United Nations Industrial Development Organization

Global Environment Facility

Bureau Of Energy Efficiency

Detailed Energy Audit Report

M/s Haroon Works
Nagaur Handtools Cluster

Under GEF- UNIDO-BEE project

Promoting energy efficiency and renewable energy in selected MSME clusters in India

January 2016

pwc

Table of Contents

List of Tables

List of Figures

List of abbreviations

APFC	Automatic Power Factor Controller
AVVNL	Ajmer Vidyut Vitran Nigam Limited
BEE	Bureau of Energy Efficiency
DISCOM	Distribution Company
GEF	Global Environment Facility
HP	Horsepower
kCal	Kilo Calories
kVA	Kilo Volt Ampere
kVAr	Kilo Volt Ampere reactive
kW	Kilo Watt
kWh	Kilo Watt Hour
MSME	Micro, Small and Medium Enterprises
MT	Metric Tonne
PMU	Project Management Unit
UNIDO	United Nations Industrial Development Organization

Acknowledgement

We sincerely thank GEF- UNIDO-BEE for associating PricewaterhouseCoopers Private Limited (PwC) in its prestigious project “Promoting energy efficiency and renewable energy in selected MSME clusters in India” which involves developing and promoting market environment for introducing energy efficiencies in process applications in 12 selected energy-intensive MSME clusters in India. Nagaur handtools cluster is one of them.

We express our sincere gratitude to all following officials of GEF-UNIDO-BEE PMU for their valuable support and guidance during the project:-

- Mr. Milind Deore, Energy Economist, BEE
- Mr. Abhishek Nath, National Project Manager, UNIDO
- Mr. Niranjan Rao Deevela, National Technology Coordinator, UNIDO
- Mr. Ashish Sharma, Project Engineer, BEE

PwC is thankful to Nagaur Handtool Manufacturer’s Association for extending support for this assignment. We are also thankful to Mr. Mohammed Ishaq, Owner, Haroon Works and his team for giving full support during the energy audit. We would like to thank Mr. Rajiv Singhal, Cluster Leader, GEF-UNIDO-BEE Project for providing on-field support during the energy audit.

Executive Summary

Haroon Works is located in Kidwai Colony area of Nagaur and is involved in finishing of pliers. During the energy audit it was found that installation of cogged belt on load side of common shaft drive will result in significant energy savings.

S.No.	Energy Efficiency measure	Investment (INR)	Savings (INR)	Payback period (months)
1	Installation of cogged belt on common shaft drive	34573	15970	26

The details about the unit and description of energy conservation measures are discussed in appropriate sections of the report.

1. Project Background

1.1. Background of the project

GEF-UNIDO-BEE is developing and promoting market environment for introducing energy efficiencies in process applications in 12 selected energy-intensive MSME clusters in India which includes Nagaur handtool cluster also.

The overall motive of this assignment is to improve the productivity and competitiveness of units as well as to reduce overall carbon emissions and improve the local environment.

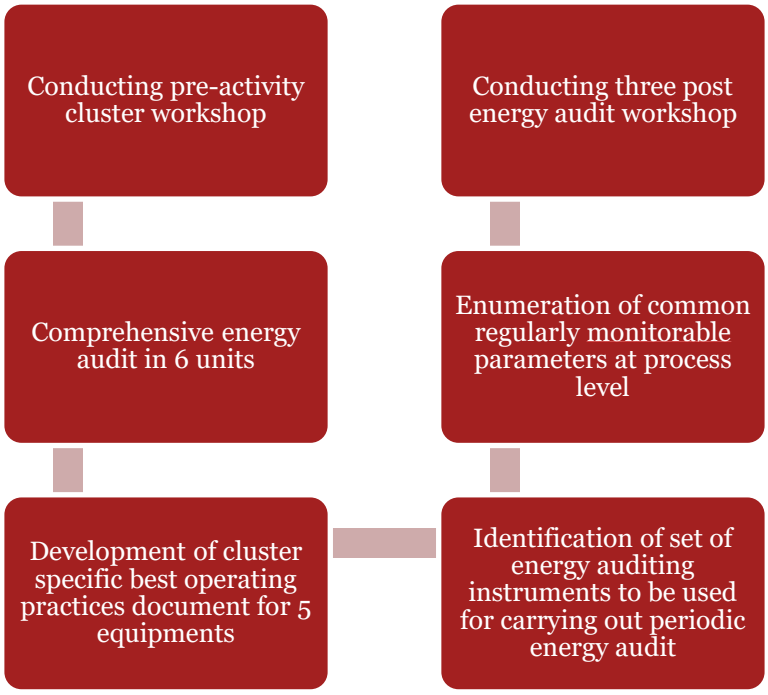
1.2. Introduction to assignment

Under GEF-UNIDO-BEE project 'Promoting energy efficiency and renewable energy in selected MSME clusters in India' India', PwC has been appointed for conducting activities of energy audit and dissemination in the Nagaur Handtools Cluster.

