ENERGY CONSERVATION STRATEGIES OF A SPINNING MILL

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ABSTRACT

India, despite being one of the largest producers of electrical energy in the world is facing a deficit of electrical energy against its exponentially growing demand. Energy audit is one of the methods to conserve the energy such that to reduce the gap between supply and demand. This paper highlights the energy audit conducted at Energy audit had been conducted in one of the leading textile mill, which is located in northern part of Andhra Pradesh. The audit has estimated energy saving potential of the spinning mill by suggesting cost effective measures. The estimated energy saving potential, Green house gas emission reduction, implementation cost and payback period for different energy conserving alternatives are accounted in this paper.

Keywords: Energy audit, Energy conservation, Payback period.

1. INTRODUCTION

Energy, material and labour are the top three operating expenses of any facility. Among them energy will always manage to become second to none and thus energy management contribute to significant cost reduction. Energy audit being one of the strategies of energy management is always a helpful tool in identifying the areas where losses occur and where scope for possible improvement exists [1-10].

In textile industry, electricity consumption and power cost is in increasing trend due to modernized machines and continuous usage of the machines in inefficient operating parameters. Apart from the power cost, man power is also shortage in textile mills due to dusty environment inside the mill and heavy noise from the textile machines. Due to these reasons workers are not showing interest in working at textile mills, which compel mill management to deploy more automated machines. Hence, textile machinery manufacturers are integrating automation in the machines indirectly requirement of power of the machines is increased. The main objective of the textile mill is to produce yarn (thread) from the raw cotton.

The energy audit is performed in at Energy audit had been conducted in one of the leading textile mill, which is located in northern part of Andhra Pradesh. The energy audit is performed by adopting three steps. The first step is the data collection which deals with collecting the preliminary data by first hand observations, interviewing concerned persons and measurements. The second step is the data analysis which deals with analyzing the data collected in first step with help of mathematical tools. The third and the final step is recommendations in which some recommendations must be suggested for the conserving the energy without sacrificing comfort level and satisfaction of the stake holders along with their cost benefit analysis based on the results obtained in second step.

2. ENERGY SCENARIO OF SPINNING MILL:

The capacity of the spinning mill is 25,920 spindles and the production per day 10,000 kg and it will change according to the count of yarn. The energy charges are Rs.6.25 per unit. The energy profile of the campus is tabulated in Table 1. The monthly KWH Consumption for the year 2016-17 is given in Fig.1 and the monthly KVAH consumption, monthly energy charges of electricity consumption are depicted in Fig.2 and Fig.3 respectively. The recorded monthly power factor at the spinning mill during the year 2016-17 is shown in Fig.4.

Table- 1: Energy Scenario of the spinning mill

Mon/Year	KWH Consumption	KVAH Consumption	Monthly bill Rs	PF
1-Apr-16	676180	676920	4320843	0.998906813
1-May-16	1318240	1319680	8606637	0.998908826
1-Jun-16	1362300	1364640	8867857	0.998285262
1-July-16	1318200	1320400	8595102	0.998333838
1-Aug-16	1317600	1320300	8602815	0.99795501
1-Sep-16	1294780	1300080	8474684	0.995923328
1-Oct-16	950580	951680	6374976	0.998844149
1-Nov-16	874000	874280	5914695	0.999679736
1-Dec-16	1353660	1356520	8833069	0.997891664
1-Jan-17	1440820	1443520	9347130	0.998129572
1-Feb-17	1290900	1294720	7443769	0.997049555
1-Mar-17	1275140	1280640	6728558	0.995705272
1-Apr-17	1286700	1290700	7216910	0.996900906
Overall	1212238	1214929	99327045	0.997886

