POTENTIAL ASSESSMENT STUDY AT TRISHUL FORGING, PUNE.

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Trishul Forging has an average energy bill of Rs. 45 Lacs per year. Through this energy audit, ECPL has assessed a potential to reduce this bill by at least 15 Lac per annum. The investment proposed shall have an attractive payback of less than two years. The modular investment plan has minimum investment requirement of upto 15 Lacs for demonstration of results.

TABLE OF CONTENTS

PROJECT INTRODUCTION & PREAMBLE:

The efficient use of energy is one of the most important sustainable solutions that allows for economic growth while mitigating green house gas emissions, a key contributor to climate change. The Bureau of Energy Efficiency (**BEE**), Government of India, has taken a lead role in implementing programs to improve energy efficiency, which is one of the key missions of the **GOI** National Climate Change Action Plan.

Despite overall Indian reductions in aggregate energy intensity, the **SME** sector has fallen behind certain larger Indian industry benchmarks in terms of productivity, technology upgradation and energy efficiency (**EE**). While **EE** projects can offer very attractive returns and banks and institutions in India are increasingly willing to finance such **EE** projects, they have not become the norm in Indian **SME** sector despite the best efforts of numerous institutions and organizations over the years. There are clearly several issues/barriers that still need to be addressed before widespread **EE** adoption by **SMEs** is a reality.

The World Bank (**WB**), in conjunction with implementing partner **BEE**, is preparing a new Initiative on **Financing Energy Efficiency in SME** industrial clusters to help overcome some of these barriers. The main objective of this initiative is to improve energy efficiency and reduce **GHG** emissions from Small and Medium Enterprises utilizing increased commercial financing. The project will systematically support development of a large number of **EE** investment proposals under a programmatic approach to aggregate demand for **EE** investment in selected **SME** industrial clusters and will work to create a sustainable mechanism for identifying, preparing and financing these proposals at the local level. The above initiative envisions supporting certain specific industrial clusters in India through provision of assistance for completion of energy audits, preparation of DPRs and support in mobilization of financing from the Indian local banks to ensure that the identified EE measures are implemented. The ultimate goal of the project is to support development of a large portfolio of **EE** projects in the selected clusters, and help improve market acceptance (both by SMEs and local banks) for this type of product.

World Bank (**WB**) has decided to retain the services of Energetic consulting Pvt. Limited (**ECPL**), an audit firm of repute (3 year award winner of MEDA for excellence in Energy audit area), for providing **EE** facilitation assistance to 5 **SME** units under the proposed **WB** scheme. **ECPL** is required to carry out 5 Potential assessment studies (**PAS**) and then carry out Detailed Energy Audits and develop Investment Grade Detailed Project reports (**DPR**) in 2 **SME** units out of 5 **PAS**. **ECPL** shall also assist the select units in preparation of application to be submitted to banks, if so desired by the units. **WB**'s ultimate objective is to develop bankable **EE** projects in 2 units (with capital expenditure of Rs. 25 Lacs or more) with simple payback period not more than 2 years for the aggregated **EE** measures and ensure that the projects are implemented and units start saving on their energy cost in most cost effective manner. **ECPL** is committed to provide advisory services to the select units during the entire project development cycle till commissioning. WB then proposes to scale up the entire efforts to @ 150 **PAS** and develop @100 bankable **EE** projects for implementation in Forging units in Pune region.

Under the proposed project **WB** will provide entire facilitation, **at its own cost**, to select **SME** units, to address the current gap between energy auditors and bank loan officers and will demonstrate a viable mechanism of synergic tie up between **SMEs**, energy auditors, financial analysts/chartered accountants, local associations and local bankers. The project will also provide complete information on current **EE** lending schemes of Indian banks, to assist the **SME** units to take well informed decision for financing the **EE** project. The ultimate financing choice for identified investments under this project will be demand driven, and participating **SME** units will be free to obtain financing from any of the sources available to them- including their existing banks, new banks who are participating in the **GEF** Project, or other internal/external sources.

A stakeholder workshop was organized by Association to present this new initiative and to solicit response from key SME Forging units in Pune region to participate actively in this WB initiative and take the advantage of soft costs being supported by WB/GEF project to implement the EE project in the SME unit, subject to off course, it being techno-commercially attractive.

FACILITY DESCRIPTION:

Trishul Forging, Chichwad, Pune, is one of the leading manufacturing firms having production capacity of average 50 MT per month. The facility mainly has forging furnaces (3 number fuel oil fired), heat treatment furnaces (2 numbers) where thermal energy is used. Furnace oil is used for forging and heat treatment applications and heat treatment furnaces are not used continuously.

