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## Energy Audit in Hindustan Coca Cola Beverages Private Limited

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**ABSTRACT:** An attempt has been made in this paper to reveal the characteristics of production process of Hindustan coca cola ® bottling plant determine that plant is the high energy-consuming and more discharging pollutants enterprise. With the restrictions of energy resources and environmental conditions, the sustainable development of Hindustan coca cola ® plants in Jammu face severe challenge. Energy audit can help to excavate the maximal energy-saving potential in production and management process, give proposals on energy-saving management and energy-saving technical renovation, promote the progress of management and energy saving technology, ensure the rapid and healthy development of Hindustan coca cola ® plant and ultimately realize the objectives . The existing energy costs for Hindustan coca cola were approximately 36 lakhs per year. It is expected that after implementation of EMOs, the reduction of energy costs may be more than 10%. It is believed that Energy Audit is one of the most comprehensive methods in achieving energy savings in industry and thus reducing excessive energy consumption. If the private sector participates in the implementation of the energy audit programmes to their buildings, wasteful consumption of energy will be minimised.

**KEYWORDS:** Energy conservation measures, Energy audits, Best efficiency point, Energy Efficient Motors.

### I. INTRODUCTION

#### DEFINITION AND OBJECTIVES OF ENERGY MANAGEMENT

The fundamental goal of energy management is to produce goods and provide services with the least cost and least environmental effect. The term energy management means many things to many people. One definition of energy management is: “The judicious and effective use of energy to maximize profits (minimize costs) and enhance competitive positions” [5]. Another comprehensive definition is “The strategy of adjusting and optimizing energy, using systems and procedures so as to reduce energy requirements per unit of output while holding constant or reducing total costs of producing the output from these systems” [5]. The objective of Energy Management is to achieve and maintain optimum energy procurement and utilisation, throughout the organization and to minimise energy costs waste without affecting production and quality and environmental effects.

#### ENERGY AUDIT: TYPES AND METHODOLOGY

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

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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.

## Type of Energy Audit

The type of Energy Audit to be performed depends on:

1. Function and type of industry.
2. Depth to which final audit is needed.
3. Potential and magnitude of cost reduction desired.

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

1. Preliminary Audit.
2. Detailed Audit.

## Preliminary Energy Audit Methodology

Preliminary energy audit is a relatively quick exercise to:

1. Establish energy consumption in the organization.
2. Estimate the scope for saving.
3. Identify the most likely and the easiest areas for attention.
4. Identify immediate (especially no- / low-cost) improvements / savings.
5. Set a ‘reference point’.
6. Identify areas for more detailed study/measurement.
7. Preliminary energy audit uses existing, or easily obtained data.

## Detailed Energy Audit Methodology

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 conducts 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.

1. Phase I - Pre Audit Phase
2. Phase II - Audit Phase
3. Phase III - Post Audit Phase

## Details About Case Company

Name	:	Hindustan Coca Cola ® Ltd .
Incorporated on	:	1973.
Location	:	National Highway Road Gangyal, Jammu.
Products	:	Cold Drinks (Approx. 6000 Cases /day).
Employees	:	120.

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Area of Supply	:	Gangyal, Rehari, New plot, Talab Tillo, Gumat, Digiana, Satwari, R.S Pura, Gandhi Nagar and Trikuta Nagar etc.
Place of work	:	Jammu.
Sanctioned Load	:	367 KW.
Monthly Electrical Bill	:	2 Lakhs to 3 Lakhs on season and 1.5 Lakhs in off season.
Energy Charges	:	Rs 2.90 to Rs 4.90 paise per unit.
Types of Consumers	:	Industrial.
Transformer Rating	:	1000 KVA, 11000 / 415 V, ONAN Delta Star connection.

## Different Sections In The Company

- Bottling unit.
- Conveyor unit.
- Chilling unit.
- Boiler unit.
- D.G unit.
- Air compressor unit.
- Bottle washer unit.
- Water treatment plant.
- Transformer.

