UNIT-1:
BASIC PRINCIPLES OF ENERGY MANAGEMENT

Energy Audit-Definition:

Energy Audit is the key to a systematic approach for decision-making in the area of energy management. It attempts to balance the total energy inputs with its use, and serves to identify all the energy streams in a facility. It quantifies energy usage according to its discrete functions. Industrial energy audit is an effective tool in defining and pursuing comprehensive energy management programme.

As per the **Energy Conservation Act, 2001**, Energy Audit is defined as "the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption".

Need for Energy Audit

In any industry, the three top operating expenses are often found to be energy (both electrical and thermal), labour and materials. If one were to relate to the manageability of the cost or potential cost savings in each of the above components, energy would invariably emerge as a top ranker, and thus energy management function constitutes a strategic area for cost reduction.

Energy Audit will help to understand more about the ways energy and fuel are used in any industry, and help in identifying the areas where waste can occur and where scope for improvement exists.

The Energy Audit would give a positive orientation to the energy cost reduction, preventive maintenance and quality control programmes which are vital for production and utility activities. Such an audit programme will help to keep focus on variations which occur in the energy costs, availability and reliability of supply of energy, decide on appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment etc.

In general, Energy Audit is the translation of conservation ideas into realities, by lending technically feasible solutions with economic and other organizational considerations within a specified time frame.

The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. Energy Audit provides a

"bench-mark" (Reference point) for managing energy in the organization and also provides the basis for planning a more effective use of energy throughout the organization.

Objectives of Energy Audit:

The energy audit provides the vital information base for overall energy conservation programme covering essentially energy utilization analysis and evaluation of energy conservation measures.

It aims at:

i. Assessing present pattern of energy consumption in different cost centres of operations.
ii. Relating energy inputs and production output
iii. Identifying potential areas of thermal and electrical energy economy.
iv. Highlighting wastage in major areas
v. Fixing of energy saving potential targets for individual cost centres
vi. Implementation of measures of energy conservation and realisation of savings.

The overall objectives of the Energy Audit are accomplished by:

i. Identifying areas of improvement and formulation of energy conservation measures requiring no investment or marginal investment through system improvements and optimisation of operations.
ii. Identifying areas requiring major investment by incorporation of modern energy efficient equipment and up-gradation of existing equipment

Type of Energy Audit:

The type of Energy Audit to be performed depends on:

- Function and type of industry,
- Depth to which final audit is needed and
- Potential and magnitude of cost reduction desired.

Thus Energy Audit can be classified into the following two types.

i) Preliminary Energy Audit
ii) Detailed Energy Audit

Preliminary Energy Audit:

The preliminary audit or simple audit or walk through audit is the simplest and quickest type of audit. It involves minimal interviews with site operating personnel, a brief review of facility utility bills and other operating data, and a walk through of the facility to become familiar with the building operation and to identify any glaring areas of energy waste or inefficiency. Preliminary analysis made to asses building energy efficiency to identify not only simple and low cost improvements but also a list of energy conservation measures to orient the future detailed audit. This inspection is based on visual verifications, study of installed equipment and operating data and detailed analysis of recorded energy consumption collected during the benchmarking phase. Following activities are envisaged in the preliminary energy audit.

- Establish energy consumption in the organization
- Estimate the scope for saving
- Identify the most likely (and the easiest areas for attention
- Identify immediate (especially no-/low-cost) improvements/ savings
- Set a 'reference point'
- Identify areas for more detailed study/measurement.

Preliminary energy audit uses existing, or easily obtained data. The plant data analysis is useful in managing and analyzing the complex plant data to optimize process performance. Typically, only major problem areas will be covered during this type of audit. Corrective measures are briefly described, and quick estimates of implementation cost, potential operating cost savings, and simple pay back periods are provided. This level of detail, while not sufficient for reaching a final decision on implementing proposed measure, it is adequate to prioritize energy efficient projects and to determine the need for a more detailed audit.