Electrical facility comprises of air compressors of total 30 HP and 1No. X 1 Tone and 1 No. X 0.5 Tone additional hammers. Transformer capacity is 250 kVA and average power factor is 1. Auxiliary system comprises of water pumps, blowers, shot blasting machines, and lighting.

The facility has a machine shop where large numbers of small motors are used for individual machines with some of the machines having hydraulic systems.

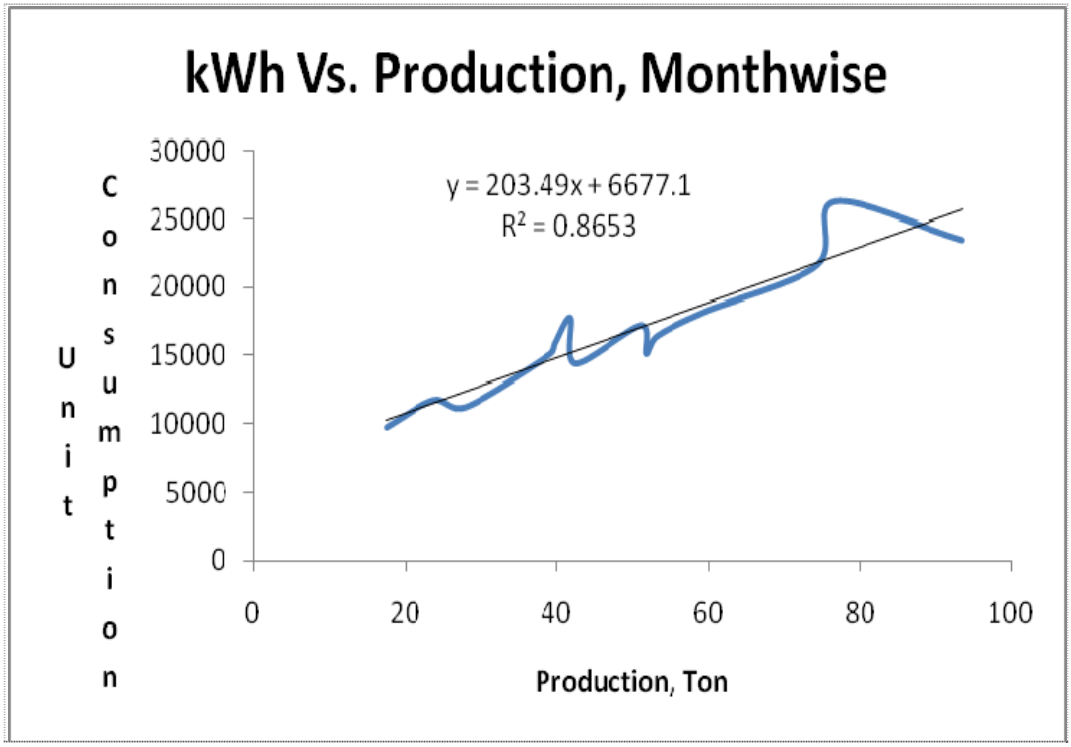
PRESENT ENERGY SCENARIO:

Following table shows energy consumption and production in the two units of the plant.

Year	Month	Net Production	Power		Furnace Oil		
					Plant		
			Total	per Ton	Total	Production	per Ton
		Tones	kWh	kWh	liters	Tones	liters
2008	January	93.53	23500	251	21390	93.41	229
	February	76.781	26338	343	21040	76.79	274
	March	74.359	21644	291	22040	74.46	296
	April	53.257	16434	309	15730	53.32	295
	May	42.47	14418	339	12590	42.53	296
	June	59.456	18226	307	14880	59.52	250
	July	51.85	15140	292	12350	51.89	238
	August	39.78	15874	399	13920	39.77	350
	September	39.171	15130	386	14260	39.18	364
	October	51.086	17238	337	15130	51.11	296
	November	28.002	11236	401	13635	28.00	487
	December	41.798	17806	426	17530	41.84	419
2009	January	17.603	9728	553	7815	17.60	444
	February	23.791	11770	495	12650	23.78	532