## Brief Description Of Machines In Industry

**1. Bottle Washer:** Bottle washing machines are widely used by a number of industries for fast and efficient washing, sterilizing and drying of bottles before being filled with solutions, liquids or powders. The output and productivity of the machine depends on the technical specification of the machine can vary from 200-300 bottles per minute. Speed of Bottle washer is 24 Bottles per Minute to 300 Bottles per Minute.

**2. Conveyor Motor System:** A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries. Many kinds of conveying systems are available, and are used according to the various needs of different industries. There are chain conveyors (floor and overhead) as well. Chain conveyors consist of enclosed tracks, I-Beam, towline, power and free, and hand pushed trolleys.

**3. Uncaser Machine:** Uncase machines that are widely used in beverages industry for damage free unpacking of bottles from cases to bottle washer conveyor. The easy operations and low maintenance of uncaser machines have made them the huge hit in the market. The easy availability and competitive prices of machines have made us the leading uncaser machines manufacturer and supplier from Jalandhar, Punjab.

**4. Caser Machine:** Case packer machines that are in wide demand in the market due to its high technical specifications. The extra ordinary case packaging machines are specially designed for automated packaging of bottles in their respective cases. These high performing case packing machines have long life of their grippers and premium safety mechanism that ensures completes safety of humans as well as bottles. The high operation speed of machines has placed among the leading case packer machines manufacturers and suppliers from Jalandhar, Punjab.

**5. Fire Hydrant:** A fire hydrant is a pipe that allows water to flow from a water main with the control of a valve in order to put out a fire. Above-ground fire hydrants originated in the 1800s, but the underground fire hydrant was used in Asia and Europe as far back as the 1700s. In the United States, a fire hydrant may also be called a "fire plug" or a "Johnny pump," depending on the region.

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**6. D.G Room:** In D.G room generators are place for electricity purpose. When SEB fail the plant load is shift from main supply to generator by change over switches.

**7. Compressor Room:** In compressor room, Air compressor is used to supply process requirements, to operate pneumatic tools and equipments and to meet instrumentation needs. Only 10 -30 % of energy reaches the point of end use and balance 70 - 90 % of energy of the power of the prime mover being converted to unusable heat energy and to a lesser extent lost in form of friction, misuse and noise.

**8. Boiler Room:** In boiler room, a boiler is used which is an enclosed vessel that provides a means for combustion heat to be transferred into water until it becomes heated water or steam. The hot water or steam under pressure is then unable for transferring the heat to a process.

**9. Chilling Plant:** The chilling unit consists of two refrigerating unit (one working at a time) having two refrigerating cycles running simultaneously. Here, refrigeration is used for the process of low temperature filling so that the dissolved CO<sub>2</sub> does not escape out of the beverage and for the syrup formation purposes. The chilling unit consists of the basic refrigerating unit having chiller (evaporator), compressor (two in numbers for two different units depending upon the load undertaken), condenser and an expansion device. The compressors are KC3 and KC6 having 3 and 6 pistons respectively. The unit also contains a tank of glycol (refrigerant).

**10. Water Treatment:** Plant: The main purpose of the water treatment is to prevent the formation of the various hard deposits caused by salts on the internal surface of the boiler as such deposits cause efficiency loses. Therefore to keep the water soft, a cation exchange resin bed together with a chemical solution doser is added in the feed water in the water treatment plant (WTP).

**11. Bore well:** Bored wells are generally constructed at locations where aquifers (water bearing geologic formations) are both shallow and low-yielding. An aquifer that yields only 1 gallon per minute will provide 1,440 gallons per day. Bored wells range in depth from 30 feet to 100 feet. To compensate for low-yielding aquifers, large diameter bored wells serve as storage reservoirs to provide water during periods of high demand. A bored well with a diameter of 3 feet, a total depth of 50 feet and a water depth of 30 feet, contains approximately 1,600 gallons of water.