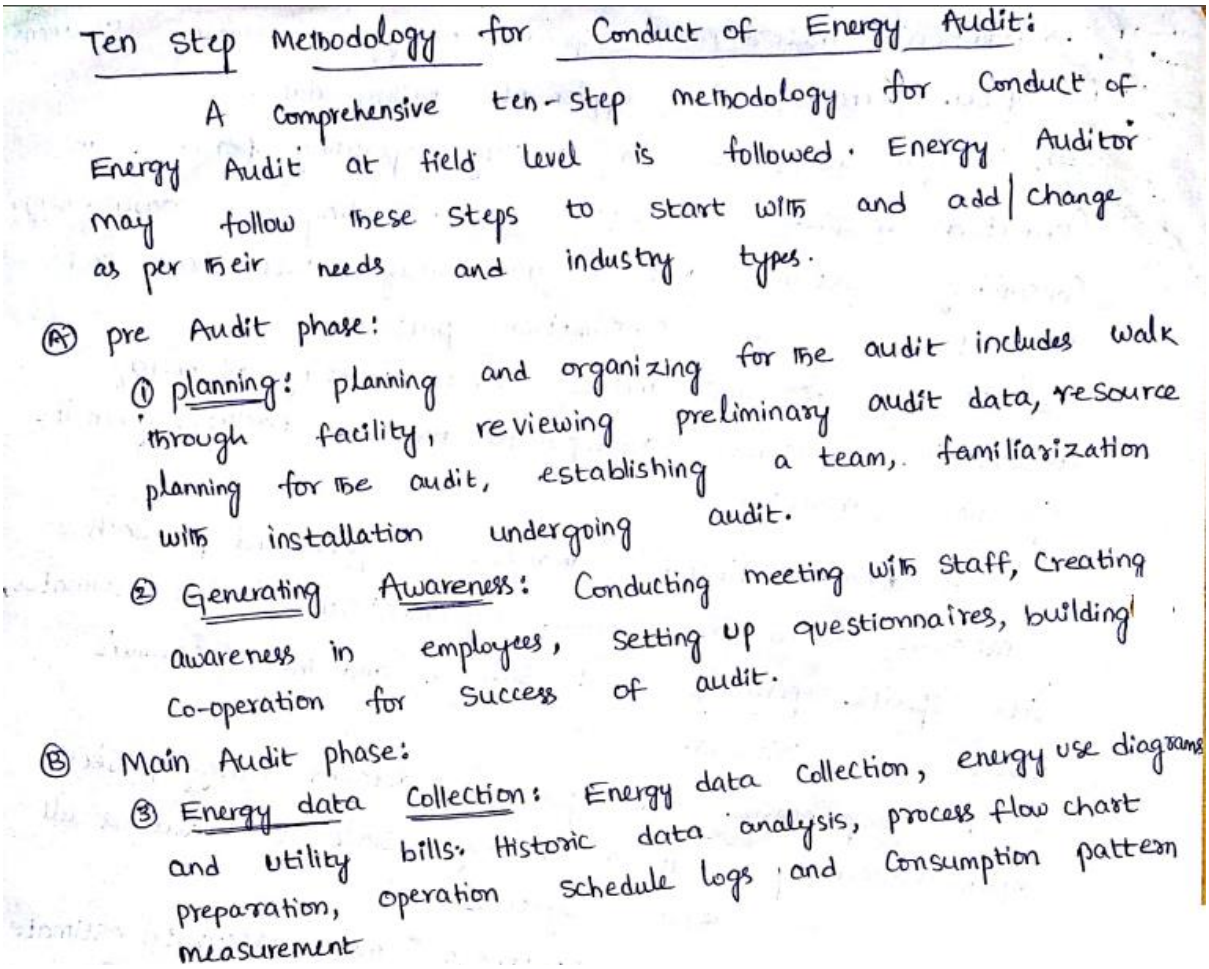
Detailed Energy Audit:

A comprehensive audit provides a detailed energy project implementation plan for a facility, since it evaluates all major energy using systems. This type of audit offers the most accurate estimate of energy savings and cost. It considers the interactive effects of all projects, accounts for the energy use of all major equipment, and includes detailed energy cost saving calculations and project cost. In a comprehensive audit, one of the key elements is the energy balance. This is based on an inventory of energy using systems, assumptions of current operating conditions and calculations of energy use. This estimated use is then

compared to utility bill charges. Detailed energy auditing is carried out in three phases: Phase I, II and III.

Phase I - Pre Audit Phase
Phase II - Audit Phase
Phase III - Post Audit Phase

A Guide for Conducting Energy Audit at a Glance Industry-to-industry, the methodology of Energy Audits needs to be flexible. A comprehensive ten-step methodology for conduct of Energy Audit at field level is presented below. Energy Manager and Energy Auditor may follow these steps to start with and add/change as per their needs and industry types



Ten Step Methodology for Conduct of Energy Audit:

A Comprehensive ten-step methodology for Conduct of Energy Audit at field level is followed. Energy Auditor may follow these steps to start with and add/change as per their needs and industry types.