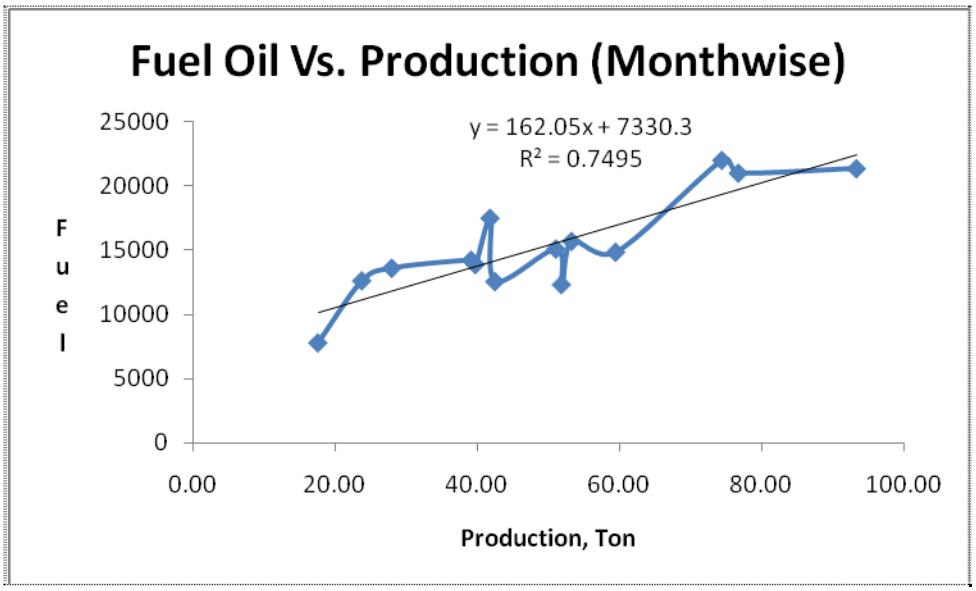
ANALYSIS OF DATA:

The production volumes have changed during the period from a level of 94 MT per month to 18 MT per month. Due to these drastic variations, there is no definite trend in the electrical energy consumption. The regression coefficient (R^2) is low (0.86), which means that the data is not representative.



It is evident from the graph that the fixed electrical energy consumption is to the extent of 6671 kWh which is very high for lower production volumes. It is necessary to minimize fixed consumptions in electrical energy.

The fixed oil consumption of the plant is 7330 and variable consumption is 162 liters per ton. Looking at overall oil consumption, 15354 liters per month is very reasonable at higher throughputs but at lower levels, it amounts to 50% of the total oil consumption. The regression coefficient (R^2) is 0.75, which means that the data is not representative. One of the reasons of large variations in the data could be that the fuel consumption figures do not distinguish between fuel consumed by forging furnaces and fuel consumed by heat treatment furnaces. The error due to that is reflected on fuel analysis.



Average overall specific energy consumption is 341 liters/Ton. Considering that the theoretical requirement of heat for metal heating is not more than 20 Liters per ton, 85% of the heat from variable energy is wasted in stack losses which are propotional to the fuel firing(and finally production volume).

RECOMMENDATIONS:

Energy conservation opportunities in forging industry are centered on basic concepts of improving energy efficiency by recouping waste heat from hot gases. There is another way to reduce energy cost by substituting fuel oil or LDO by cheaper fuel like coal or briquettes.

Alternatively, overall system efficiency can be improved by shifting to electrical forging and captive generation of electricity by using Fuel Oil fired generator sets. Though highly capital intensive this option has substantial energy conservation potential. Following chapter provides energy saving potential of each of the ideas and also their budgetary cost benefit analysis:

1. **Waste Heat Recovery though recuperator:**

   Flue gases coming out of the furnace are at 1000 deg C and are vented to the atmosphere. There is a common chimney through which all the furnace exhausts are connected.

   It is recommended to install a recuperator to recoup waste heat and utilize it in the furnace through combustion air preheating. It is possible to increase temperature of the combustion air from ambient upto 500 deg C. This combustion air shall then require lesser fuel to achieve desired temperatures, thus resulting in energy conservation.

   Design basis of 50 liters of oil per hour is considered for computation of energy conservation potential and investment analysis. Typical production output from the furnace shall be 0.5 MT/shift or 1.5 MT per day. The recuperator installation is expected to reduce the oil consumption to 38 liters per hour expected to result in 12 liters of FO saving per hour. Specific fuel consumption per ton shall thus reduce from 341 liters/ton to 256 liters per ton. For average production volume of 1.5 MT per day the savings amount to 128 liters per day. Considering 250 working days per year of the furnace and Rs. 18 per liter of FO, the annual energy savings go upto Rs. 5.74 Lacs per annum **or Rs. 1500 per MT**.

   Capital investment proposed shall be in the range of 9 Lacs and the simple payback period is expected to be 18 months.

