Energy Audit of a Bus Body Building Unit – A Case Study

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Abstract:

This is a case study of a Bus Body Building unit located in the outskirts of Hyderabad. The energy audit was sponsored by Non-conventional Energy Development Corporation of A.P. (NEDCAP) the State Designated Agency (SDA) for implementation of Energy conservation activities in the state of Andhra Pradesh. The energy audit indicated scope areas for conservation of energy to the tune of 40%. Now the various energy conservation options are in the different stages of implementation.

Introduction:

This is a case study of a Bus Body Building unit located in the outskirts of Hyderabad.. The bus body building unit was commissioned in the year 1988. It gets the engine chassis from either Tata Motors or Ashok Leyland. The unit has a capacity to assemble 100 buses per month, but the present production is only about 50-55 buses per month.

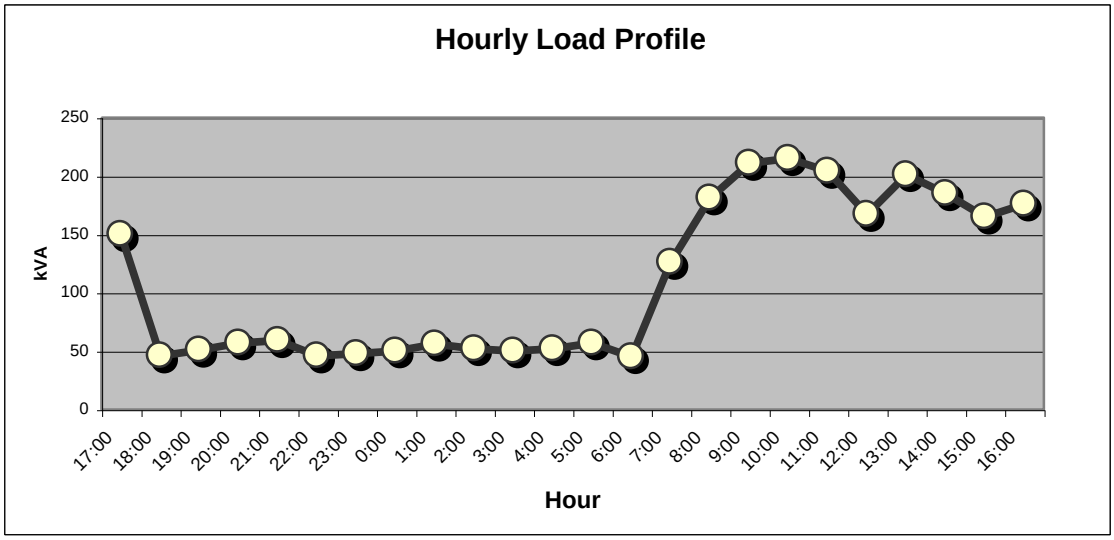
The unit receives power at 11KV, and has a contract demand of 350 KVA with the local Discom. The total connected load of the plant is around 1500 KW. The plant operates only one shift from 800 hrs to -1700hrs. The major energy input is electricity. Diesel is used in the DG set for emergency purpose. The major electrical loads at body building unit are Air Compressors, Arc Welding machines, Hand drilling machines, lathe machines, paint booth, water pumps, lighting etc.

The average monthly power consumption is around 30,000 kWh and the monthly bill varies from Rs. 1.5 to 2.1 lakhs, at an average of Rs. 1.6 Lakhs/month. The electricity charges are Rs.3.5/Kwh, but actual unit cost works out to Rs. 5.3/Kwh including demand charges,. Though the energy cost in the total value addition of the plant is only 1%, the specific power consumption of the plant is 550-600 Kwh/bus. For comparison, we did not have benchmarking figures of other similar

units, but what we feel, this specific power consumption figure is on the higher side.

Load Profile:

As a part of energy audit, the power measurements & load analysis of all the motors & electrical equipment running were carried out by connecting the load analyzer. The following figure gives the typical load profile of the plant for one day.