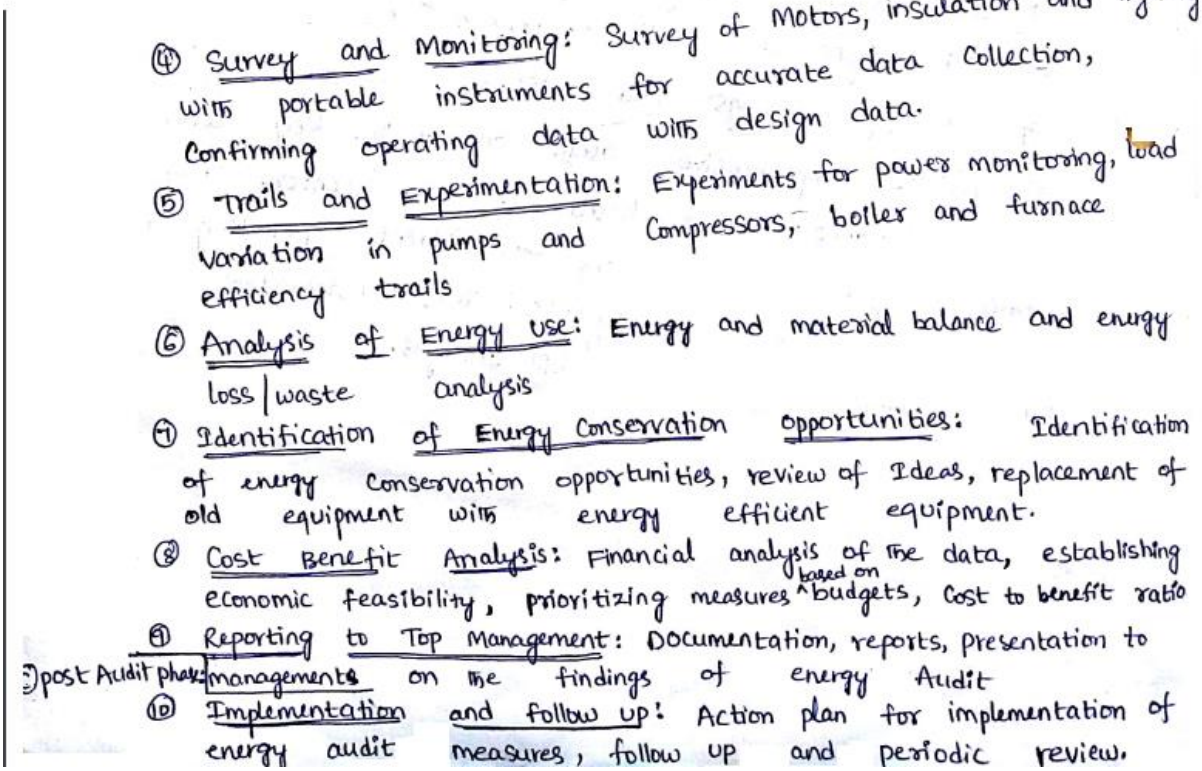
(A) pre Audit phase:

① planning: planning and organizing for the audit includes walk through facility, reviewing preliminary audit data, resource planning for the audit, establishing a team, familiarization with installation undergoing audit.

② Generating Awareness: Conducting meeting with staff, Creating awareness in employees, Setting up questionnaires, building Co-operation for Success of audit.

(B) Main Audit phase:

③ Energy data Collection: Energy data Collection, energy use diagrams and utility bills. Historic data analysis, process flow chart preparation, operation schedule logs and Consumption pattern measurement



④ Survey and Monitoring: Survey of Motors, insulation and lighting with portable instruments for accurate data Collection, Confirming operating data with design data.

⑤ Trails and Experimentation: Experiments for power monitoring, load variation in pumps and Compressors, boiler and furnace efficiency trails

⑥ Analysis of Energy use: Energy and material balance and energy loss | waste analysis

⑦ Identification of Energy Conservation opportunities: Identification of energy Conservation opportunities, review of Ideas, replacement of old equipment with energy efficient equipment.

⑧ Cost Benefit Analysis: Financial analysis of the data, establishing economic feasibility, prioritizing measures based on budgets, Cost to benefit ratio

⑨ Reporting to Top Management: Documentation, reports, presentation to managements on the findings of energy Audit

⑩ Implementation and follow up: Action plan for implementation of energy audit measures, follow up and periodic review.

Post Audit phase

Step No.	PLAN OF ACTION	PURPOSE / RESULTS
	Phase I –Pre Audit Phase	
Step 1	· Plan and organise	· Resource planning, Establish/organize a Energy audit team
	· Walk through Audit	· Organize Instruments & time frame
	· Informal Interview with Energy Manager, Production / Plant Manager	· Macro Data collection (suitable to type of industry.)
		· Familiarization of process/plant activities
		· First hand observation & Assessment of current level operation and practices
Step 2	Conduct of brief meeting / awareness programme with all divisional heads and persons concerned (2-3 hrs.)	· Building up cooperation
		· Issue questionnaire for each department
		· Orientation, awareness creation
	Phase II –Audit Phase	
Step 3	Primary data gathering, Process Flow Diagram, & Energy Utility Diagram	· Historic data analysis, Baseline data collection
		· Prepare process flow charts
		· All service utilities system diagram (Example: Single line power distribution diagram, water, compressed air & steam distribution.
		· Design, operating data and schedule of operation

		· Annual Energy Bill and energy consumption pattern (Refer manual, log sheet, name plate, interview)
Step 4	Conduct survey and monitoring	Motor survey, Insulation, and Lighting survey with portable instruments for collection of more and accurate data. Confirm and compare operating data with design data.
Step 5	Conduct of detailed trials /experiments for selected energy guzzlers	Trials/Experiments:
		. 24 hours power monitoring (MD, PF, kWh etc.)
		. Load variations trends in pumps, fan compressors etc.
		. Boiler/Efficiency trials for (4 – 8 hours)
		. Furnace Efficiency trials
		. Equipments Performance experiments etc
Step 6	Analysis of energy use	· Energy and Material balance & energy loss/waste analysis
Step 7	Identification and development of Energy Conservation (ENCON) opportunities	· Identification & Consolidation ENCON measures
		. Conceive, develop, and refine ideas
		. Review the previous ideas suggested by unit personal
		. Review the previous ideas suggested by energy audit if any
		. Use brainstorming and value analysis techniques
		. Contact vendors for new/efficient technology
Step 8	Cost benefit analysis	· Assess technical feasibility, economic viability and prioritization of ENCON options for implementation
		· Select the most promising projects
		· Prioritise by low, medium, long term measures
Step 9	Reporting & Presentation to the Top Management	Documentation, Report Presentation to the top Management.
<u>Phase III –Post Audit phase</u>		
Step 10	Implementation and Follow-up	Assist and Implement ENCON recommendation measures and Monitor the performance . Action plan, Schedule for implementation . Follow-up and periodic review

