

# To Carry Out Energy Audit at Manufacturing Plant and Come Up With the Recommendation to Reduce the Cost of Energy

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**Abstract :-** Energy audits don't save money and energy for companies unless the recommendations are implemented. Audit reports should be designed to encourage implementation, but often they impede it instead. In this Project experience with writing industrial energy audit reports and suggest some ways to make the reports more user-friendly. The goal in writing an audit report should not be the report itself; rather, it should be to achieve implementation of the report recommendations and thus achieve increased energy efficiency and energy cost savings for the customer. In this project from the Electricity Bill we have reduce the cost of energy with low cost. This Project gives some Idea's how to conserve the energy from the Electricity Bill in the any type of industry. This project having good scope in future for saving the electricity from electricity bill.

This Project also gives the calculation & formulation of Electricity bill for industrial load management. Lighting is an essential service in all the industries. The power consumption by the industrial lighting varies between 2 to 10% of the total power depending on the type of industry. Innovation and continuous improvement in the field of lighting, has given rise to tremendous energy saving opportunities in this area. Lighting is an area, which provides a major scope to achieve energy efficiency at the design stage, by incorporation of modern energy efficient lamps, luminaries and gears, apart from good operational practices. It provides merely to indicate some of the options that energy auditor can consider when performing an analysis of an industry. Energy conservation and exploration of new energy avenues are the well accepted solution to fulfill the growing industrial demand in future. Implementation of energy audit can improve the plant efficiency and thereby reducing the energy wastages.

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## Introduction to Energy Audit

### 1.1 Definition & Objectives of Energy Management

The basic objective of energy management is to deliver products and give benefits the slightest cost and minimum ecological impact.

The term energy management implies numerous things to numerous individuals. One meaning of energy management is: "The reasonable and viable utilization of energy to expand benefits (minimize expenses) and upgrade aggressive positions" On the other hand

"The methodology of modifying and upgrading energy, utilizing frameworks and strategies in order to lessen energy necessities per unit of yield while holding steady or diminishing aggregate expenses of delivering the yield from these frameworks"

The goal of Energy Management is to accomplish and keep up ideal energy acquisition and use, all through the association and:

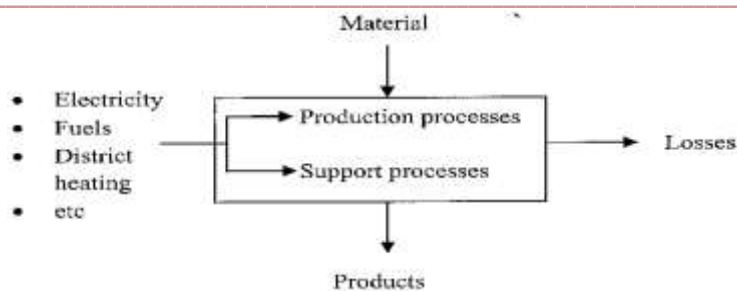
- To minimize energy costs/squander without influencing creation and quality
- To minimize ecological impacts.

### 1.3 Need for Energy Audit

In any industry, the three top working costs are regularly observed to be vitality (both electrical and warm), work and materials. If one somehow happened to identify with the reasonability of the cost or potential cost reserve funds in each of the above segments, vitality would constantly develop as a top ranker, and hence vitality administration work constitutes a key zone for cost lessening. Vitality Audit will see more about the ways vitality and fuel are utilized as a part of any industry, and help in distinguishing the ranges where waste can happen and where scope for development exists. The Energy Audit would give a positive introduction to the vitality cost lessening, preventive support and quality control programs which are essential for generation and utility exercises. Such a review program will keep concentrate on varieties which happen in the vitality costs, accessibility and unwavering quality of supply of vitality, settle on suitable vitality blend, distinguish vitality preservation advancements, retrofit for vitality protection gear and so forth.