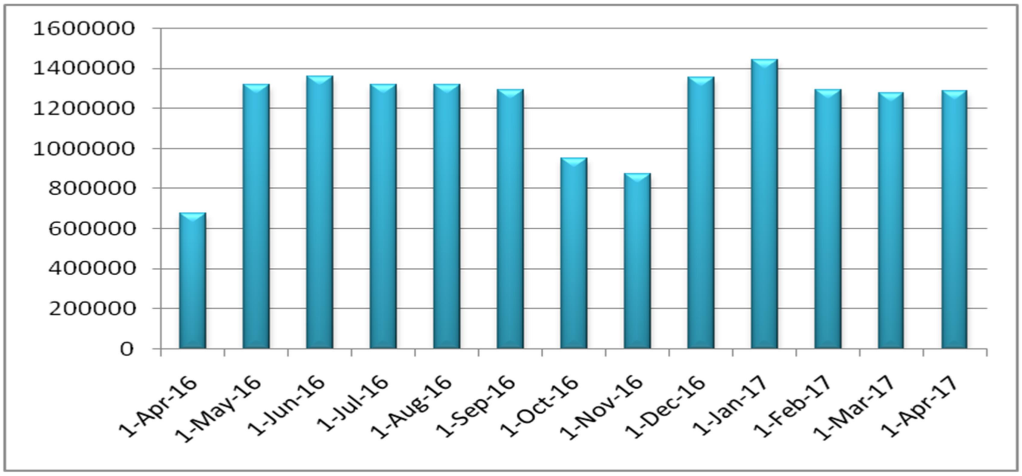

Figure.1. Recorded monthly KWH Consumption at the spinning mill during the year 2016-17

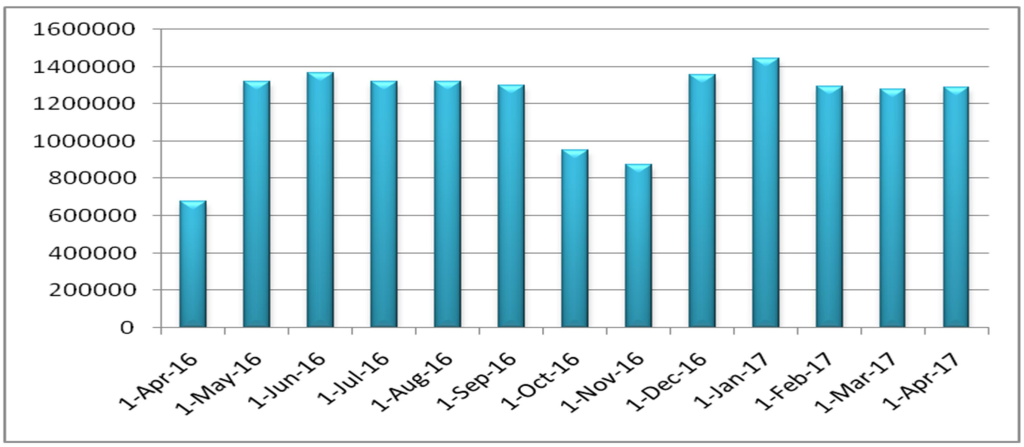

Figure.2. Monthly KVAH Consumption at the spinning mill during the year 2016-17

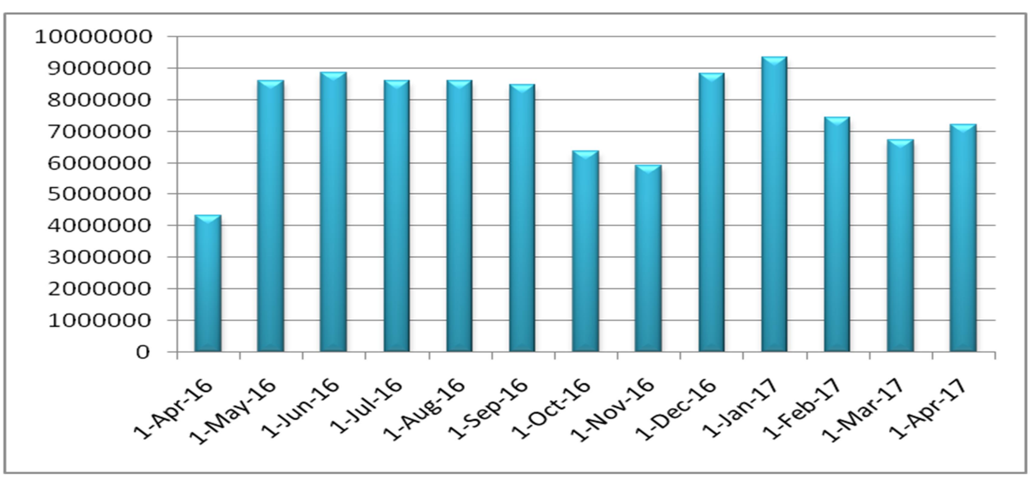

Figure.3. Monthly Energy Charges (INR) at the spinning mill during the year 2016-17