ENERGY INDEX:

It is a useful parameter to monitor and compare energy consumption whenever the industry/firm (or a facility in general) is producing a specified product.

$$Energy\ Index = \frac{\text{Energy used}}{\text{Production output}}$$

This may be calculated weekly/monthly/annually. For better monitoring, the total energy indices are calculated. If there is any increase or decrease in the Energy Index, with the implementation of any conservation scheme, the particular source can be identified and investigated immediately.

COST INDEX:

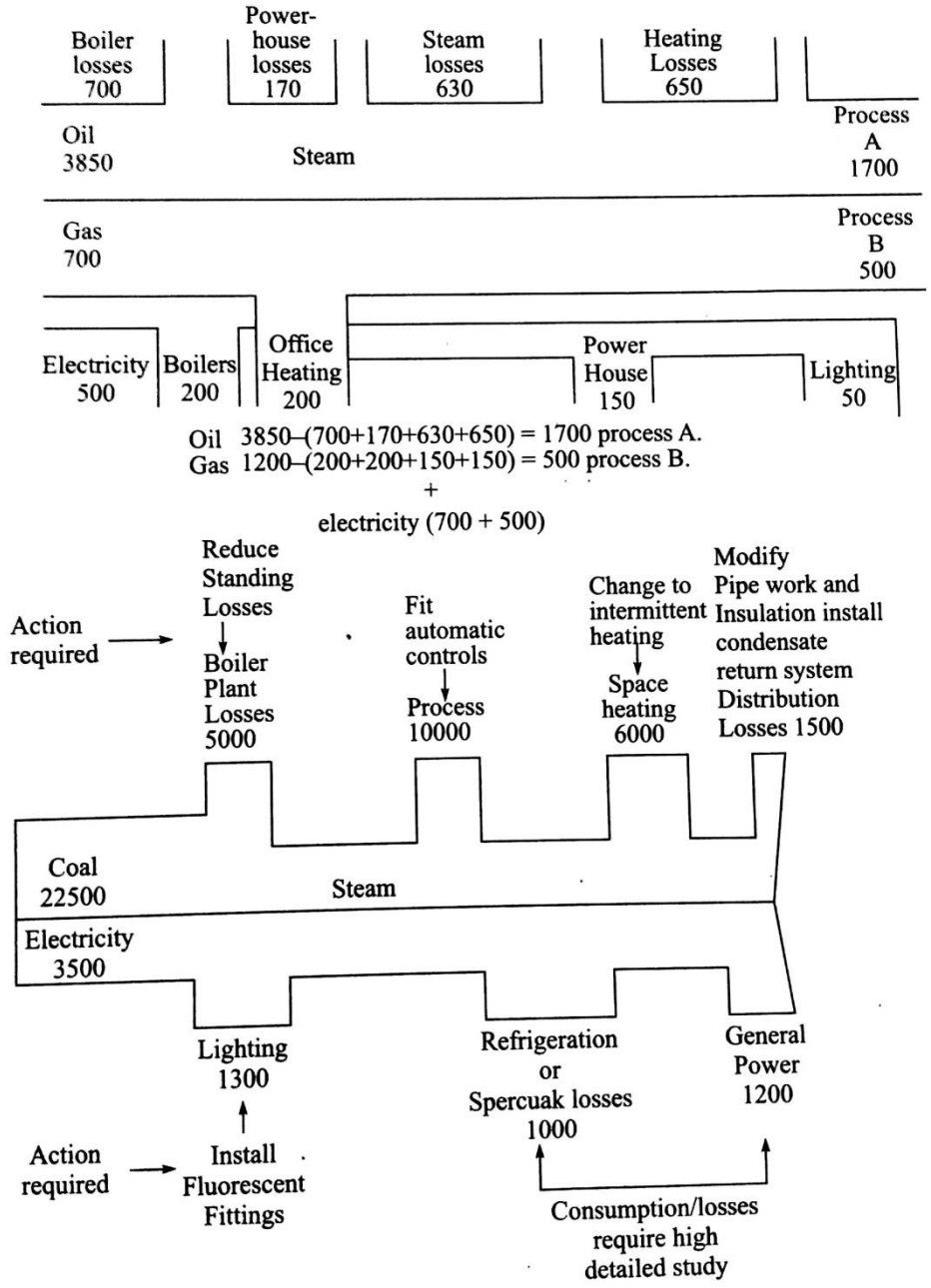
Another parameter which is useful in monitoring and assessing energy use of a facility is cost index. It is defined as the ratio of the cost of energy to the production output. Any changes in energy consumption which can be investigated and remedied are indicated by comparison of cost indices. The trends and fluctuations are clearly visible with such comparisons.