## Process Flow Diagram and Technical and Economical Feasibility

### 4.1 Electricity bill Analysis of the Manufacturing plant



**Electricity bill Analysis of the Manufacturing plant**

Sr No.	Months	MAY	JUNE	JULY	AUGEST	SEPTEMBER	OCTOMBER	DECEMBER
1	Connected Load (KW)	851	851	<b>851</b>	851	851	851	851
2	Sanctioned Load (KW)	273	273	<b>273</b>	273	273	273	273
3	Contract Demand (KVA)	660	660	<b>660</b>	660	660	660	660
4	Sanctional Demand (KVA)	182	182	<b>182</b>	182	182	182	182
5	50 % of Contract Demand (KVA)	330	330	<b>330</b>	330	330	330	330
6	Supply Type HT/LT	HT	HT	<b>HT</b>	HT	HT	HT	HT
7	Tariff HT-1N	56	56	<b>56</b>	56	56	56	56
8	KW (MD)	0	0	<b>0</b>	0	0	0	0
9	KVA (MD)	44.878	61.503	<b>54,941</b>	56.546	58.693	57	44.827
10	Billed Demand (KVA)	486	615	<b>549</b>	565	587	565	461
11	Feeder Voltage (KV)	11	11	<b>11</b>	11	11	11	11
12	Rs. (Rs. / KVA Fixed ) Charges @ (B.D * @ Rs)	92,340	1,35,300	<b>1,20,780</b>	1,24,300	1,29,140	1,24,300	1,01,420
13	Billed P.F	0.999	0.995	<b>0.998</b>	0.991	0.994	0.997	0.998
14	Consumption Type (Industrial) (Units * Rate)	1039006.2	12,80,133.8	<b>14,38,221.4</b>	13,811,86.4	13,09,523.60	12,92,278.90	12,28,802.30
15	Total Units Consumed (Zona A + Zone B + Zone C + Zone D)	1,64,140	1,90,780	<b>2,14,340</b>	2,05,840	1,95,160	1,92,590	1,83,130
16	Rate / Units	6.33	6.71	<b>6.71</b>	6.71	6.71	6.71	6.71
17	Total Charges in Rs. (Zone C + Zone D)	47,990	55,845	<b>62,877</b>	60,312	56,239	55,576	52,725
18	<b>Zone wise consumption (Units)</b>							
19	Zone A (22.00 to 06.00 hrs)	59,900	66,850	<b>74,930</b>	71,990	70,550	68,640	65,430
20	Zone B (06.00 to 09.00 & 12.00 to 18.00 hrs)	56,920	67,860	<b>76,380</b>	73,310	68,580	68,970	65,290
21	Zone C (09.00 to 12.00 hrs)	13,540	19,440	<b>21,520</b>	20,940	17,980	16,340	16,420
22	Zone D (18.00 to 22.00 hrs)	33,780	35,630	<b>41,510</b>	39,600	38,050	38,640	35,990
23	<b>Zone wise consumption (Demand)</b>							
24	Zone A (22.00 to 06.00 hrs)	400	501	<b>483</b>	506	518	513	446
25	Zone B (06.00 to 09.00 & 12.00 to 18.00 hrs)	398	615	<b>549</b>	565	587	500	422

