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Energy Audit Case Study Of Tobacco Factory

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Abstract: Energy audits play a pivotal role in reshaping the fortunes of any organization. In India, the conservation and efficient utilization of energy have long been a priority for the government. Mandated by the Energy Conservation Act of 2001, energy audits are now obligatory for all commercial firms in the country. This has spurred a heightened focus on energy conservation among industrial consumers, driven by the realization that saving energy equates to generating it, all while maintaining cost-effectiveness.

This paper delves into the firsthand experiences of an energy conservation project undertaken within the manufacturing sector of Maharashtra state. Despite budget constraints, the project diligently pursued economically viable and efficient measures for energy conservation. The tangible outcomes of these efforts were evident in the subsequent reduction of energy costs, coupled with the added benefit of promoting environmental safety. By sharing these experiences, the paper aims to offer insights into practical approaches for achieving energy efficiency, thus inspiring similar initiatives in other organizations.

Keywords: Energy audits, Energy conservation , Enviromental safety,Cost-effectiveness.

I. INTRODUCTION

An energy audit serves as a comprehensive examination of energy usage within an organization, aimed at promoting conservation. It involves analyzing energy flows to identify areas where consumption can be reduced without compromising productivity. This process not only suggests alternative approaches for energy efficiency but also highlights the importance of transitioning away from fossil fuels due to their limited availability and environmental impact. Rupali Ingle

Typically, electricity is generated using fossil fuels, water, or wind power. However, given the finite nature of fossil fuels and their environmental implications, there's a growing emphasis on adopting alternative energy sources and implementing energy-saving measures.

The primary goal of energy auditing and management is to deliver products or services while minimizing costs and environmental harm. Conducting an energy audit helps in pinpointing areas for potential savings, understanding energy usage patterns, identifying wasteful practices, and uncovering opportunities for improvement.

The industry is primarily engaged in the packaging of tobacco products. The operations within the facility encompass various tasks such as pouch making, printing, labeling, filling, pasting, and packing.

The plant relies on a range of utilities to support its operations efficiently. The primary power distribution system is facilitated by a single transformer with a capacity of 315 kVA. Additionally, the plant ensures uninterrupted power supply through the presence of two diesel generator sets, one with a capacity of 250 kVA and the other with 125 kVA. A compressed air system, comprising two compressors, is employed to cater to the instrumentation and tooling air requirements. Liquefied Petroleum Gas (LPG) is utilized in the production process for adhesive preparation (khal). Beyond the production floor, energy consumption extends to auxiliary areas such as the warehouse, administration building, canteen, and street lighting, albeit on a smaller scale.

II. METHODOLOGY

Conducting an energy audit is essential for maintaining a clear focus on improving overall energy utilization within a facility. This process involves evaluating feasible energy conservation measures from both operational and maintenance perspectives. Key facility personnel were interviewed during a preliminary audit to determine the scope of work, facility regulations, team member roles and responsibilities, and descriptions of scheduled project activities.

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During a comprehensive facility tour, major energy consumption areas were identified. Additionally, various documents related to major consumption were reviewed to assess availability and accuracy. The findings and recommendations resulting from the audit were summarized to guide future energy conservation efforts.

STUDY OF EXISTING CONDITION

The industry considered as following description and is given in table

Parameters	Details
Sanction demand	400Kw
Contract Demand	290KVA
Tariff	HT-I A /Industrial
Monthly consumption	39605.714 units
Average unit cost	Rs 9.54
Monthly energy cost	467395 lakhs

Table 1: Industry Description

Energy Scenario at the Plant:

The plant runs majorly on electrical energy. Primary source of energy is power from grid supplied by MSEDCL. Diesel generators are used as backup power source. The electrical power for the plant is supplied by state electricity board (MSEDCL) through 11 kV HT line. The power received is further stepped down to 433 V via 1 transformer of capacity 315 kVA. Further it is distributed to various electrical MCC panels in the facility.

Table 2 : Energy Source used

Sr no	Energy source	Avg Monthly Consumption	Avg monthly energy bill
1	Electricity	39606Kwh	4.67 lakhs

Table 3: Cost of Energy Source

Sr no	Energy Source	Rs./Unit
1	MSEDCL	9.54 INR/Kwh

Table 4: Total Connected Electrical Load

Sr.no	Department	Total watt	K.W
1	Labelling dept.	172863.12	173
2	Pouch dept.	43820.04	44
3	Old pouch dept.	59396.52	59
4	Badshaha dept.	14912.54	15
5	Rawal dept.	30464.00	30
6	Workshop dept.	30690.44	31
7	Water pumps	16412.00	16
8	Other lighting	58389.42	58
9	ETP plant	13142.03	13
	TOTAL	440090.11	440.09

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Performance Assesment of SPS (Solar photovoltaic system):

Solar Photovoltaic system of 310kW is installed in plant. Out of which 260kW is on grid connected. SMA inverters of 25kW of 10 quantity and 10kW of 1 quantity is connected to the plant.