PIE CHART:

This is a circular chart depicting the energy usage where the quantity of a particular type is represented as a segment of a circle. The size of the segment is proportional to the energy consumption using a particular fuel relative to the fuel usage. The relevant conversion factors are used to rationalize all the energy units to one particular unit.

Sankey Diagrams:

All the energy flows in and out of a Facility arc represented by Sankey diagram, The widths of the bands are directly proportional to energy production, utilization and losses. The primary energy resources which in this case arc the gas, electricity and oil, represent the energy inputs at the left-hand side of the sankey diagram. A typical Sankey diagram is shown representing energy usage, MJ/hour.

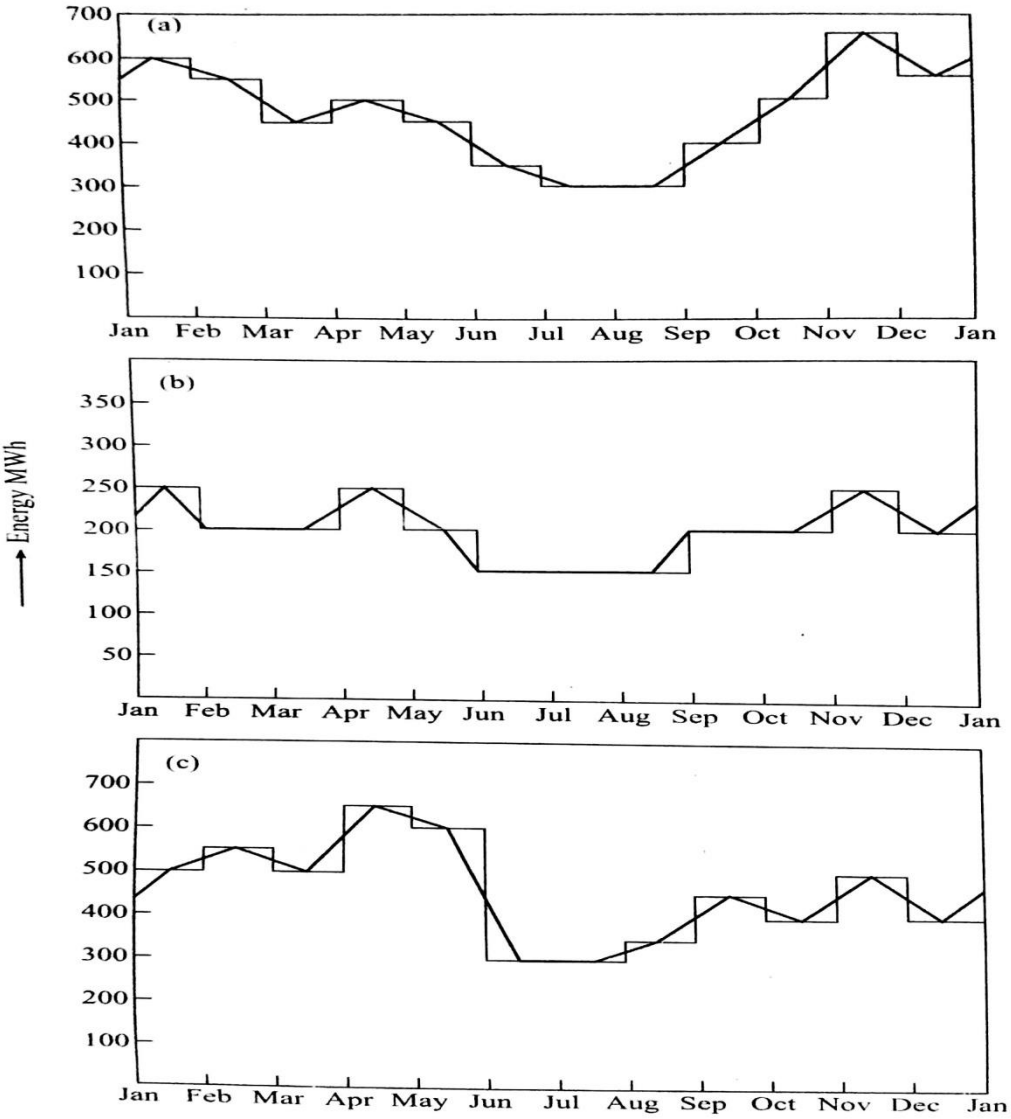


For a small factory, the energy input and losses are shown in the Sankey diagram above. The units used are kWh. The losses are identified and quantified and the required-action is also suggested in the diagram.

Sankey diagrams are very difficult to construct since they involve accurate measurements for all energy flows i.e., inputs, throughputs, and outputs. Considerable metering and instrumentation are needed in this regard. This construction or drawing of Sankey diagram is an excellent exercise in energy management.