26	Zone C (09.00 to 12.00 hrs)	307	444	<b>475</b>	472	454	425	376
27	Zone D (18.00 to 22.00 hrs)	449	514	<b>534</b>	518	575	565	448
28	<b>Zone wise consumption (Rs.)</b>							
29	Zone A (22.00 to 06.00 hrs)	1,49,750	1,00,275	<b>1,12,395</b>	1,07,985	1,05,825	1,02,960	98,145
30	Zone B (06.00 to 09.00 & 12.00 to 18.00 hrs)	0	0	<b>0</b>	0	0	0	0
31	Zone C (09.00 to 12.00 hrs)	10,832	15,552	<b>17,216</b>	16,752	14,384	13,072	13,136
32	Zone D (18.00 to 22.00 hrs)	37,158	40,293	<b>45,661</b>	43,560	41,855	42,504	39,589
32	Demand Charges (Billed Demand * @ Rs.)	92,340	1,35,300	<b>1,20,780</b>	1,24,300	1,29,140	1,24,300	1,01,420
33	Energy Charges (Total Units consumed * Rate)	10,09,008.20	12,80,133.80	<b>14,38,221.40</b>	13,81,186.40	13,09,523.60	12,92,278	12,28,802.30
34	Electricity Duty	0	0	<b>0</b>	0	0	0	0
35	TOD Tariff EC	-101760	-44430	<b>-49518</b>	-47673	-49586	-47384	-45420
36	P.F Penal Charges / P.F Incentive	-66832	-103300	<b>-113899</b>	-78785	-75043.26	-	-101129
37	Charges For Excess Demand	0	0	<b>0</b>	0	0	0	0
38	FAC @ Ps/U	-74831	1,04,719.14	<b>1,17,651</b>	1,17,905.15	1,11,787.65	1,68,169.59	1,59,909.12
39	Other Charges	0	0	<b>0</b>	0	0	0	0
40	Interest Arrears	0	0	<b>0</b>	0	0	0	0
41	Tax on Sale @ Ps/U	13131.20 (8)	15262.40 (8)	<b>17,147 (8)</b>	18,607.94 (9.04)	17642.46 (9.04)	17,410.14 (9.04)	16,554.95 (9.04)
42	Total Bill Amount (Rounded) Rs.	9,01,050	13,87,690	<b>15,30,380</b>	15,22,870	14,43,470	14,47,160	13,60,140
43	Bill Date	03-06-15	06-07-15	<b>07-08-15</b>	03-09-15	05-10-15	03-11-15	05-01-16
44	Due Date in Rs.	17/06/2015 , Rs. 9,01,050	20/07/2015 , Rs. 13,87,690	<b>21/08/2015 , Rs. 15,30,380</b>	18/09/2015 , Rs. 15,22,870	19/10/2015 , Rs. 14,43,470	17/11/2015 , Rs. 14,47,160	19/01/2016 , Rs. 13,60,140
45	If paid upto in Rs.	09/06/2015 , Rs. 8,91,500	13-07-2015 , Rs. 13,72,930	<b>13/08/2015 , Rs. 15,14,110</b>	09/09/2015 , Rs. 15,07,110	12/10/2015 , Rs. 14,28,460	09/11/2015 , Rs. 14,32,860	11/01/2016 , Rs. 13,46,700
46	If paid after in Rs.	17-06-2015 , Rs. 9,19,070	20/07/2015 , Rs. 14,15,440	<b>21/08/2015 , Rs. 15,60,990</b>	18/09/2015 , Rs. 15,53,330	19/10/2015 , Rs. 14,72,340	17-11-2015 , Rs. 14,76,100	19/01/2016 , Rs. 13,87,340

#### 4.2 Electricity Bill Parameters Calculations

Sr No.	Months	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	DECEMBER
1	Connected Load (KW)	851	851	<b>851</b>	851	851	851	851.000
2	Sanctioned Load (KW)	273	273	<b>273</b>	273	273	273	273.000
3	Contract Demand (KVA)	660	660	<b>660</b>	660	660	660	660.000
4	Sanctional Demand (KVA)	182	182	<b>182</b>	182	182	182	182.000
5	50 % of Contract Demand (KVA)	330	330	<b>330</b>	330	330	330	330.000

6	Supply Type HT/LT	HT	HT	HT	HT	HT	HT	HT
7	Tariff HT-1N	56	56	56	56	56	56	56.000
8	KW (MD)	0	0	0	0	0	0	0.000
9	KVA (MD)	44.878	61.503	54.941	56.546	58.693	57	44.827
10	Billed Demand (KVA)	486	615	549	565	587	565	461.000
11	Feeder Voltage (KV)	11	11	11	11	11	11	11.000
12	Rs. (Rs. / KVA Fixed ) Charges @ (B.D * @ Rs)	92,340	1,35,300	1,20,780	1,24,300	1,29,140	1,24,300	1,01,420
13	Billed P.F	0.999	0.995	0.998	0.991	0.994	0.997	0.998
14	Consumption Type (Industrial) (Units * Rate)	103900 6.2	12,80,1 33.8	14,38,2 21.4	13,811, 86.4	13,09,52 3.60	12,92,27 8.90	12,28,80 2.30
15	Total Units Consumed (Zona A + Zone B + Zone C + Zone D)	1,64,140	1,90,780	2,14,340	2,05,840	1,95,160	1,92,590	1,83,130
16	Rate / Units	6.33	6.71	6.71	6.71	6.71	6.71	6.710
17	Total Charges in Rs. (Zone C + Zone D)	47,990	55,845	62,877	60,312	56,239	55,576	52725.000
18	<b>Zone wise consumption (Units)</b>							
19	Zone A (22.00 to 06.00 hrs)	59,900	66,850	74,930	71,990	70,550	68,640	65430.000
20	Zone B (06.00 to 09.00 & 12.00 to 18.00 hrs)	56,920	67,860	76,380	73,310	68,580	68,970	65290.000
21	Zone C (09.00 to 12.00 hrs)	13,540	19,440	21,520	20,940	17,980	16,340	16420.000
22	Zone D (18.00 to 22.00 hrs)	33,780	35,630	41,510	39,600	38,050	38,640	35990.000
23	Total	164,140	189,780	214,340	205,840	195,160	192,590	183,130
24	<b>Zone wise consumption (Demand)</b>							
25	Zone A (22.00 to 06.00 hrs)	400	501	483	506	518	513	446
26	Zone B (06.00 to 09.00 & 12.00 to 18.00 hrs)	398	615	549	565	587	500	422.000
27	Zone C (09.00 to 12.00 hrs)	307	444	475	472	454	425	376.000
28	Zone D (18.00 to 22.00 hrs)	449	514	534	518	575	565	448.000
29	<b>Zone wise consumption (Units * Demand = Charges Rs.)</b>							
30	Zone A (22.00 to 06.00 hrs)	149750.000	100275.000	112395.000	107985.000	105825.000	102960.000	98145.000
31	Zone B (06.00 to 09.00 & 12.00 to 18.00 hrs)	0	0	0	0	0	0	0.000
32	Zone C (09.00 to 12.00 hrs)	10832.000	15552.000	17216.000	16752.000	14384.000	13072.000	13136.000
33	Zone D (18.00 to 22.00 hrs)	37158.000	39193.000	45661.000	43560.000	41855.000	42504.000	39589.000
34	Demand Charges (Rs.)	92340	135300	120780	124300	129140	124300	101420.000
35	Energy Charges (Rs.)	1101379.400	1273423.800	1438221.400	1381186.400	1309523.600	1292278.900	1228802.300
36	TOD @ Tariff EC	41860.000	45530.000	49518.000	47673.000	49586.000	47384.000	45420.000
37	FAC (Fuel adjustment cost)	143327.048	165715.896	187161.688	179739.488	170413.712	168169.588	159909.116
38	Tax On Sale	13131.200	15262.108	17147.200	18607.936	17642.464	17410.136	16554.952