1.3. Scope of services

The activities being conducted by PwC under this assignment are shown at Figure 1.

Figure 1: Scope of services



This current report has been prepared under the task 2 of above scope of services i.e. conducting comprehensive energy audits in 6 units in the cluster.

2. Energy Audit at Haroon Works

2.1. Baseline information of Haroon Works

In order to assess the present energy consumption levels and possible energy efficiency measures at 'Haroon Works', basic and general information was collected during the audit conducted on 8th and 9th June 2015.

The details of energy audit of unit are provided below.

2.1.1. About the Unit

This unit is located in Kidwai Colony of Nagaur. The baseline profile of the unit is presented in Table 1.

Table 1: Baseline profile

Parameters	Details
Name of the unit	Haroon Works
Address of the unit	Kidwai Colony, Nagaur
Name & contact number of contact person	Mr. Mohammed Ishaq Mobile-9352911102
Date of Audit	8th and 9th June 2015
Raw material	Pliers
Final product	Finished Plier with holes, teeths, rivets and other fittings
Daily production	10,000 pieces
Operating hours/day	7 hours
Sanction load (Haroon Unit)	12 hp
Sanction load (Mohammed Ishaq Unit)	20 hp

2.2. Past electricity bill analysis

The electricity bills of unit are based on small industry tariff (LT-5) specified by AVVNL. The details of this tariff category are:

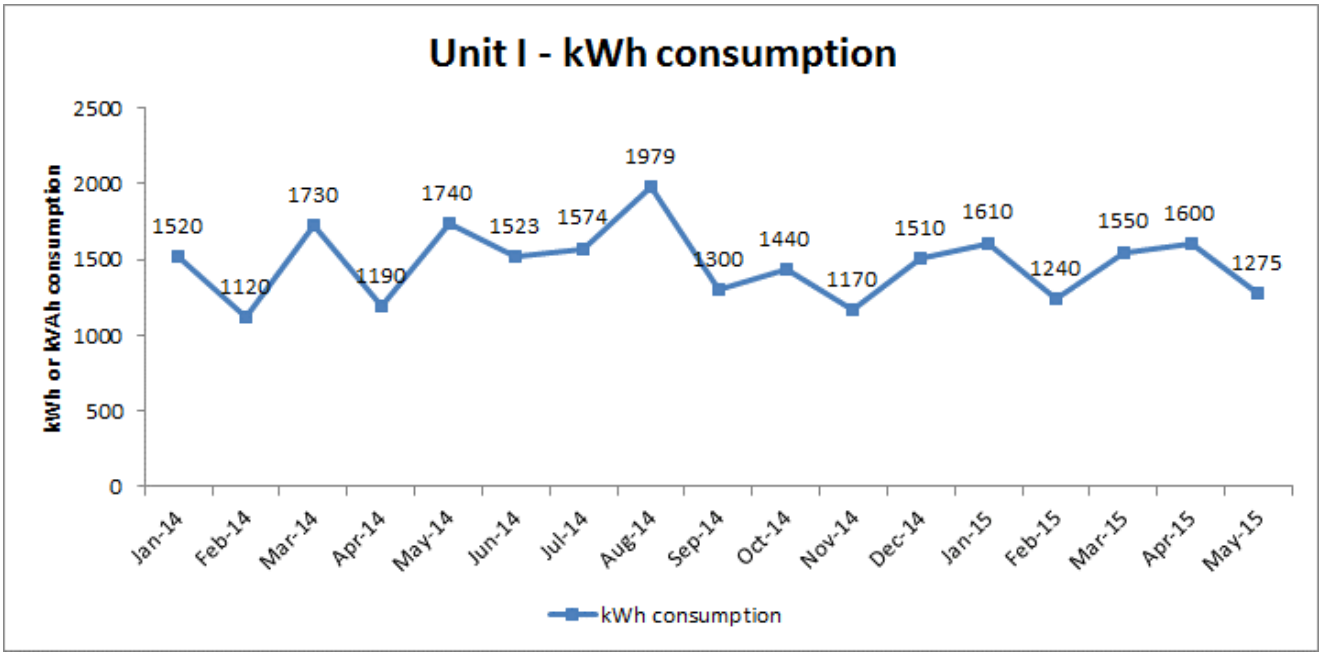
Table 2: Tariff description

Parameter	Specifications
Category description	Sanction load above 5 kW and not exceeding 25 hp
Fixed charges	INR 60/ kVA
Energy charges	INR 4.85/ kWh