LOAD PROFILE:

It is a tedious task to draw Pie charts and Sankey diagrams to monitor and check energy usage on weekly or monthly basis. Load profile is an alternative method that is used for monitoring energy consumption on a time dependent basis. The usage of oil, coal, gas and electricity, considering all the months are shown as cumulative monthly load profile. The results illustrate seasonal variations. After a period of time, energy consumption patterns emerge and it is possible to indicate at a glance whether an area is exceeding its predicted energy use.



Energy conservation schemes:

One of the primary sources of energy in future is the conservation of energy. Energy conservation should always be viewed in a broad perspective in which financial manpower and environmental factors all play a role. The investment for energy conservation, in general, is to be regarded and judged exactly in the same manner as any other form of capital investment. On economic basis, energy conservation may be classified into three categories as under:

(a) Short-term energy conservation schemes

(b) Medium-term energy conservation schemes

(c) Long-term energy conservation schemes

Short-and medium-term schemes can achieve savings of 5 to 10%, the long-term schemes may achieve a further savings of 10 to 15%.

(a) **Short-term energy conservation schemes**:

This group consists of tasks of tightening of operational control and improved housekeeping.

(i) Furnace efficiencies:

For good combustion, minimum excess air over stoichiometric air is to be maintained. A continuous monitoring of oxygen level in flue gases is to be done. The oil burners should be cleaned regularly and well maintained.

(ii) Heal exchangers:

In case of heat exchangers where there is a transfer of useful heat from product streams to feed streams. The optimum cycles can be determined by continuous performance monitoring. An improved heat recovery can be achieved by frequent cleaning.

(iii) Good housekeeping:

When natural light is available and sufficient, artificial light should be avoided. During the heating season doors and windows should be closed as much as possible. Encouragement should be given to staff to wear suitable clothing in the working areas.

(iv) Electrical Power:

In most of the industries, electrical power is 'imported'. About 10 to 15% of electrical energy costs can be reduced by adopting conservation measures. At locations whcrc natural air cooling is sufficient, the usage of I.D. fans can be avoided. Gravity flow application can minimize pumping costs of liquids.

(v) Steam usage—The majority of steam leaks should be repaired as soon as possible after they occur. The quality as well as quantity of steam required should be optimized and a careful control of the supply and distribution of steam is essential. The payback period for this type of schemes is less than or equal to one year.

(b) Medium-term energy conservation schemes:

Considering a payback period of less than two years, considerable savings in energy consumption are often available for quite modest outlays of capital. Some examples are given below:

(i) Insulation: Improving insulation prevents the leakage of cold air into the room and also thermal losses in the steam distribution system. Optimum thickness of insulation or critical radius of insulation is to be evaluated based on the study under consideration. Due consideration is to be given to economical thickness of insulation also.

(ii) The temperature control and operational time of cooling/heating systems.

(iii) Whenever necessary, the air compressors are to be replaced.

(iv) The reliable measurement and control of energy parameters can be achieved by providing adequate instrumentation at all places.

(v) Certain processes of the industry need modification. For example, the uncontaminated steam condensate may be used as boiler feed water. This results in heat recovery in the condensate as well as in reduction of raw water amount and its treatment costs.

(vi) Considerable savings can be obtained by suitably adjusting the electrical power factor correction.

(vii) The control and atomizing of steam in boilers and oil in furnaces is found to be in excess of the optimum designed value. This optimal value when used results in energy conservation.

(c) Long-term energy conservation schemes:

Further energy saving can be attained by adopting policies which require large amount of capital expenditure. The return on capital for the long-term investment may not be as good as that of the medium-term. Economical appraisal techniques are to be used to ensure the economical viability of such schemes, involving certain modifications to the existing systems or refurbishments. Some examples are:

(i) Heater modification: The installation of heating tubes, air pre-heaters or any other suitable heat exchangers results in extraction of more heat from furnace flue gases.

(ii) Additional lagging (improved insulation) for storage tanks minimizes thermal energy losses.

(iii) To obtain improved heat recovery, additional heat exchangers are to be provided in the processing areas.

Example:

A company uses on an hourly basis, 4.32 x 10^9 J of oil, 11.72 x 10^3 therms of gas and 500 kW of electricity. Draw a Pie chart for this company's energy usage. (To convert 1 therm to J/s divide by 29.31 x 10^-3)