(a)



(b)

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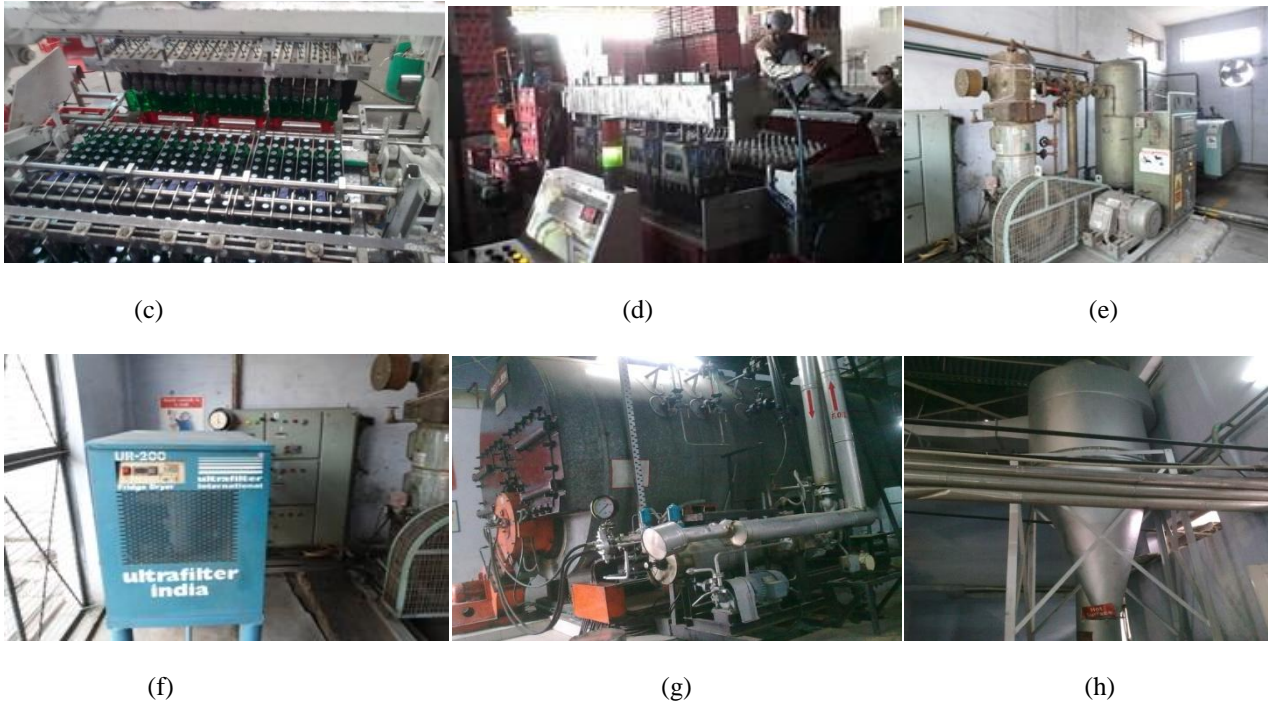


Fig.1 (a) Courtesy Bottle Washer HCCBPL, Jammu (b) Courtesy Conveyor Motor System HCCBPL, Jammu (c) Courtesy Uncaser Machine HCCBPL, Jammu (d) Courtesy Caser Machine HCCBPL, Jammu (e) Courtesy Air Compressor HCCBPL, Jammu (f) Courtesy Air Compressor Filter HCCBPL, Jammu (g) Courtesy Fire Tube Boiler HCCBPL, Jammu (h) Courtesy Dust Separator HCCBPL, Jammu

## II. RELATED WORK

The electrical energy audit has been carried out for motors only which are installed in plant and It was concluded that the necessary and quick action is the need of the hour and recommendations have been given accordingly.