**Tariff for HT Category**

Consumer Category and Consumption Slab	Approved Tariff Rate	
	Fixed / Demand Charge	Energy Charge (Rs. / kWh)
<b>HT I: HT – Industry</b>		
HT I (A): Express Feeders	Rs 220 per kVA per month	7.21
HT I (B): Non-Express Feeders	Rs 220 per kVA per month	6.71
HT I (C): Seasonal Industry	Rs 220 per kVA per month	7.8
<b>HT II: HT – Commercial</b>		
HT II (A): Express Feeders	Rs 220 per kVA per month	11.15
HT II (B): Non-express Feeders	Rs 220 per kVA per month	10.62
<b>HT III: HT – Railways</b>	<b>NIL</b>	<b>8.46</b>
<b>HT IV: HT – Public Water Works &amp; Sewage Treatment Plants</b>		
HT IV (A): Express Feeders	Rs 220 per kVA per month	5.64
HT IV (B): Non-express Feeders	Rs 220 per kVA per month	5.42
<b>HT V: HT – Agriculture</b>	<b>Rs 30 per kVA per month</b>	<b>3.32</b>
<b>HT VI: HT – Bulk Supply (Residential)</b>	<b>Rs 220 per kVA per month</b>	<b>5.81</b>
<b>HT VIII: HT – Temporary Supply</b>		
HT VIII (A): HT – Temporary Supply Religious (TSR)	Rs 290 per connection per month	3.71
HT VIII (B): HT – Temporary Supply Others (TSO)	Rs 290 per connection per month	12.5

<b>HT IX: HT – Public Services</b>		
<b>HT IX (A): HT - Public Services – Government</b>		
HT IX (A) (i): Express Feeders	Rs 220 per kVA per month	7.2
HT IX (A) (ii): Non-Express Feeders	Rs 220 per kVA per month	6.6
<b>HT IX (B): HT - Public Services - Others</b>		
HT IX (B) (i) Express Feeders	Rs 220 per kVA per month	8.89
HT IX (B) (ii) Non-express Feeders	Rs 220 per kVA per month	8.41
<b>HT X: HT – Ports</b>	<b>Rs 220 per kVA per month</b>	<b>10.91</b>
<b>HT XI: HT – Metro/Monorail</b>	<b>Rs 220 per kVA per month</b>	<b>8.46</b>
<b>ToD Tariffs (in addition to above base tariffs) – compulsory for HT I, HT II, HT IV, HT IX and HT X categories</b>		
2200 Hrs – 0600 Hrs		-1.5
0600 Hrs – 0900 Hrs & 1200 Hrs – 1800 Hrs		0
0900 Hrs – 1200 Hrs		0.8
1800 Hrs – 2200 Hrs		1.1