Sol: All the units are first converted into a particular unit, namely kW, thus

$$Oil = \frac{4.32\ X\ 10^9}{3600\ X\ 10^3} = 1200\ kW$$

$$Gas = \frac{11.72\ X\ 10^3}{29.31\ X\ 10^{-3}} = 400\ kW$$

Electricty = 500kW

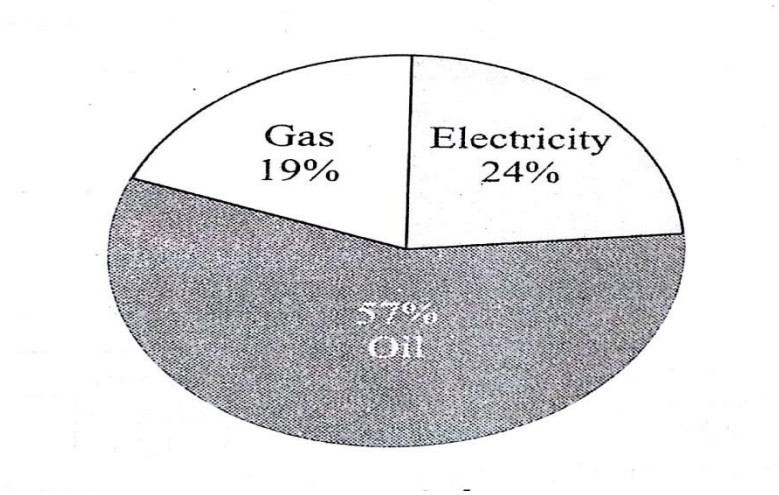
Total hourly energy consumption = 2100kWThen the segment angles of the pie chart are obtained and percentage of consumption are calculated as:

$$Oil = \frac{1200}{2100} X\ 360^0 = 206^0\ ; 57.2\%$$

$$Gas = \frac{400}{2100} X\ 360^0 = \ 68^0\ ; 18.9\%$$

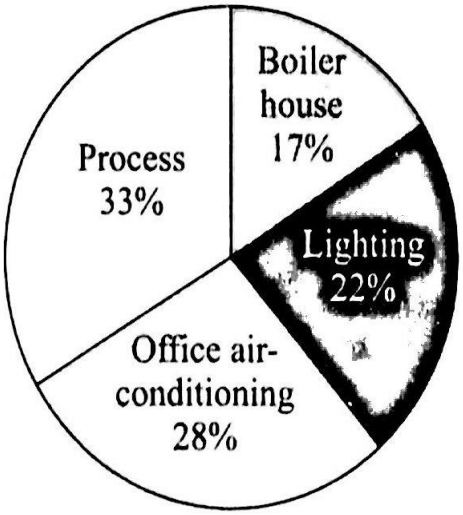
$$Electricity = \frac{500}{2100} X\ 360^0 = \ 86^0\ ; 23.9\%$$

Pie chart is shown as



The Pie charts may also be extended to indicate the consumption of a particular type of energy throughout an (Industry) facility. For example, consider the consumption of electricity of an industry. The consumption, angles and percentages are evaluated as follows:

Office air-conditioning	= 150 kW	= 100°	= 27.8 %
Lighting	= 120 kW	= 80°	= 22.2 %
Boiler house	= 90 kW	= 60°	= 16.7 %
Process	= 180 kW	= 120°	= 33.3 %
Total	= 540 kW	=360°	=100%



The Pie charts enable the energy manager/energy auditor to identify the areas where energy conservation opportunities are to be identified, analyzed and evaluated in the order of priority. The technical feasibility and economical viability of such proposals are then considered for execution or implementation of them.

Example:

Find the cost index of an industry producing 15000 MT per year. Whose energy cost details are given as under:

Energy Type	Consumption	Energy costs/unit in Rupees	Total cost in Rupees
Coal	1500 MT	410/MT	615 x 10^3
Oil	18.000 litres	40.0/litre	720 x 10^3
Electricity	1.0 x 10^5 kWh	3.0/kWh	300 x 10^3
Total			1635 x 10^3

Coal cost index = $\frac{615 \text{ x } 10\text{^}3}{15\text{x}10\text{^}3} = \text{Rs } 41.0/\text{MT}$

Oil cost index = $\frac{720 \text{ x } 10\text{^}3}{15\text{x}10\text{^}3} = \text{Rs } 48.0/\text{MT}$

Electricity cost index = $\frac{300 \text{ x}10\text{^}3}{15\text{x}10\text{^}3} = \text{Rs } 20/\text{MT}$

Total cost index =Rs109 /MT

Example:

An industry uses three forms of energy, namely gas, oil and electricity. Their annual energy consumption is 146 MWh_ 520 MWh and 995 MWh respectively and produces 105 tonnes (MT) per annum. Calculate the energy indices.

$$\text{Gas energy index} = \frac{520 \text{ x } 10^6}{10^5} = 5.2 \text{ kWh/tonne}$$

$$\text{Oil energy index} = \frac{146 \text{ x } 10^6}{10^5} = 1.46 \text{ kWh/tonne}$$

$$\text{Gas energy index} = \frac{995 \text{ x } 10^6}{10^5} = 9.95 \text{ kWh/tonne}$$