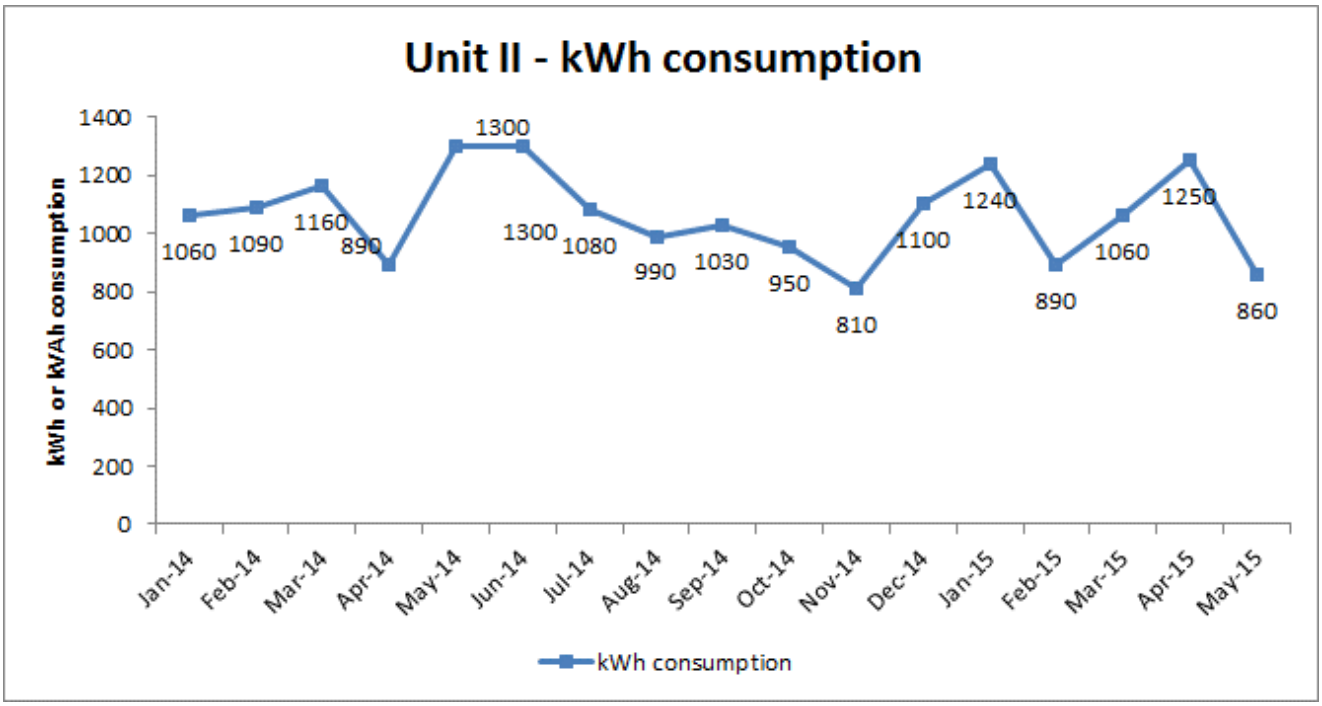
* Electricity tariff has been revised to INR 5.85 from March 2015

Electricity bills were collected from January 2014 to May 2015 for the purpose of analysis.

Figure 2: Energy consumption pattern



It can be inferred from above figure that the energy consumption is in the range of 1120 Kwh to 1740 Kwh. It peaked in month of Aug'14 to 1979, apart from which, energy consumption in every month was within the range. Further the average energy consumption, for the said period, is 1475 kWh/month.



It can be inferred from above figure that the energy consumption is in the range of 1300 Kwh to 810 Kwh. The average energy consumption, for the said period, is 1063 kWh/month.