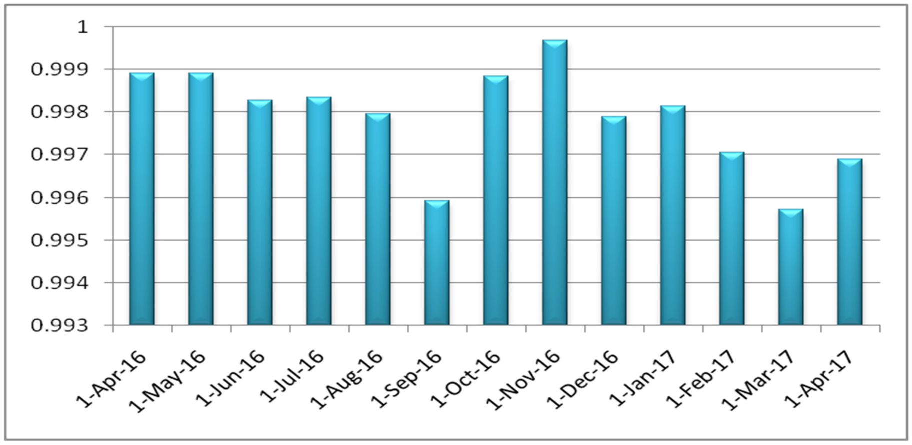

Figure.4. Recorded Monthly Power factor at the spinning mill during the year 2016-17

3. Load Distribution of the Spinning Mill:

In order to determine which equipments consumes more power compared to the rest an equipment wise analysis has been performed at the spinning mill. Table 2 summarizes the results of energy consumption of various appliances after ignoring the equipments whose energy consumption is less than 1%.

Table- 2: Load distribution of the spinning mill in KW

Department	Machine Type	Lights	fans	Computers	ACs	Printers	Motors
Blow room	bale plucker	2.205	0	0	0	0	11.85
Blow room	vario clean	1.395	0	0	0	0	12.67
Blow room	Unimix	0	0	0	0	0	32.54
Blow room	flexi clean	0	0	0	0	0	22.74
Blow room	vetal scan	0.36	0	0	0	0	19.5
Carding	LC 300	2.25	0.08	0	0	0	232.538
Carding	fine feed	0	0	0	0	0	41.21
Carding(dropping)	Vxl	0.63	0	0	0	0	144.22
Preparatory	breaker d/f	6.3	0.16	0	0	0	27.06
Preparatory	Lap former	0	0	0	0	0	29.4
Preparatory	Combing	0	0	0	0	0	86.4
Preparatory	finisher d/F	0	0	0	0	0	41
Preparatory	Simplex	0	0	0	0	0	90.05
Spinning	ring frame	14.715	0.16	0	0	0	1507.02
Auto coner	Murata	3.285	0	0	0	0	228
Preparatory&spinnin	Ohtc	0	0	0	0	0	59.4

Preparatory HM	humidificatio	0	0	0	0	0	122.5
Spinning HM plant	humidificatio	0	0	0	0	0	232.5
power room	air	0.225	0.08	0.018	0	0	70
packing section	NA	1.125	0.08	0	0	0	0
Training room	NA	0.18	0.16	0.018	0	0	0
store room	NA	0.585	0.08	0.018	0	0	0
office room	NA	0.72	0	0.216	15.8	0.09	0
security room	NA	0.0009	0.08	0	0	0	0
Others	Bore well	1.215	0	0	0	0	9
Quality room	NA	0.0009	0	0.036	1.02	0.18	12
Total	NA	35.190	0.88	0.306	16.8	0.27	3031.808

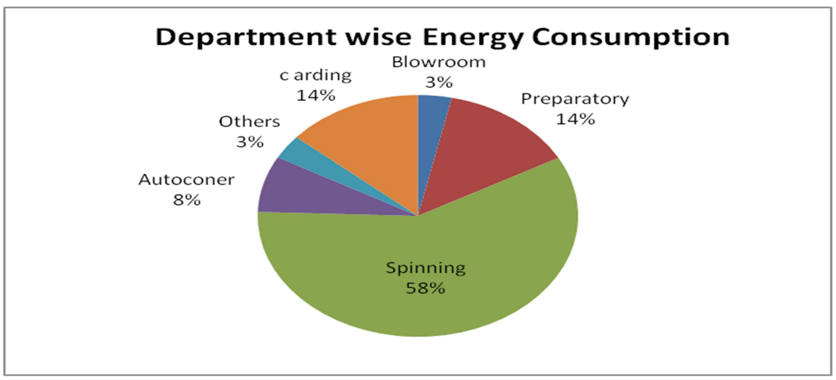

Figure.5. Department wise energy consumption of the spinning mill

The department wise power consumption of the spinning mill is shown in Fig.5.The diagram shows the spinning department consumes high energy of 58%, carding and preparatory departments consumes 14% each. The power consumption of the blow room is 3% and auto coner is 8% and others like office, power room, quality room, security room and colony is 3%.