Total Energy Index = 5.2 + 1.46 + 9.95 = 16.61 kWh/tonne

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

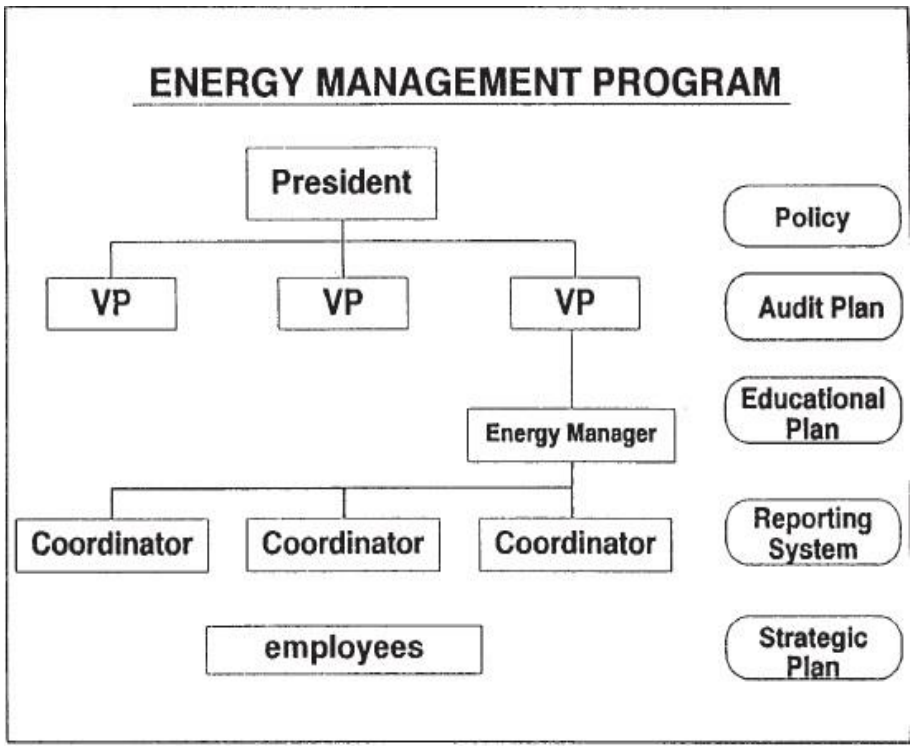
The third principle is **to *control and meter only the main energy functions***—the roughly 20% that make up 80% of the costs. A few functions usually account for a majority of the costs. It is important to focus controls on those that represent the meaningful costs and aggregate the remaining items 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.

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

4) 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.

QUALITIES AND FUNCTIONS OF AN ENERGY MANAGER:

Energy managers can come from a variety of backgrounds, since energy is a multi-disciplinary specialty. It is difficult to lay down hard and fast rules about the qualities required for an energy manager. Generally, the energy manager will be drawn from the existing workforce. Since, he should be thoroughly familiar with the whole range of organizations activities from input to output of the process and finance. The energy managers should have the ability and open-mindedness to keep abreast of the latest developments in energy efficiency technology. The energy manager may also be an external person, appointed, considering his experience and expertise in the relative field of the process involved. There is no precise blueprint for a successful energy manager and the job is also not clearly defined.

- The energy managers should have high visibility within the organization.
- They have more responsibility to get the job done with very less authority. They need a good grasp of both the design aspects and nuts/bolts details of conservation programmes i.e., they should have a thorough understanding of the company's process, products, maintenance procedures and facilities.
- A good energy manager should be able to communicate clearly and persuasively with lawyers, engineers, accountants, financial planners, public relation specialists, government officials etc., in their own language.
- To have a continuous support of top management, the energy manager has to develop and present his programme and investment with predictable returns instead of unrecoverable costs.
- The energy manager should control and coordinate the conservation campaigns.
- He should control his area of responsibility very efficiently.
- He must be capable of directing all the personnel involved in consuming the supply of energy for which he is responsible.
- He has to decide regarding investment in a particular project analyzing the costing techniques.

The role of the energy manager discusses direct access to senior management and their full support and commitment and answers the questions like:

(i) Who should be appointed?
(ii) What benefits will an energy manager bring?
(iii) How does he fit into the company's structure?

An important concept to energy manager is efficiency. Losses some of which are thermody-namically unavoidable and some are economically irretrievable, contribute to inefficiency. The challenge to energy manager is to first identify those which he can do something about, find how to do it, and then get the management agree to do it.

He needs a questioning mind and should possess the ability to command the support of colleagues.

The terms of reference of the energy manager should be clearly defined i.e., whether he has an authority within a service or production department or whether he acts only in an advisory and coordinating role. Based on the type and size of the organization, the duties of energy manager should include any/all of the following:

(i) To generate interest in energy conservation and to sustain the same with new ideas and activities and for lecturing training courses.
(ii) To ensure that the records and accounting system are maintained in consistent units and are uniform.
(iii) To give technical advice on energy saving techniques and equipment.
(iv) To identify the sources of technical guidance.
(v) To coordinate the efforts of all energy users and set realistic targets.
(vi) To maintain essential records of purchases, stock, consumption reviewing the energy utili-zation performance periodically, watching the trends and to advice the senior management.
(vii) To identify the source of energy wastage, quantify the wastage or losses in financial terms and suggest practical recommendations to reduce these losses.
(viii) To identify areas requiring deep study, maintain records of such in-depth studies and to review the progress.
(ix) To provide material of good energy practice to suit the needs of the organization.
(x) To give special advices, with due consideration to energy conservation, safety and healthy aspects, to various departments of the organization.

(xi) To keep track of all the significant developments in the field of energy conservation by maintaining contact with appropriate research organizations.

(xii) To advise the senior management on matters of energy with latest developments in the global scenario.

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.