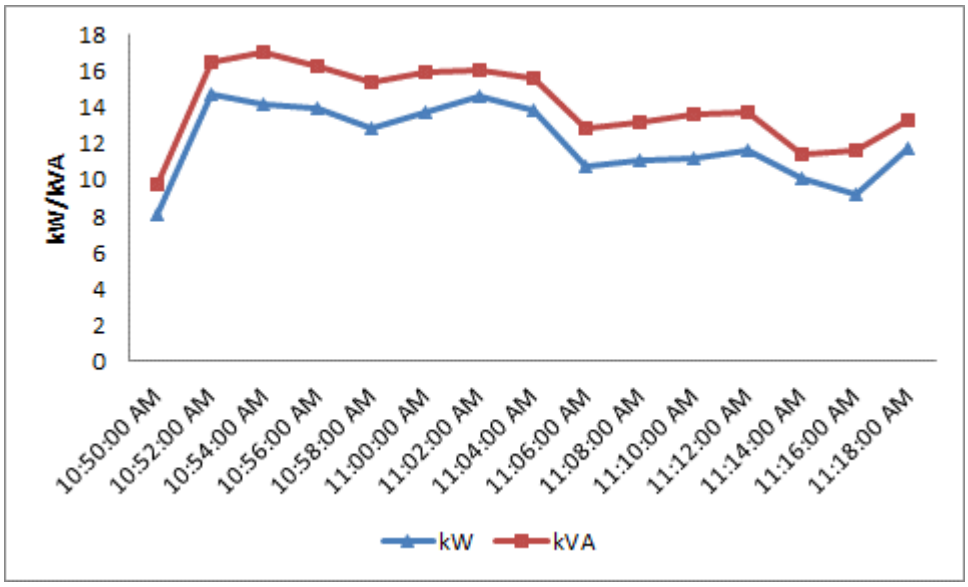
2.3. Load profile of Haroon Handtools

In order to derive the load profile of the unit, many electrical parameters were measured by using a sophisticated portable 3-phase power analyser (KRYKARD). During the audit, Unit-II was not operating and hence load profile was obtained for Unit-I.

2.3.1. Load (kW) and apparent power (kVA) profile

Load profile and apparent power profile is a graph of the variation in the electrical load versus time. In any electrical system, the vector sum of the active power (kW) and reactive power (kVAr) make up the total (or apparent) power (kVA) used. This is the power generated by a generation station for the user to perform a given amount of work. Total Power is measured in kVA (Kilo Volts-Amperes) and the load or active power is measured in kW (kilowatts) and they become equal as and when the power factor approaches unity. Total electricity charges (units and demand) are based on the load or active power (kW) and apparent power (kVA).

Figure 3: Active power (Load) and apparent power profile during audit



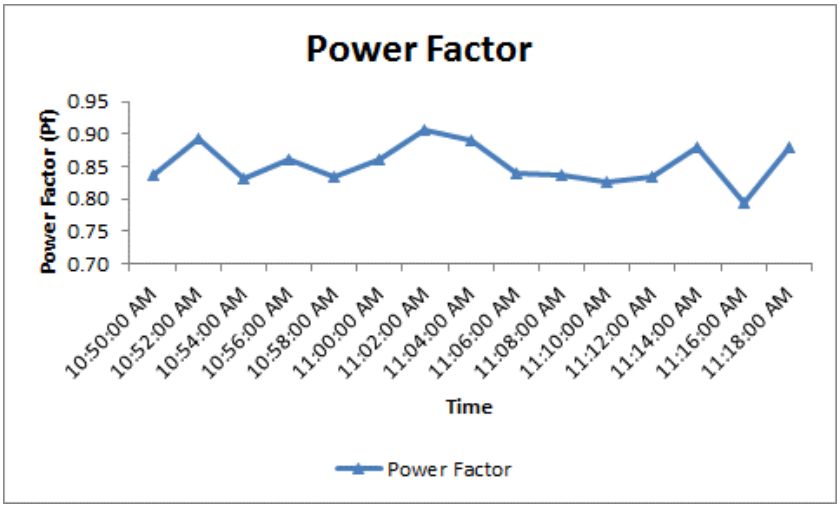
Observations made from the above graph:

- The maximum input power drawn by the unit is 14.7 kW.
- Apparent power curve (kVA) line is significantly above the active power (kW) line indicating that power factor is on lower side.