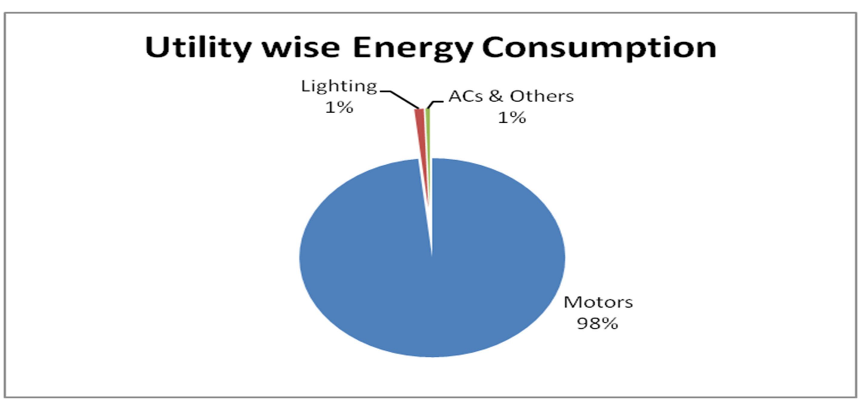

Figure.6. Utility wise energy consumption of the spinning mill

The utility wise power consumption of the spinning mill is shown in Fig.6. The energy consumption is 98.281% from motors, 1.145% from lighting load, 0.542% from air conditioners, 0.004% from refrigerators and 0.0036% from computers and printers. The highest energy consumption is obtained from motors used in different departments of the spinning mill.

4. ENERGY CONSERVATION OPPORTUNITIES:

In order to reduce the energy consumption considerably in the spinning mill, replacement of some of the technologies is suggested. The following alternatives for different existing systems are recommended to reduce the electricity bill considerably.

4.1 Replacing of old motors by new energy efficient motors:

About 98% of the energy consumption comes from the motors used in different departments of textile mill. During the energy audit visit, it has been found that the plant is using 30kW, 82% efficiency motors in the spinning mill. It is suggested to replace the existing motors with energy efficient IE2 motors (30 kW, 92% efficiency) or IE3 motors (30 kW, 92% efficiency). The comparison of operating load profile and efficiency of the different motors at different loadings is tabulated in Table 3.

Table -3: Comparison of different Motors

Motor Loading	Operating hours per day	Power Output (KW)	Efficiency (%)		
			Existing Motor	IE2 Motor	IE3 Motor
½ Load	6	15	82.9	92.6	94.4
¾ Load	9	22.5	83.2	92.8	94.4
Full Load	7	30	82.1	92.3	93.6

4.1.1 Replacing of old motors by new energy efficient IE2 motors:

At present, the existing old motors used in the spinning mill have the power rating of around 3031W. It is recommended to replace the existing old motors by new energy efficient IE2 motors . Table 4 summarizes energy conservation opportunities in motors. The amount of energy saving is estimated to be around 1, 46,025Kwh with a payback of 3.6 years.

Table- 4: Energy conservation opportunities in IE2 Motors

Parameter	Existing system	Recommended system (IE2 Motors)
Number of Motors	100	100
Wattage	3031 W	3031 W
Annual Energy Consumption	2,18,808 Kwh	1,95,444 Kwh
Cost of 1 Unit	Rs. 6.25	Rs. 6.25
Annual Energy Cost	Rs. 13,67,550	Rs. 12,21,525
Cost of the Motor	Rs. 64,600	Rs. 70,469
Saved Units of Power	1,46,025Kwh	
Saved Money	Rs. 9,12,656	
Old Units net cost with depreciation	Rs. 38,00,000	
Capital Investment	Rs. 70,46,900	
Net capital investment	Rs. 32,46,900	
Payback Period	3.6 Years	
IPCC emission factor for Indian power generation	0.944 tCO_2/MWh	
Reduced CO_2 Emissions	1, 37,848 $KgCO_2$	

4.1.2 Replacing of old motors by new energy efficient IE3 motors:

At present, the existing old motors used in the spinning mill have the power rating of around 3031W. It is recommended to replace the existing old motors by new energy efficient IE3 motors . Table 5 summarizes energy conservation opportunities in motors. The amount of energy saving is estimated to be around 1, 65,600Kwh with a payback of 4.39 years.

