
|---|---|
| *Top Management* | *Objective Evidence* |
| a. Describe your role in the development of the environmental policy. | |
| b. How do you know that your policy is appropriate for your activities, products, and services? | |
| c. What is management's role in the review and revision of the policy? | |
| d. How does management ensure continued adherence to the policy throughout the company? | |
| e. How does the policy help guide organizational decisions? | |
| f. How are employees made aware of the environmental policy? | |
| g. How is the policy made available to the public? | |
| *[Auditor Note: Is there evidence that the policy was issued by top management? (e.g., Is the policy signed? By whom? At what level in the organization are they?)]* | |
| Notes: | |

| 2. Objectives and targets | |
|---|---|
| *Top Management* | *Objective Evidence* |
| a. What are the environmental objectives and targets for your organization? What is your role in approving them?<br>What are the relevant functions and levels within your organization that support the attainment of each of the objectives and targets? | |
| b. How are the environmental objectives linked to other organizational goals (and vice versa)? | |
| c. Are the objectives/targets consistent with the goals of the environmental policy for prevention of pollution and continual improvement? | |
| d. How were the objectives and targets developed by or communicated to management? | |
| e. How does management keep up with progress in meeting their objectives and targets throughout the year? | |
| f. How often are you informed of the status of the objectives and targets? | |
| g. On what basis are the objectives and targets reviewed and modified? | |
| Notes: | |

| 3. Structure and responsibility | |
|---|---|
| *Top Management* | *Objective Evidence* |
| a. At what level within the organization is the designated EMS representative placed?<br><br>*Auditor Note: Is the EMS representative at a level within the organization to effectively implement an EMS for his/her organization?]* | |
| b. What authority does the EMS representative have to carry out his/her responsibilities? | |
| c. How does the organization assess its resource needs for environmental management? How are these factored into operating and strategic plans (and vice-versa)? | |
| d. What resources (financial, technical personnel) has management provided to develop or maintain the EMS? | |
| e. How are you informed on the performance of the EMS? Do you receive routine reports? | |
| f. Are responsibilities for the environmental management of the organization documented? If so, where?<br>Is an integrated structure in place in which accountability and responsibility are defined, understood, and carried out? | |
| g. How are these responsibilities communicated to all employees (including managers)? | |
| Notes: | |

| 4. Communication | |
|---|---|
| *Top Management* | *Objective Evidence* |
| a. How are you informed of the environmental issues within your organization? How often does this take place? Does this include compliance issues? | |
| b. How are you kept up to date with progress in meeting your organization's environmental objectives and targets?<br>How is this information passed on to your managers? | |
| c. How do you communicate with the organization on environmental issues?<br><br>How is this done? How frequently? | |
| d. How does the organization handle inquiries from interested parties (e.g., the public, regulators, other organizations) on environmental matters?<br><br>Who has responsibility for responding to such inquiries? | |

| 4.6 Management review | |
|---|---|
| *Top Management* | *Objective Evidence* |
| a. Describe the organization's management review process. | |
| b. How often are management reviews performed? How was this frequency determined? | |
| c. Who is involved in the management review process? What are their roles in this process? | |
| d. What changes have been made to the EMS as a result of the last review? | |
| Notes: | |

## Energy Management Checklist for Top Management

### 1. Leadership & Commitment

- ☐ Have we formally committed to improving energy performance?
- ☐ Is energy management integrated into our strategic planning?
- ☐ Have clear roles and responsibilities been defined for energy management?
- ☐ Are adequate resources (human, financial, technical) allocated for energy initiatives?

### 2. Energy Policy

- ☐ Do we have a documented and communicated energy policy?
- ☐ Does our policy include a commitment to continual improvement and compliance with legal and other requirements?

### 3. Planning & Objectives

- ☐ Have we established measurable energy performance objectives and targets?
- ☐ Are these objectives aligned with our overall business goals?
- ☐ Do we have a system to identify significant energy uses (SEUs)?
- ☐ Have we evaluated risks and opportunities related to energy use?

### 4. Energy Review & Baseline

- ☐ Have we conducted a comprehensive energy review?
- ☐ Do we have accurate data on energy consumption by department, process, and equipment?
- ☐ Have we set energy performance indicators (EnPIs) and a baseline for tracking improvement?

### 5. Legal & Compliance

- ☐ Are we compliant with all local and national energy-related regulations?
- ☐ Is there a system in place to monitor upcoming changes in energy laws or policies?

### 6. Operational Control

- ☐ Are operational controls in place for significant energy-consuming assets?
- ☐ Do we have energy-efficient design criteria for procurement and renovations?
- ☐ Is there a preventive maintenance schedule for major energy-consuming systems?

### 7. Procurement & Investment

- ☐ Is energy performance a criterion in procurement decisions?
- ☐ Do we evaluate lifecycle energy costs (not just purchase price)?
- ☐ Are energy efficiency investments tracked with ROI or payback calculations?

### 8. Training & Awareness

- ☐ Do key staff receive training on energy awareness and efficient practices?
- ☐ Is energy performance included in job descriptions or performance reviews?

### 9. Monitoring & Measurement

- ☐ Is there a system in place for real-time or periodic energy monitoring?
- ☐ Do we regularly review energy consumption reports?
- ☐ Are anomalies or inefficiencies investigated and corrected?

**10.** Performance Evaluation & Review

- ☐ Do we conduct regular management reviews of energy performance?
- ☐ Are lessons learned and best practices shared across departments?
- ☐ Are targets updated based on performance outcomes?

**11. Continual Improvement**

- ☐ Are we actively seeking new technologies or methods to improve efficiency?
- ☐ Is there a process to encourage and evaluate energy-saving suggestions from staff?
- ☐ Are successful projects celebrated and replicated?