2.3.2. Power factor profile of the unit

Power factor is an important parameter for the unit since its billing is based on kVAh wherein power factor plays a major role. Also, DISCOM's supplying power to the units impose power factor surcharge on the bills in case the power factor is below 0.90. The following graph captures the power factor profile of the unit:

Figure 5: Power factor profile during audit



Observations made from the above graph:

- The power factor of the unit is on lower side with maximum power factor being at 0.91
- The unit may consider installing capacitor banks for improving the power factor so that they do not get charged with power factor surcharge.

3. Energy Conservation Measures

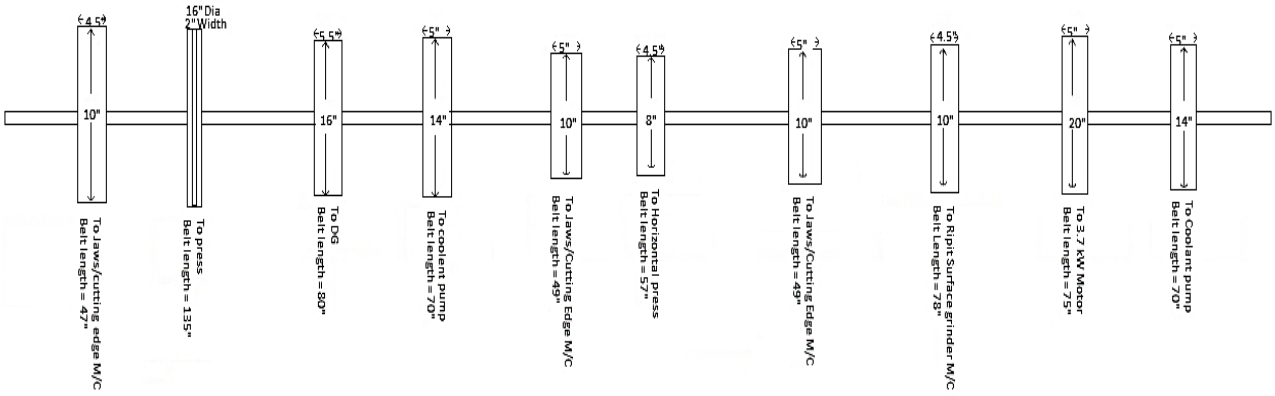
During the energy audit, we identified that installation of cogged belt on load side will be beneficial for the unit in terms of energy consumption. We have analysed this measure next.

3.1. Installation of cogged belt on load side and poly-V belt on common shaft drive side

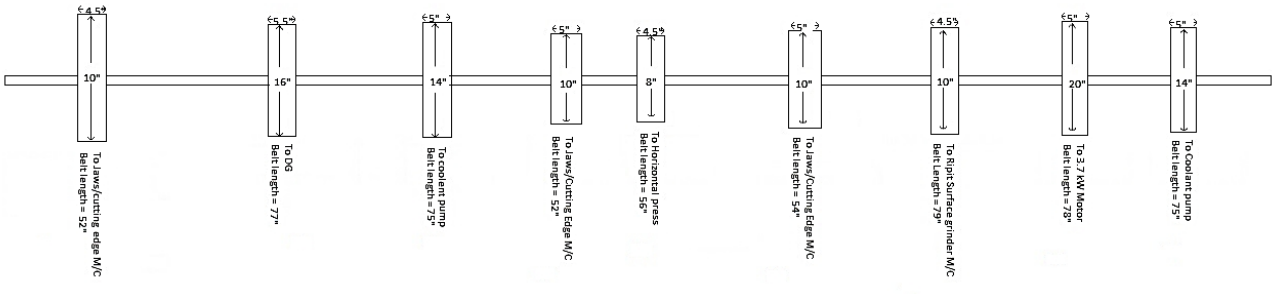
Recommendation

Since the drive system in the unit is based on common shaft and different belts give input to other loads in the unit. Presently, the unit is flat belts on load side. However, if we replace existing belts with V-belt on load side then it will give significant savings in electricity consumption of common drive motor as well as lower slippage losses.