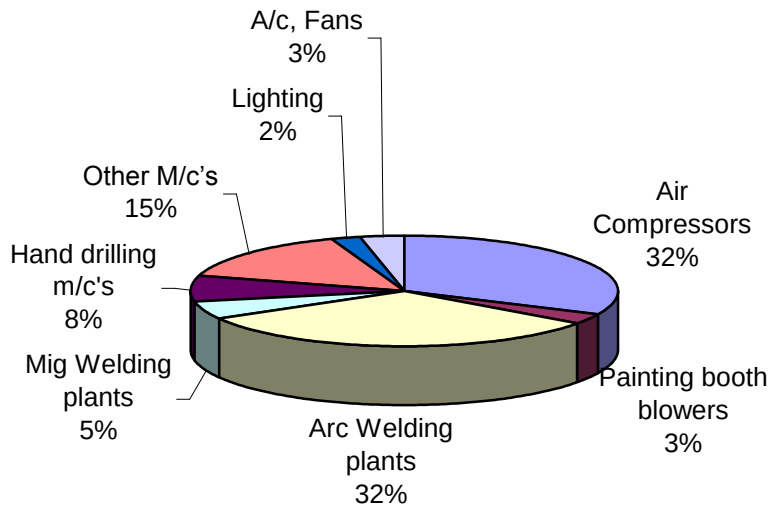


Though the plant had a Contract Maximum Demand of 350 KVA, the typical normal running load is never crossing 200 - 210KV for the present level of production. This gives an idea for optimizing the demand for electricity bill reduction.

Electrical load break-up:

Since the major loads in the bus body building workshop are, air compressors, welding plants, lathes, painting blowers and lights & fans, typical break-up of power consumption by these equipments arrived based on the running hours and the instantaneous power consumption by these equipment. The following table & figure gives the energy consumption break-up of all the equipment in the plant.

Sl.No.	Load	%
1.	Air Compressors	31.87
2.	Painting booth blower motors	3.0
3.	Arc Welding plants	31.7
4.	Mig Welding plants	5.25
5.	Hand drilling machines	7.5
6.	Other M/c's	14.8
7.	Lighting in Workshop	2.4
8.	A/c, Fans in Workshop	3.3
	Total	100



Break-up of Energy Consumption

From the figure it can be seen that the major energy consumption in the plant is by the air compressors and welding machines, followed by blowers & lighting. So, maximum concentration is given towards compressed air & welding sets to save energy.

Energy Conservation Options:

Based on motor load analysis, lighting lux level measurements and the trails conducted on the major equipment like air compressors, the following energy conservation options were identified for implementation.

1. Reduction of Contract Maximum Demand (CMD)

The present contract maximum demand (CMD) is 350 KVA. As already mentioned, the normal recorded demand during the study period was 210 KVA, where as the recorded maximum demand is around 256 KVA based on the past 12 months average (Jan 2006 – Dec 2006). But the billed demand paid by the plant is 80% of the 350 KVA CMD, i.e. 280 KVA. This means that Rs. 50,200/- is being paid as fixed charges @ Rs.195/KVA every month to the electricity board. Since the production has reduced much during the recent past, and assuming present trend of 50-55 buses per month, it was recommended to reduce the CMD by 50 KVA. By lowering the CMD from 350 KVA to 300 KVA, the anticipated savings are to the tune of Rs. 0.93 Lakhs /annum. To be safer side, it is better to incorporate Demand controller, which trips non-essential loads, in case of demand crossing beyond limits to avoid penalty if any.

2. Energy saving potential by arresting compressed air leaks

Being the major load, detailed trials like leakage test and capacity test were conducted on the air compressors. Based on the leakage test during lunch time, the air leak quantity assessed to be 29 %. In addition, physical leakage survey in the plant, indicated many compressed air leak points. As a typical norm up to 10 % leakage is acceptable. It is recommended to arrest all the major leaks that are physically sensed by the walk through survey. It is also recommend to carryout physical leakage survey regularly and arrest the compressed air leaks. The anticipated annual energy savings would be 65,727 kWh, worth Rs. 2.3 lakhs, at a specific power consumption of 0.109 Kwh/CFM. The envisaged investment is minimal towards arresting the compressed air leaks.

3. Energy savings due to compressed air pressure reduction

The existing compressor load and Un-load set points are fixed at 6.5 and 7.5 kg/cm^2 respectively. Maximum pressure required at majority of the compressed air end use points ranges between 4.5 – 5 kg/cm^2(g). It is a thumb rule that for every 1 Kg/cm^2 pressure reduction, we can get a savings of 10% in power consumption. It is recommended to reduce the pressure settings to 5.5 – 6.5 Kg/cm^2, after attending the some of the identified compressed air leaks. By reducing the compressed air working pressure, the leakage quantity also gets reduced. The anticipated annual energy savings would be 20880 kWh, worth Rs. 72,000/-.