Table 5: Solar Performance Calculation

	Value	Units
Maximun Generation	37854	Kwh/Month
Efficiency	15%	
Irradiation	1.33	Kwh/m^2
Total Panel	969	Nos
Monthly Kwh	29751.26	Kwh/Month
Performance ratio	79%	

Energy Conservation majors

Improvement of Power factor: It is observed that the current average billed PF is maintained at 0.987 on lagging as well as leading side. By adding small steps of capacitors in existing panel i.e. 2 kVAR, 3 kVAR and 5 kVAR an even better P.F can be achieved and the difference between kWH and kVAH. To improve the power factor from 0.98 to 0.995 the APFC panel to be variable in the system at low loading.

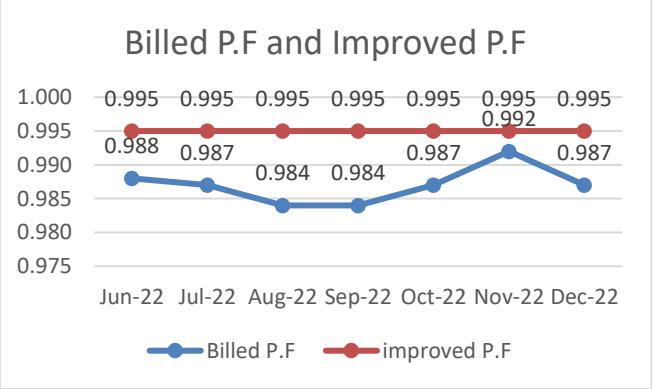

Fig : Graph of billed & improved P.F

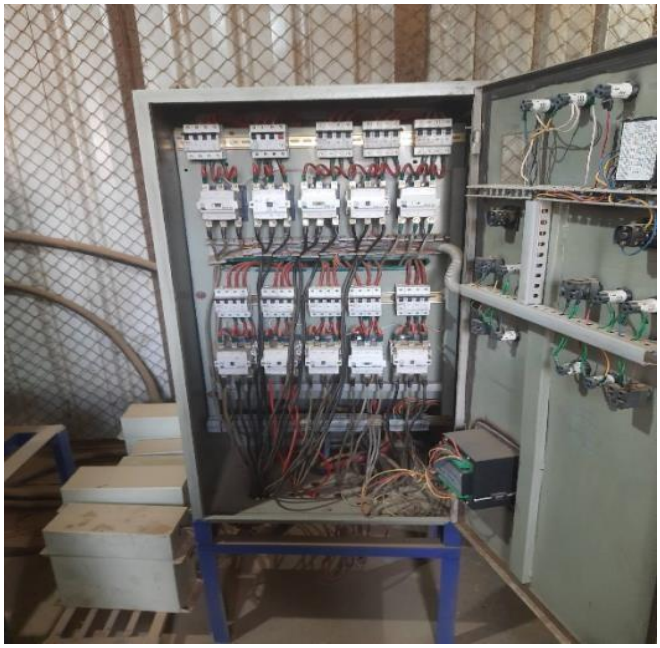

Fig : APFC panel

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Parameters	Description
Title	Improvement in PF from 0.987 to 0.995
Monthly saving kVAh	323
Annual Savings (Rs)	36941
Investment (Rs)	10000
Payback (Month)	3

Replace conventional street lights with LED Street light

It is observed that 150W halogen lights are installed in all 34 street lights

It is recommended to replace 150W halogen lights to 75W LED lights

We have considered a cost of LED lamp along with fitting charges to be Rs 4,500 per fixture. Expected annual saving is Rs 1,06,552

Parameters	Description
Title	Replace Street light with LED lights
No of street light fixture	34
Savings (kVAh)	11169
Savings Annual (Rs)	106552
Investment (Rs)	153000
Payback (Month)	17

Optimization of Suction Blower Operation:

There are suction blowers installed at packing area for sucking and carrying the spilled tobacco to the feeding hopper (one blower per line). It is observed that the blowers are operating continuously even when there is no tobacco in the bin. An operator pushes the spilled tobacco from packing machine, in the bins.

It is recommended to control the operation of the suctions blowers when there is material accumulated in the bins. The automation can be done using level sensor based operation of the blower

Parameters	Description
No of operating blowers	4
Savings (kWh)	73920
Savings (INR)	705197
Investment (INR)	400000
Payback (Month)	7

Reduction in Contract demand

There is also an opportunity in reducing the contract demand from 290kVA to 270kVA. Further reduction wont be possible as there is a 260kw installed solar plant as per your MSEDCL bill

Reducing sanction load to 270 will get down the billed M.D to 70% of contract demand since April 2023 =189.

Hence saving will be (203-189)*463 = 6482 Rs monthly =77,784 annually.