### Methodology Of Study

To achieve the objective of energy audit .The following methodology was adopted:

- Data regarding the number of sections in industry has been collected.
- Different electrical points have been noted .e.g. fans, tubes, motors etc.
- Comparative study has been done between the existing system and newer proposed plan.
- Saving and payback period have been calculated.
- 

### Present Work on Energy Conservation in Different Units of Hindustan Coca Cola ® Industry

By following the guidelines of bureau of energy efficiency an energy audit has carried out. The steps are as follows:-

- Collection of data on operational parameters, electrical energy consumption and measurement.
- Study the capacity and performance of particular unit of Coca Cola ® industry.
- Study of the specific energy consumption department-wise and unit as a whole.
- Study of the power sources, distribution system, load factor and efficiency of large motors, illuminations etc.
- Collection of requisite data and analysis and identification of specific areas with potential for conservation of energy.
- Preparation of no investment/marginal investment and capital cost estimates and establishing techno-economic feasibility for recommended measures.

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- Undertaking broad cost benefit analysis in terms of savings in energy consumption per unit of production and pay-back period.

### Preliminary Energy Audit

Preliminary Energy Audit (PEA) consumption area in the different units of Coca Cola ® industry is studied and following data is collected from all the relevant written, oral and visual information's that help in quick diagnosis of the plant energy situation. A detail of installed machinery in particular unit of the organization is as below:

### Detailed Energy Audit

Preliminary energy audit PEA from the above collected data the scope of saving is estimated. Since the collected data is huge and all the energy consuming devices may not be able to save energy. Therefore, a reference point of 15 HP with 12 and above working hours for motors installed in the particular unit. On the basis of this reference point we short listed the installed motor from the collected data which are given below with their KW rating and working hours along with per day energy consumption.

Sr no.	Location	Kw	H.p	R.p.m	Make	Description	Existing Normal Motor	Proposed Energy Efficient motor
1.	Conveyors	0.37	0.5	1410	Cromton Greaves	$\text{Rated KW} = (\text{H.P} \times 740) / 1000$ RPM (note down from name plate of motor) Efficiency (note down from name plate of motor) Year of Make (note down from name plate of motor) % Loading (Check by clamp on meter and discuss with technicians of the industry.) $\text{Actual Load (KW)} = (\text{rated KW} \times \% \text{ loading})/100$ $\text{Energy Consumed /day} = (\text{Actual loading}/\text{Efficiency}) \times 100 \times \text{working hours per day}$ $\text{Energy Consumed /Year (assume 360 days)} = (\text{Energy consumed per day} \times 360)$ Difference of Energy Consumed = (Energy consumed per year by Existing normal motor- Energy consumed per year by Proposed Energy efficient motor) $\text{Energy Cost @4.90 per unit} = \text{Difference of Energy consumed} \times 4.90$ Cost of New KW motor $\text{Pay Back Period} = (\text{Cost of new motor}/\text{Energy cost per annum})$	110 KW	110 KW
2.	Conveyors	0.74	1	1410	PBL		1470	1470
3.	Conveyors	1.48	2	1410	Hindustan Motors		0.90	0.94
4.	Conveyors	11	1.5	1410	Primo		1990	2011
5.	Conveyors	1.85	2.5	1410	ABB		90	90
6.	Compressor Room	2.2	3	1410	ABB		99	99
7.	Canister Water Pump	2.59	3.5	1410	ABB		1320	1263.8
8.	Circulation Water Pump	2.96	4	1410	ABB		475200	454968
9.	Syrup Pump	3.7	5	1410	ABB		20232	
10.	Main Cip Pump	5.5	7.5	1440	ABB		Rs 99136.8	
11.	Raw Syrup Agitator	7.4	10	1440	ABB		Rs 430,000	
12.	Glocol Hot Pump	11	15	1450	ABB		4 yrs and 4 months.	
13.	Compressor Motor	14.8	20	1440	ABB			
14.	Compressor Motor	18.5	25	1440	ABB			
15.	Compressor Motor	22.2	30	1470	ABB			
16.	Compressor Motor	55.5	75	1470	Kirloskar			
17.	Main Pump	45	60	1470	Kirloskar			