#### Power Factor Incentive

Sr. No.	Range of Power Factor	Power Factor Level	Incentive
1	0.951 to 0.954	0.95	0%
2	0.955 to 0.964	0.96	1%
3	0.965 to 0.974	0.97	2%
4	0.975 to 0.984	0.98	3%
5	0.985 to 0.994	0.99	5%
6	0.995 to 1.000	1	7%

## Power Factor Penalty

Sr. No.	Range of Power Factor	Power Factor Level	Penalty
1	0.895 to 0.900	0.9	0%
2	0.885 to 0.894	0.89	2%
3	0.875 to 0.884	0.88	3%
4	0.865 to 0.874	0.87	4%
5	0.855 to 0.864	0.86	5%
6	0.845 to 0.854	0.85	6%
7	0.835 to 0.844	0.84	7%
8	0.825 to 0.834	0.83	8%
9	0.815 to 0.824	0.82	9%
10	0.805 to 0.814	0.81	10%

## Tips for Energy Conservation for Industries

### ➤ **Boilers:-**

- ✓ Preheat combustion air with waste heat (22 °C reduction in flue gas temperature increases boiler efficiency by 1%).
- ✓ Use variable speed drives on large boiler combustion air fans with variable flows.
- ✓ Burn wastes if permitted.
- ✓ Clean burners, nozzles, strainers, etc.

### ➤ **Furnaces:-**

- ✓ Check against infiltration of air: Use doors or air curtains.
- ✓ Monitor O<sub>2</sub>/CO<sub>2</sub>/CO and control excess air to the optimum level.
- ✓ Improve burner design, combustion control and instrumentation.

### ➤ **Insulation :-**

- ✓ Repair damaged insulation (A bare steam pipe of 150 mm diameter and 100 m length, carrying saturated steam at 8 kg/cm<sup>2</sup> would waste 25,000 litres furnace oil in a year.)
- ✓ Insulate any hot or cold metal or insulation.
- ✓ Replace wet insulation.

### ➤ **Compressors :-**

Consider variable speed drive for variable load on positive displacement compressors.

- ✓ Use a synthetic lubricant if the compressor manufacturer permits it.
- ✓ Be sure lubricating oil temperature is not too high (oil degradation and lowered viscosity) and not too low (condensation contamination)

### ➤ **Electricity Distribution System :-**

- ✓ Optimize the tariff structure with utility supplier
- ✓ Schedule your operations to maintain a high load factor
- ✓ Shift loads to off-peak times if possible.
- ✓ Minimize maximum demand by tripping loads through a demand controller

### ➤ **Motors :-**

- ✓ Properly size to the load for optimum efficiency. (High efficiency motors offer of 4 - 5% higher efficiency than standard motors)
- ✓ Use energy-efficient motors where economical.
- ✓ Use synchronous motors to improve power factor.
- ✓ Check alignment.

### ➤ **Drives :-**

- ✓ Use variable-speed drives for large variable loads.

- ✓ Use high-efficiency gear sets.
- ✓ Use precision alignment.
- ✓ Check belt tension regularly.
- ✓ Eliminate variable-pitch pulleys.
- ✓ Use flat belts as alternatives to v-belts

➤ **Pumps** :-

- ✓ Modify pumping to minimize throttling.
- ✓ Adapt to wide load variation with variable speed drives or sequenced control of smaller units.
- ✓ Stop running both pumps -- add an auto-start for an on-line spare or add a booster pump in the problem area.
- ✓ Use booster pumps for small loads requiring higher pressures.

➤ **Lightning** :-

- ✓ Reduce excessive illumination levels to standard levels using switching, delamping, etc. (Know the electrical effects before doing delamping.)
- ✓ Aggressively control lighting with clock timers, delay timers, photocells, and/or occupancy sensors.
- ✓ Install efficient alternatives to incandescent lighting, mercury vapor lighting, etc. Efficacy (lumens/watt) of various technologies range from best to worst approximately as follows: low pressure sodium, high pressure sodium, metal halide, fluorescent, mercury vapor, incandescent.
- ✓ Select ballasts and lamps carefully with high power factor and long-term efficiency in mind.
- ✓ Upgrade obsolete fluorescent systems to Compact fluorescents and electronic ballasts
- ✓ Consider daylighting, skylights, etc.

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