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Month	Billed demand (KVA)	MD(KVA)	Unit rate	Demand charge
Jun-22	189	165	454	85806
Jul-22	189	159	454	85806
Aug-22	189	171	454	85806
Sep-22	189	158	454	85806
Oct-22	189	175	454	85806
Nov-22	189	165	454	85806
Dec-22	189	171	454	85806
Total			454	600642
Avg.	189	166	454	85806
M.D Expected since april 2023	203	166	463	93989

The MD seems to be fluctuating throughout the months of June to December. It's highest in December at around 175 kVA and lowest in June at around 150 kVA.Shown in below Fig.

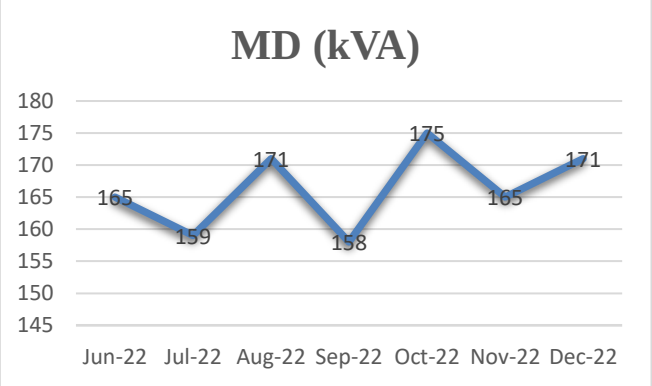

Fig :Graph of maximun demand

III. CONCLUSION

An energy audit serves as a vital instrument in crafting a comprehensive energy management strategy. Through a meticulous audit, industries can derive a plan to efficiently oversee their energy systems, minimizing costs while maximizing effectiveness. Similar to financial or production parameters, it's imperative to establish and consistently review norms throughout operations.

For audited industries, implementing measures like enhancing power factor to 0.995 using Automatic Power Factor Correction (APFC) panels can yield significant annual savings in billing costs. Similarly, reducing contract demand to 270kVA can result in substantial savings. Transitioning from halogen to LED street lights proves to be a cost-effective energy-saving measure, with the investment recouped within a short span of two years.

Optimizing the operation of suction blowers, ensuring they operate only when tobacco is present in the bin, presents a pragmatic approach for industries to combat escalating energy expenses. Additionally, such measures can yield ancillary benefits such as enhanced production, improved product quality, increased profitability, and, crucially, contribute to global energy conservation efforts.

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REFERENCES

[1]. Mendis, N. N. R., & Perera, N. (2006). *Energy Audit: A Case Study. 2006 International Conference on Information and Automation.* doi:10.1109/icinfa.2006.374149.

[2]. Isasare, M. S., & Zadey, S. A. (2016). *A case study: Energy audit at AVBRH, Sawangi (M), Wardha. 2016 International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT).* doi:10.1109/iceeot.2016.7754985

[3]. Magdum, P. S., Lokhande, S. R., Maskar, P. M., & Pharne, I. D. (2017). *A case study: Energy audit at commercial and educational building. 2017 IEEE International Conference on Power, Control, Signals and Instrumentation Engineering (ICPCSI).* doi:10.1109/icpcsi.2017.8391933

[4]. Chakraborty, A., Dey, D., & Das, P. (2018). *Investigation of Energy Consumption and Reservation Scheme using Energy Auditing Techniques. 2018 International Conference on Smart Systems and Inventive Technology (ICSSIT).* doi:10.1109/icssit.2018.8748724

[5]. Desai, U., Patel, J., Patel, J., Rana, A., & Vora, D. (2017). *Electrical energy audit in a Uka Tarsadia University — A case study. 2017 International Conference on Trends in Electronics and Informatics (ICEI).* doi:10.1109/icoei.2017.8300831

[6]. Malkovska, M., & Boychev, B. (2019). *Energy Audit of Buildings. 2019 11th Electrical Engineering Faculty Conference (BulEF).*

[7]. Jadhav, V., Jadhav, R., Magar, P., Kharat, S., & Bagwan, S. U. (2017). *Energy conservation through energy audit. 2017 International Conference on Trends in Electronics and Informatics (ICEI).* doi:10.1109/icoei.2017.8300974

[8]. Saravanakumar, R., Chetan, N., Chakaravarthy, P., Karthickkeyan, Rakesh, S., & Ramkiran. (2017). *M Energy audit report. 2017 Third International Conference on Advances in Electrical, Electronics, Information, Communication and Bio-Informatics (AEEICB).* doi:10.1109/aeeicb.2017.7972360

[9]. Kayalvizhi, S. B., Thenmalar, K., Raja, T., Gopal, S. B., Nanthiya, D., & Sreemanjari, S. (2021). *A Campus Energy Auditing in Energy Utilization and Conservation using Renewable Source. 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV).* doi:10.1109/icicv50876.2021.9388508

[10]. Bureau Of Energy Efficiency *www.bee-india.nic.in*