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Energy Audit Proposal for KR Flour Mill in Karnataka Davangere Region

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***Abstract* - This project presents an energy audit of a flour mill to analyse energy consumption and improve efficiency. Data is collected on a daily, monthly, and yearly basis to identify high energy usage areas. Key components such as motors and machinery are evaluated, and inefficient equipment is suggested for replacement with energy-efficient alternatives. Calculations are performed to estimate energy savings, replacement costs, and economic benefits. The study shows that proper component replacement reduces energy consumption and operating costs, making the system more efficient and cost-effective.**

Keywords – Energy, Carbon footprints, Energy patterns.

I. INTRODUCTION

Flour mills play a significant role in the food processing industry by converting raw grains such as wheat, rice, and maize into fine flour used for daily consumption. These mills rely heavily on electrical energy to operate various machines like pulverisers, conveyors, cleaning units, and motors. Among these, the pulveriser is a key machine responsible for grinding grains into fine powder, and it consumes a major portion of the total energy in the system. Due to continuous operation and heavy load conditions, flour mills often experience high energy consumption, which directly increases operational costs.

In many small and medium-scale flour mills, outdated equipment, poor maintenance practices, and lack of proper energy monitoring, lead to inefficient energy usage [1]. Energy losses occur due to factors such as oversized or inefficient motors, improper loading, mechanical friction, and poor power factor [2]. These inefficiencies not only increase electricity bills but also reduce the overall productivity and lifespan of the equipment [3]. Therefore, it becomes essential to analyse how energy is being used and identify areas where improvements can be made [4].

An energy audit is a systematic method used to evaluate energy consumption, identify losses, and recommend measures to improve efficiency. This project focuses on conducting a detailed energy audit of a flour mill, with special attention to the pulveriser and other major energy-consuming components. The study involves collecting and analysing energy consumption data on a daily, monthly, and yearly basis to understand usage patterns and peak demand conditions [5]. This helps in identifying which machines consume the most energy and where wastage occurs.

Based on the audit results, suitable energy-saving measures are proposed, including the replacement of inefficient components with energy-efficient alternatives [6]. Calculations are performed to compare the existing system with the proposed system in terms of power consumption, efficiency, and performance. Additionally, an economic analysis is carried out to determine the cost of replacement, expected energy savings, payback period, and overall financial benefits [7]. This ensures that the suggested improvements are not only technically effective but also economically feasible [8].

The main objective of this project is to reduce energy consumption, minimize operational costs, and improve the efficiency of the flour mill. By implementing proper energy management practices and upgrading key components like the pulveriser, significant energy savings can be achieved. This study highlights the importance of energy auditing in small-scale industries and demonstrates how systematic analysis and timely improvements can lead to sustainable and cost-effective operations [9].

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II. ENERGY USAGE OF INDUSTRY

TABLE I. ONE DAY CALCULATION

SL. NO	INCH	COMPONENTS	QUANTITY	HP	WATTAGE	DURATION	TOTAL POWER (1 DAY)
1	16	PEM-PO MACHINE	3	7.5	5.5*3=16.5KWH	5	82.5KWH
2	10	PULVER-RISER MACHINE	1	1.5	1.1*1=1.1 KWH	5	5.5KWH
3	12	PEM-PO MACHINE	1	3	2.2*1=2.2 KWH	5	11KWH
4	18	PEM-PO MACHINE	1	10	7.5*1= 7.5 KWH	5	37.5KWH
		ME STARTER (STAR-DELTA)	2		50*2=100 KWH	5	500W
6		TABLE FAN	1		50*1=50 W	5	250W
7		FLURO-SCENT LAMP	2		36*2=72 W	4	288W
8		LED BULB	2		9*2=18W	4	72W
9		KIRLOSKAR MOTOR	2	10	7.5*2=15 KWH	5	75KWH
10							TOTAL=212,61W

The above table I represents the daily power consumption of different machines and electrical components used in the flour mill industry. The total energy consumed per day is 212.61 kWh. Among all the equipment, the Pem-po machines and Kirloskar motors consume the highest amount of electricity.

A. About the Industry

The flour mill industry is selected for this energy audit project because it is one of the most common and essential small-scale industries, especially in local areas. It operates continuously to meet daily food requirements, which makes it a significant consumer of electrical energy.

Flour mills mainly use machines like pulverisers, motors, and conveyors that run for long hours. Due to this, even small inefficiencies can lead to high energy losses and increased electricity costs. Many of these mills use old or poorly maintained equipment, making them ideal for studying energy-saving opportunities.