Energy saving potential estimation in forging furnaces based on past 12 months

Year	Month	Furnace Oil					
		Present Fule Consumption, Liters	Present Production, ton	Present specific Fuel Consumption, liters/ton	Propose specific fuel Consumption, Liters/ton	Saving Potential, Ltrs./month	Saving Potential, Rs./month
2008	January	21390	93.41	229	256	-2522	-45395
	February	21040	76.79	274	256	1382	24879
	March	22040	74.46	296	256	2978	53611
	April	15730	53.32	295	256	2080	37432
	May	12590	42.53	296	256	1701	30624
	June	14880	59.52	250	256	-357	-6428
	July	12350	51.89	238	256	-934	-16813
	August	13920	39.77	350	256	3739	67293
	September	14260	39.18	364	256	4231	76158
	October	15130	51.11	296	256	2045	36803
	November	13635	28	487	256	6468	116415
	December	17530	41.84	419	256	6820	122752
2009	January	7815	17.6	444	256	3309	59563
	February	12650	23.78	532	256	6563	118130

From the above table it is seen that the overall potential to save is in the range of Rs. 6.75 Lacs per annum. Considering the new furnaces having potential to forge 1.5 MT per day, two such furnaces can deliver the desired output. Capital investment for two furnaces shall be Rs. 18 Lacs and simple payback period shall be 32 months.

2. Energy cost reduction through Producer Gas:

Furnace oil, as a fuel can be replaced by coal fired Producer Gas. This gas, which is mixture of carbon Monoxide and Hydrogen, is generated at site by incomplete combustion of coal. There are several advantages of PG over furnace oil viz;

1. Reduction in fuel cost
2. Downsizing of furnace and making it compact thereby reducing radiation losses and improving furnace efficiency
3. Reduction in scaling losses of metal due to clean combustion with less excess air

Once again, design basis of 15 liters of oil per hour is considered for computation of energy conservation potential and investment analysis. Typical production output from the furnace shall be 0.5 MT/shift or 1.5 MT per day. Imported coal is considered as replacement fuel and the PG plant capacity after recuperator installation is expected to be equivalent to 1.0 MT of coal per day. Cost of imported coal shall be Rs. 4500/- per day (@Rs. 4.5 per kg) as against equivalent Furnace oil cost of Rs. 6,480/- per day (@Rs. 18 per liter). The average production volume considered is 1.5 MT per day, and the savings amounts to Rs. 1980/- per day or equivalent to **Rs. 1320 per MT**. Considering 250 working days per year of the furnace the annual energy savings go upto Rs. 5.00 Lacs per annum. ***Please note that this saving is over and above the Rs. 6.75 Lacs saving expected out of recuperator.***

Capital investment proposed shall be in the range of 7 Lacs and the simple payback period is expected to be 17 months.

Overall, the FO consumption is expected to reduce to 150 MT per annum due to recuperator and lower production volumes compared to previous year. Equivalent imported coal consumption is expected to be 420 MT if PG is considered as fuel. Cost reduction potential due to implementation of this suggestion is expected to be Rs. 8.10 Lacs per annum. Though exact investment can be calculated only after knowing number of furnaces (or PG plants), an estimation of 2 furnaces and PGs works out to be Rs. 14 Lacs. The simple payback works out to be slightly more than one and half year.

3. Lighting energy controller:

The plant lighting load is around 8.38 kW (based on the data provided by plant personnel) which corresponds to 15 kVA equivalent load. Considering 12 hours per day of light burning hours, the average energy bill of lighting would be Rs. 1.5 Lacs per annum out of which 25% can be reduced by installing lighting controller panel on the lighting feeders. Typical cost of the system would be Rs. 0.65 Lacs depending upon number of panels required. The payback period is expected to be in the range of 20 months or less. Vendors have been informed to contact facility and provide exact quotation.

4. Oxygen enrichment of air:

This is one of the proven techniques to improve efficiency of furnaces, particularly where the temperature requirements are above 600 deg C. Conceptually, every kg of oxygen required for combustion is associated with 3.27 kg of nitrogen in air. This nitrogen does not contribute to chemical reaction with carbon from fuel but carries heat at very high temperature (around 1000 deg C) amounting to huge heat loss.

It is possible to enrich atmospheric air oxygen content from 23.6% to 35% thereby reducing energy loss by 15%. Cost benefit analysis of this suggestion can be worked out only after detailed study as nitrogen separated from air is available to replace compressed air and composite benefit should be considered.

CONCLUSION

There are several opportunities for the units to reduce their energy cost substantially. Innovation would be the essence of such implementation project. Demonstration projects shall be implemented in this phase of pilot study and the benefits shall be showcased.

Summary of all ideas for energy conservation are as follows:

Particulars Of Proposed Recommendation	**Investment, Rs. Lacs**	**Energy Saving potential, Rs. Lacs**	**Simple Payback, Months**	**GHG Reduction Potential, ton of CO_2**
Waste Heat Recovery though recuperator	15	6.75	27	94
Energy cost reduction through Producer Gas	14	8.10	21	NA
Lighting energy controller	0.65	0.38	21	NA
Oxygen enrichment of air	NOT QUANTIFIED			

Though the figures indicated in the savings and investment column are fairly indicative, the basis of calculations is data provided by the unit. It is essential to verify the data through detailed measurements by auditors at the DPR stage and design the solutions in consultation with the plant management.