Table- 5: Energy conservation opportunities in IE3 Motors

Parameter	Existing system	Recommended system (IE3 Motors)
Number of Motors	100	100
Wattage	3031 W	3031 W
Annual Energy Consumption	2,18,808 Kwh	1,92,312 Kwh
Cost of 1 Unit	Rs. 6.25	Rs. 6.25
Annual Energy Cost	Rs. 13,67,550	Rs. 12,01,950
Cost of the Motor	Rs. 64,600	Rs. 83,480
Saved Units of Power	1,65,600 Kwh	
Saved Money	Rs. 10,35,000	
Old Units net cost with depreciation	Rs. 38,00,000	
Capital Investment	Rs. 83,48,000	
Net capital investment	Rs. 45,48,000	
Payback Period	4.39 Years	
IPCC emission factor for Indian power generation	0.944 tCO_2/MWh	
Reduced CO_2 Emissions	1,56,326 $KgCO_2$	

After implementing all the above mentioned alternatives for different existing systems, the projected annual energy savings of the campus is around 3,79,467 Kwh i.e. Rs. 23,71,668. The Energy saved and GHG emission reduction for each appliance varies as shown in the Fig.7.

4.2 Replacing all Florescent lamps by LED lamps:

At present, the existing Fluorescent Lamps used in the spinning mill have the power rating of around 45W. It is recommended to replace the Fluorescent Lamps by LEDs having the power rating of 18W with nearly equal lumens output. Table 6 summarizes energy conservation opportunities in fans. The amount of energy saving is estimated to be around 1,84,959 Kwh with a payback of 4 months. The amount of cost saving is estimated to be around Rs. 11,55,993.

Table- 6: Energy conservation opportunities in Lighting System

Parameter	Existing system (Fluorescent Lamps)	Recommended system (LED Lamps)
Number of Lamps	782	782
Wattage	45W	18W
Lumens	2950	2400
Annual Energy Consumption	3,08,265Kwh	1,23,306Kwh
Cost of 1 Unit	Rs. 6.25	Rs. 6.25
Annual Energy Cost	Rs. 19,26,656	Rs. 7,70,663
Cost of the Lamp	Rs.60	Rs.550
Saved Units of Power	1,84,959Kwh	
Saved Money	Rs. 11,55,993	
Capital Investment	782*550= Rs. 4,30,100	
Payback Period	4 months	
IPCC emission factor for Indian power generation	0.944 tCO_2/MWh	
Reduced CO_2 Emissions	1,74,601 $KgCO_2$	

4.3 Replacing all Split Air Conditioners by Inverter Technology:

At present, the existing Split Air Conditioners used in the university have the power rating of around 1090W. It is recommended to replace the existing Split Air Conditioners by Air Conditioners which work with Inverter Technology having the power rating of 900W. Table 7 summarizes energy conservation opportunities in Air Conditioners. The amount of energy saving is estimated to be around 28,908 Kwh with a payback of 3.15 years.

Table- 7: Energy conservation opportunities in Air Conditioners

Parameter	Existing system	Recommended system
Tons of split ACs	15	15
Wattage of each unit	1090	900
Total Wattage	16.8 KW	13.5 KW
Annual Energy Consumption	1,47,168 Kwh	1,18,260 Kwh
Cost of 1 Unit	Rs. 6.25	Rs. 6.25
Annual Energy Cost	Rs. 9,19,800	Rs. 7,39,125
Saved Units of Power	28,908 Kwh	
Saved Money	Rs. 1,80,675	
Old Units net cost with	Rs. 1,20,000	

Capital Investment	Rs. 6,90,000
Net capital investment	Rs. 5,70,000
Payback Period	3.15 Years
IPCC emission factor for Indian power generation	0.944 tCO_2/MWh
Reduced CO_2 Emissions	27,289 $KgCO_2$