Another important reason is that energy audits in such industries can provide practical and real-world benefits. By identifying energy wastage and suggesting efficient replacements, we can help reduce operating costs and improve performance. This also makes the project more useful and applicable compared to theoretical studies.

Additionally, flour mills are easy to study and analyse, as their working process is simple and data collection (daily, monthly, yearly energy use) is manageable. This allows accurate calculations for energy savings, cost benefits, and payback period.

Therefore, choosing the flour mill industry helps in understanding real industrial energy consumption and provides effective solutions for improving efficiency and reducing costs.

B. One Day & Yearly Calculations of Energy

TABLE II. ONE MONTH & ONE YEAR CALCULATION

212,610W=212.61KWH=212.61 UNITS

ONE MONTH (30DAYS)	6,378,300W	6378.300KWH
ONE YEAR (365DAYS)	77,602,650W	77602.650KWH

The flour mill consumes a total of 212.61 kWh (units) of electrical energy per day as shown in table II. Based on this consumption, the estimated monthly energy usage for 30 days is 6378.30 kWh, and the yearly energy consumption for 365 days is 77602.65 kWh.

III. EFFICIENT EQUIPMENT REPLACEMENT (WITH IN 1.5 LAKH)

TABLE III. ONE DAY CALCULATION

Sl. No	Inch	Components	Quantity	Hp	new wattage	Duration	Total power (1 day)
1	16	IE3 Pump +VFD	3	7.5	4.2*3=12.6kwh	5	63kwh
2	10	Efficient	1	1.	0.8kwh	5	4.0kwh

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		Pulver-riser		5			
3	12	IE3 Pump +VFD	1	3	1.7kwh	5	8.5kwh
4	18	IE3 Pump +VFD	1	10	5.8kwh	5	29kwh
5		VFD Drives (Energy Saving)	2		0.02*2= 0.04kwh	5	0.20kwh
6		BLDC Fan	1		0.03w	5	0.15w
7		LED Tube Light	2		0.02*2= 0.04w	4	0.16w
8		LED Bulb	2		0.007*2 =0.014w	4	0.056w
9		IE3 Kirloskar Motor +VFD	2	10	5.8*2=11.6kwh	5	58kwh
10							**Total=162,070w**

The improved flour mill system consumes 162.07 units/day of electricity as shown in table III. The estimated monthly consumption is 4862.1 units, and yearly consumption is 59155.5 units. This reduction in energy usage helps in lowering electricity cost and improving energy efficiency.

TABLE IV. ONE MONTH & ONE YEAR CALCULATION

162,070w=162.07kwh=162.07units			
One month (30 days)	4,862,100w	4862.1kwh	4862.1units
One year (365 days)	59,155,500w	59155.5kwh	59155.5units

The improved flour mill system consumes 162.07 units/day of electricity as shown in table IV. The estimated monthly consumption is 4862.1 units, and yearly consumption is 59155.5 units. This reduction in energy usage helps in lowering electricity cost and improving energy efficiency.

IV. NEW ELECTRICITY BILL CALCULATIONS

TABLE V. NEW ELECTRICITY BILL CALCULATION

Sl. No	Particulars	Calculation	Amount
1	Fixed Charges	20hp*150	3000.00
2	Energy Charges	400*4.5	1800.00
3	FPPCA Charges	400*0.47	188.00
4	P&G Charges	400*0.36	144.00
	Sub total		5132.00
5	TAX (9%)	5132*0.09	461.88
6	Interest (if any)	8.30	8.30
7	Arrears	1	1.00
	Final Payable Amount		Rs 5603

The table V shows the electricity bill calculation for the flour mill industry, the total bill amount is calculated by including fixed charges, energy charges, taxes, and additional charges, the final payable electricity bill amount is Rs. 5603.This calculation helps in understanding the overall electricity expenditure of the industry. It also helps in comparing old and new energy consumption for cost-saving analysis.

TABLE VI. SAVINGS DATA

Sl.no	Particulars	Old system	New system
1	Units/Month	489units	400units
2	Load	20hp	20hp
3	Tariff	LT5	LT5

The table VI represents the connected load for both systems is 20 HP under the LT5 tariff category. The new system reduces monthly power consumption from 489 units to 400 units. This reduction helps in improving energy efficiency and lowering electricity cost.