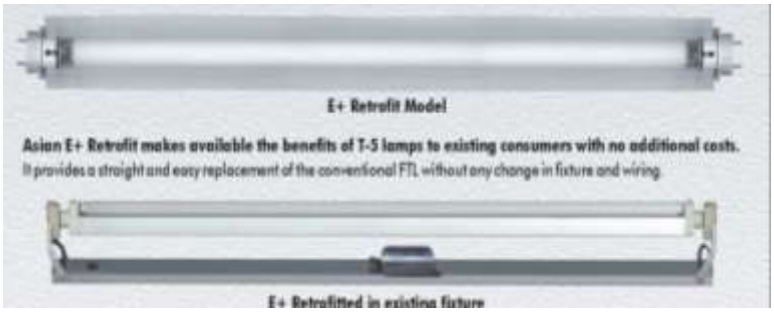
4. Energy savings through incorporation of Energy saver

Energy saver was tested at Bus Body Building workshop on a trial basis, by connecting it to L-wing feeder. The average operating load of Left wing feeder is 29 kW. The major loads in this feeder are machines and fans. By connecting the energy saver, a savings of 15% observed during the trial duration. It is recommended to install energy savers L-Wing feeder - Rating 60 KVA, R-Wing feeder - Rating 30 KVA. The anticipated annual energy savings would be 26,966 kWh, worth Rs. 94,381/-@ 15% savings. The envisaged investment would be around Rs.3.15 Lakhs, which would be paid back with in 3.3 years.

5. Energy savings by installing energy savers for Welding Sets

There are 19 Nos. of arc welding machines that are being used for the welding operations. Each welding machine has rating of 25 kW. Though the welding machines are ON continuously, the actual welding job work will be carried out only for 30-40% of the time. Remaining time the unit will be no-load condition. The measurements indicate, during No-load also the welding machines are consuming around 0.315 kW power. It is recommended to install energy savers in each welding unit, by which the No-load power consumption during No – Load can be completely eliminated for the arc welding machines. The mig welding machines are already having this feature. The anticipated annual energy savings would be 4725 kWh, worth Rs. 16,538/-. The envisaged investment would be around Rs.30,000/- (@ Rs.3000/ per machine) for 10 welding sets.

6. Energy savings through incorporation of Efficient Lighting Systems



Lighting inventory accounting has revealed that around 373 Nos. of Fluorescent Tube Light's each of 40 W are installed throughout the plant in various areas. Most of the tube lights glow though out the day. The (40 W) Tube light with conventional ballast consumes a total power of 52 watts. Now the energy efficient state of art T5 tubes, consumes around 26 Watts including ballast. A savings of 50 %, in energy consumption which would be 15,666 kWh/annum amounting to Rs. 0.54 lakhs per annum. It would call for

an initial investment of Rs. 1.8 lakhs per annum towards installation of T5 tube lights (@ Rs. 500/ T5). The investment would be paid back within a period of 3 years. The other main advantages would be the lighting efficacy would improve from 60 lumen/watt to 104 lumens/watt and also the life of the FTL would improve from 5000 hrs to 20,000 hrs.

7. Replacement of HPSV Street lights with T5 street lights

The bus body building unit has 90 x 250 Watt HPSV street lights. The 250 W HPSV lamp consumes 275 watts along with ballast. The energy efficient T5 tube lights with 4 x 24 Watts will give equivalent light, with a savings of almost 60% (175 W) per fitting, It is recommended to replace all the street lights with T5 street lights. The annual savings would be 63236 Kwh, worth Rs. 2.2 Lakhs. The envisaged investment would be Rs. 5.5 lakhs.

8. Energy Savings by Speed regulation of Pedestal Fans.

At present there are 45 pedestal fans, with a rating of 500 Watts each. Most of the time all the pedestal fans are operated at maximum speed either summer or winter. The measured power consumption of each pedestal fan is around 360 Watts. It is suggested to install remote electronic regulators to reduce the speed of the fans by 10%. By this measure the power reduction of upto 30 % can be achieved. The anticipated annual energy savings would be 4860 kWh, worth Rs. 17,000/-. The envisaged investment would be around Rs.9,000 which would be paid back with in 1.89 years.

Conclusion:

By carrying out energy audit, energy savings worth Rs. 7.96 lakhs, equivalent to 40% of the total bill identified. The total investment envisaged is about Rs. 10.84 Lakhs with a simple payback period of less than 18 months. Presently these encon options are in various stages of implementation. Though this energy audit pertains to bus body building unit, almost all the suggestions are applicable to other automobile industries such as car manufacturing or 2-wheeler units also to reduce their specific energy consumption per vehicle.