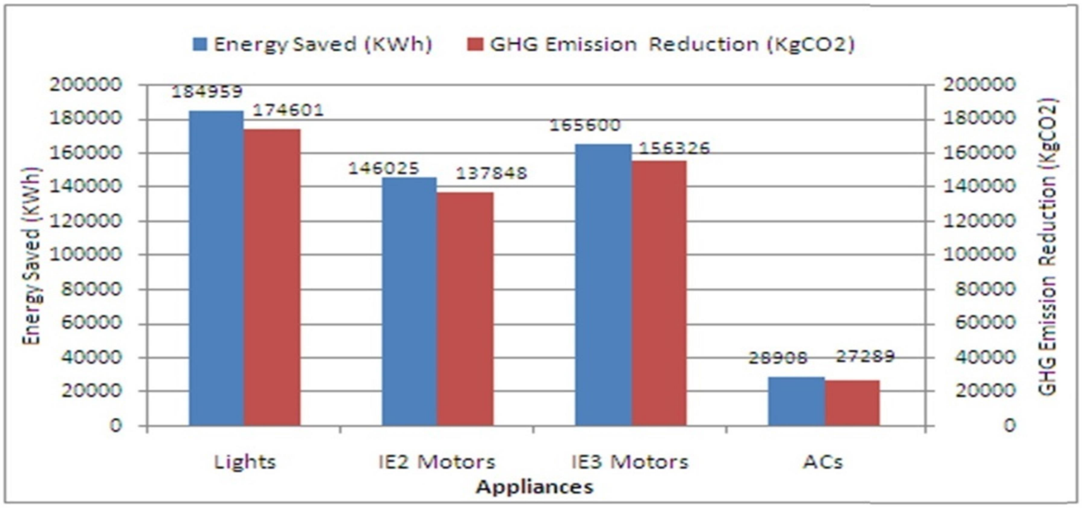

Figure.7. Energy saved and GHG emission reduction for different appliances

The total net capital investment for the recommended energy conservation alternatives is Rs. 94,68,100 for different appliances. The pay-back period and initial investment for each appliance varies as shown in the Fig.8

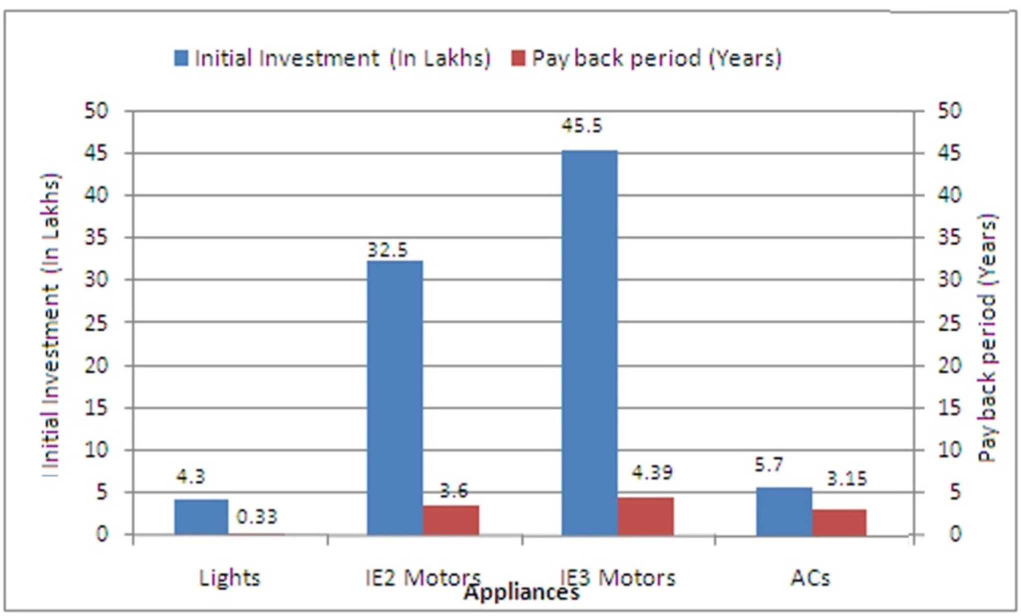

Figure.8. pay-back period and initial investment for different appliances

5. CONCLUSION

The paper highlights the energy audit conducted at Energy audit had been conducted in one of the leading textile mill, which is located in northern part of Andhra Pradesh. The high energy intensive appliances are identified. In order to reduce the power consumption considerably in these appliances, replacement of some of the technologies is suggested. The audit has estimated energy saving potential of the spinning mill by suggesting cost effective measures. The energy saving potential, Green house gas emission reduction, estimated implementation cost and payback period for different energy conserving alternatives are accounted in this paper.

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