V. MONTHLY SAVINGS

TABLE VII. ENERGY SAVINGS

Sl.no	Particulars	Calculations	Value
1	Units Before	489units	489
2	Units After	400units	400
3	Saving	489-400	89units/Month

The table VII represents the electricity consumption before implementation was 489 units per month, which reduced to 400 units after implementing the new system. The monthly energy saving achieved is 89 units, calculated by subtracting 400 from 489 units. this reduction in power consumption helps in lowering electricity cost and improving overall energy efficiency.

TABLE VIII. COST SAVINGS

SL.NO	PARTICULARS	Calculations	Value
1	Old Bill		Rs5819
2	New Bill		Rs5603
3	Savings	5813-5603	Rs211/Month

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The table VIII represents the electricity bill of the old system was Rs. 5819, while the new system reduced the bill to Rs. 5603.The monthly savings achieved is approximately Rs. 211 through reduced power consumption and improved efficiency, this reduction in electricity cost helps in minimizing operating expenses and improving energy management.

TABLE IX. YEARLY SAVINGS

Sl.No	Particulars	Calculations	Value
1	Energy Savings	89*12	1068units/year
2	Cost Savings	211*12	Rs2532/year

The table IX represents the annual energy saving achieved by the new system is 1068 units, calculated from 89 units saved per month. The yearly electricity cost saving is Rs. 2532, based on monthly savings of Rs. 211. These savings indicate improved energy efficiency and reduced operating expenses over a year.

TABLE X. PERCENTAGE SAVINGS

Sl.No	Particulars	Calculations	Savings%
1	Efficiency	(211/5814) *100	3.6%

The table X represents the efficiency improvement of the new system is calculated based on the reduction in electricity cost by comparing the monthly savings of Rs. 211 with the old bill amount of Rs. 5814, the efficiency gain is obtained, the overall savings achieved through the new system is approximately 3.6%.

VI. CARBON FOOT PRINTS

TABLE XI. CARBON EMISSION MONTHLY

Sl.no	Particulars	Old system	New system
1	Units/Month	489kwh	400kwh
2	Emission Factor	0.82kg/kwh	0.82kg/kwh
3	CO2	489/0.082	400*0.082
	Total CO2	401kg	328kg

The table XI represents the comparison of carbon dioxide (CO_2) emissions between the old system and the new system the old system consumes 489 kWh/month and produces approximately 401 kg of CO_2 emissions. the new system consumes only 400 kWh/month and emits around 328 kg of CO_2.

Hence, the new system helps in reducing energy consumption and minimizes environmental pollution.

TABLE XII. CARBON EMISSION YEARLY

Sl.no	Particulars	Old system	New system
1	CO2/Month	401kg	328kg
2	CO2/Year	401*12	328*12
3	Total CO2	4812kg	3936kg

The table XII shows the yearly carbon emission comparison between the old system and the new system. The old system produces 401 kg of CO_2 per month, resulting in 4812 kg of yearly carbon emissions. the new system emits only 328 kg of CO_2 per month, which totals 3936 kg annually. Therefore, the new system significantly reduces yearly carbon emissions and supports a cleaner environment.

TABLE XIII. CARBON SAVINGS

Sl.no	Particulars	Calculations	Value
1	Monthly Savings	401-328	73kgCO2
2	Yearly Savings	4812-3936	876kgCO2

The table XIII represents the carbon emission savings achieved by replacing the old system with the new system. the monthly carbon saving is 73 kg of CO_2, calculated from the difference between old and new system emissions.

TABLE XIV. PERCENTAGE OF CARBON EMISSION REDUCTION

Sl.no	Particulars	Calculations	Reduction%
1	Efficiency	(73/401) *100	18.2%

The yearly carbon saving is 876 kg of CO_2, showing a significant reduction in environmental impact. hence, the new system contributes to energy conservation and promotes eco-friendly operation.

The table XIV shows the percentage reduction in carbon emissions achieved by the new system. The reduction efficiency is calculated by comparing the monthly carbon savings with the old system emissions. the system achieves an overall carbon emission reduction of 18.2%. This indicates improved energy efficiency and better environmental sustainability.

VII. CONCLUSION

The energy audit demonstrates that reducing consumption from 489 to 400 units lowers the electricity cost from ₹5814 to ₹5603, achieving measurable cost savings. Additionally, the system reduces annual carbon emissions by 876 kg CO_2, enhancing both operational efficiency and environmental sustainability. The improvement is achieved through better energy management and the use of efficient equipment, without compromising system performance. This highlights the importance of optimizing energy usage in reducing operating costs.

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