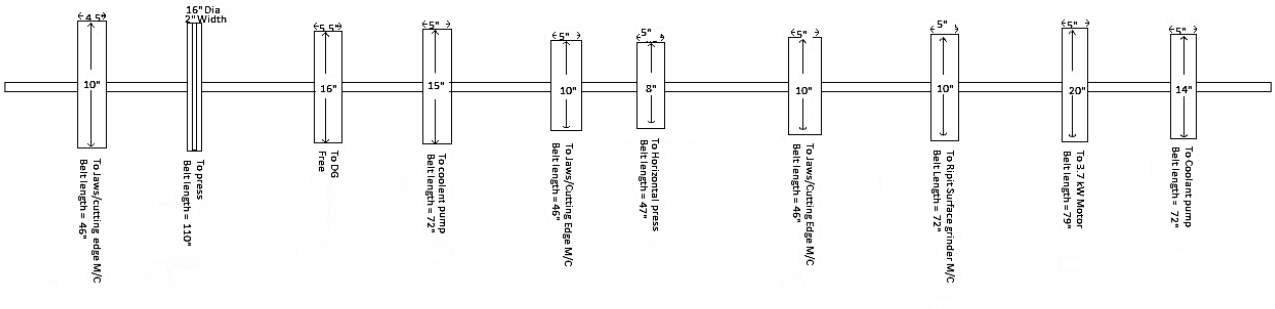
The existing scenario is shown below.



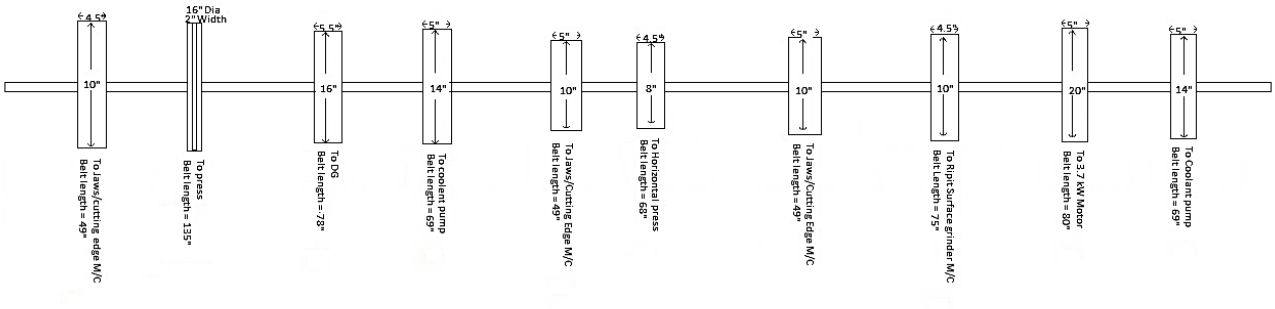
Mohd. Haroon Karkhana - I



Mohd. Haroon Karkhana - II



Mohd. Haroon Karkhana - III



Mohd. Haroon Karkhana - IV

Energy and financial savings

The following parameters and assumptions have been considered to estimate the energy savings and financial viability of this option:

Table 3: Installation of cogged belt on load side of common shaft drive side - Assumptions and parameters considered for estimation of energy and financial savings

Assumptions and Input parameters		
Assumptions		
Particulars	Unit	Value
Efficiency of V-belt	%	0.85
Efficiency of normal belt	%	0.8
Efficiency of poly V-belt	%	0.92
Efficiency of cogged belt	%	0.85
Hours of operation per day	Hours	7
Annual operation days	Days	300
Tariff	INR/kWh	5.85
Present Scenario		
kW consumed	kW	10
kW at drive shaft	kW	8.5
kW at load	kW	6.8

Proposed scenario		
kW consumed	kW	8.7
kW at drive shaft	kW	8
kW at load	kW	6.8
Cost elements		
Cost of total 59.1 feet cogged belt type “C” for Haroon Karkhana 1	INR	6932
Cost of total 49.8 feet cogged belt type “C” for Haroon Karkhana 2	INR	5845
Cost of total 49.1 feet cogged belt type “C” for Haroon Karkhana 3	INR	5767
Cost of total 60.1 feet cogged belt type “C” for Haroon Karkhana 4	INR	7048
Installation of pulleys of appropriate size	INR	8980
Total cost	INR	34573
Benefits		
Power savings	kW	1.30
Annual electricity savings	kWh/annum	2730
Monetary electricity savings	INR	15970
Simple payback period	Months	26

The implementation of this recommendation will help Haroon Works to save around INR 15970 per year by installing cogged belts with an investment of INR 34573. The simple payback period of this investment is around 26 months.

Annexure A: List of Energy Audit Instruments

PwC has multiple energy audit instruments kits. All the instruments are of have high quality, precision and are periodically calibrated. The instruments are capable to cover all electrical and thermal measurements required in the plants. A list of instruments used by PwC during the audit are shown below:

S. No.	Name of the Instrument	Make	Quantity Used
Electrical Instruments			
1	3-phase Power Analyzer	Circutor and Extech	3

DISCLAIMER:

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