Table No.1 Identified A.C Squirrel Cage Motor capacity from 0.5 H.P to 150 H.P with 12 and above Working hours

Table No.2 Payback Period Calculations for 150 H.P/110 KW 3 φ A.C SC Motor

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Description	Existing normal motor	Proposed EEM
Rated KW	55 KW	55 KW
RPM	1478	1478
Efficiency	0.90	0.935
Year of Make	1990	2011
% Loading	87	87
Actual Load (KW)	47.85	47.85
Energy Consumed /day	638	609.62
Energy Consumed /Year	229680	219463.2
Difference of Energy Consumed (KWH)	10216.8	
Energy Cost @4.90 per unit	50062.32	
Cost of New KW motor	240000	
Pay Back Period	4 yrs and 9 months.	

Table No.3 Payback Period Calculations for 75 H.P/ 55 KW 3  $\phi$  A.C SC Motor

Description	Existing normal motor	Proposed EEM
Rated KW	22 KW	22 KW
RPM	1470	1470
Efficiency	0.90	0.94
Year of Make	1990	2011
% Loading	90	90
Actual Load (KW)	19.8	19.8
Energy Consumed /day	264	252.76
Energy Consumed /Year	95040	90993.6
Difference of Energy Consumed (KWH)	4046.4	
Energy Cost @4.90 per unit	19827.36	
Cost of New KW motor	90,000	
Pay Back Period	4yrs and 6 months.	

Table No. 4 Pay Back Period Calculations for 30 H.P/ 22 KW 3  $\phi$  A.C SC Motor

### III. CONCLUSION

The characteristics of production process of Hindustan coca cola ® bottling plant determine that plant is the high energy-consuming and more discharging pollutants enterprise. With the restrictions of energy resources and environmental conditions, the sustainable development of Hindustan coca cola ® plants in Jammu faces severe challenge. Energy audit can help to excavate the maximal energy-saving potential in production and management process, give proposals on energy-saving management and energy-saving technical renovation, promote the progress of management and energy saving technology, ensure the rapid and healthy development of Hindustan coca cola ® plant and ultimately realize the objectives . The payback period of Energy audit programme for Hindustan coca cola ® plant Jammu is given in below table .The existing energy costs for Hindustan coca cola were approximately 36 lakhs per year. It is expected that after implementation of EMOs, the reduction of energy costs may be more than 10%. It is believed that Energy Audit is one of the most comprehensive methods in achieving energy savings in industry and thus reducing excessive energy consumption. If the private sector participates in the implementation of the energy audit programmes to their buildings, wasteful consumption of energy will be minimised.

### IV. FUTURE SCOPE

Energy audit is quite easier method to solve energy crises problem. It can be performed to any organization where the scope of conservation exists as the saving of energy is production of energy. Further work is recommended for

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optimum utilization of energy, knowledge of employee on conservation measures as well as emphasis on reduction in environmental pollution with performing energy audit at regular interval. Energy audit emphasis on the use of non Conventional energy. It will bring pollution free environment.

- Proper utilization of energy will improve the development rate.
- Energy audit will recommend the ways to improve and implement the performance and
- Efficiency of the system as well as appliances through installation of energy conservation measures.
- Identification of energy with cost saving opportunity and analyse the impact of improvements.

The term energy management refers to the saving of energy. This notably means improving the efficiency of powered devices such as electrical equipment and the development of renewable energies. The energy management is often referred to as demand management. Energy demand management usually implies actions that affect the quantity of energy consumed by users. Energy conservation is the practice of decreasing the quantity of energy used while achieving a similar output at the end for use. On a larger scale, energy conservation is an element of energy policy. Cheap and sub standard gadgets consume more power as compared to expensive standard gadgets and prove to be costlier on a long run. Consideration should be given to the life Cycle cost rather than capital cost while purchasing any gadget. It should always be kept in mind that electricity saved is money saved.

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## BIOGRAPHY



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