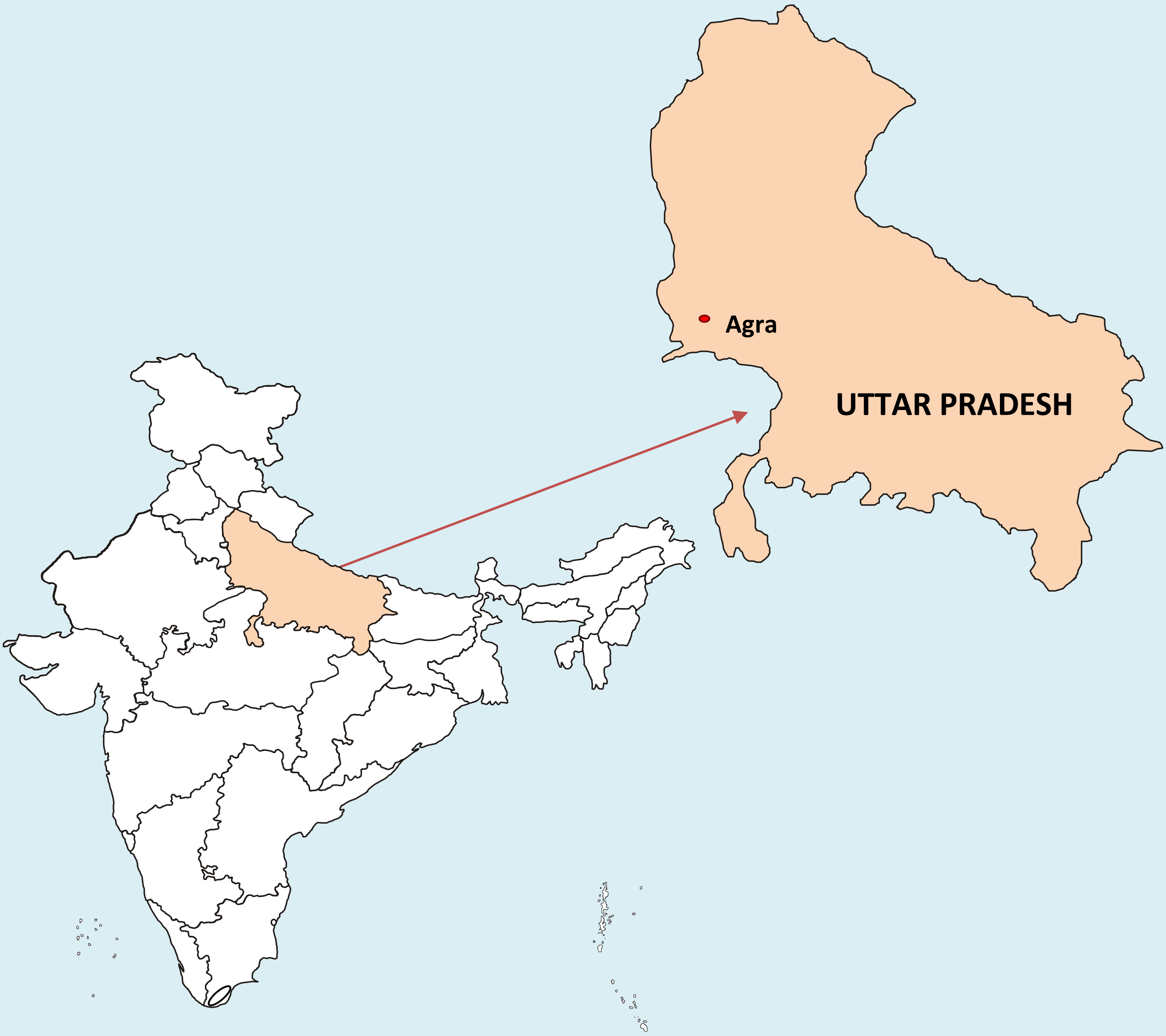
Cluster Profile
Agra footwear industries







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Certificate of originality

Original work of TERI done under the project "INDIA: TERI-SDC Partnership: Scaling up Energy Efficient Technologies in Small Enterprises (EESE)"

Suggested format for citation

TERI. 2015
Cluster Profile Report – Agra footwear industries
New Delhi: The Energy and Resources Institute 10 pp.
[Project Report No. 2014IE15]

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Published by

T E R I Press
The Energy and Resources Institute
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi-110 003
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Acknowledgements

TERI places on record its sincere thanks to the Swiss Agency for Development and Cooperation (SDC) for supporting the long-term partnership project focusing on energy intensive MSME clusters in India.

TERI team is indebted to MSME-DI, Agra for facilitating field visits to footware industries in Agra. TERI places on record the support provided by Mr R K Kapoor, Deputy Director and Mr P K Singhal, Assistant Director of MSME-Development Institute, Ministry of MSME, Agra.

TERI extends its sincere thanks to Mr Jatin Agarwal - Bhagwati Plastic (India), Mr. Deepak Manchanda - Top Lasts, Mr Mayank Agarwal – Rupmaya Shoe Lasts, and Mr Shantanu Chandra - Chandra & Associates Leather Industries, Mr Virendra Mahajan and Bharat Mahajan – Weston Rubber Industries for sharing information on the processes and energy consumption during field visits.

Last but not least, the interactions with MSME entrepreneurs and other key stakeholders in the cluster for providing valuable data and inputs that helped in cluster analysis.

Agra footwear industries

Overview of cluster

Agra is one of the prominent footwear component clusters in the country. There are about 200 industries engaged in production of various types of footwear components. The production meets both domestic requirements as well as exports. The footwear industries are located either in Foundry Nagar or Industrial Area Sikandra around Agra town. About 75% of the units are unorganized and unregistered. About 25% of the units are registered under small category. The footwear component industries are estimated to provide employment for about 4000 people. Majority of them is associated with heels and sole manufacturing industries.

Product types and production capacities

The primary sources of raw material for plastic shoe component products are petrochemical industries. Depending upon the type, quality and source, the cost of different raw materials varies in the range of Rs 110-350 per kg. These industries use one or more of the following raw materials in their production processes depending upon the target production. ABS is one of the most expensive raw materials, which costs about Rs 350 per kilogram and is generally sourced from Bayer and Lloyd. Different sources of major raw materials are shown in the table.

- High Density Poly Ethylene (HDPE)
- Polypropylene (PP)
- Polyvinyl Chloride (PVC)
- Thermoplastic Elastomers (TPE)
- Thermoplastic Rubber (TPR)
- Acrylonitrile Butadiene Styrene (ABS)
- Thermoplastic Polyurethanes (TPU or TPE-U)
- Natural rubber
- Styrene-Butadiene Rubber (SBR)
- Tanned leather

Sources of raw materials of plastic products

Raw material	GAIL	Haldia	IOCL	IPCL	Reliance
HDPE	✓	✓	✓	✓	✓
PVC	-	-	-	✓	✓
PP	✓	✓	✓	✓	✓

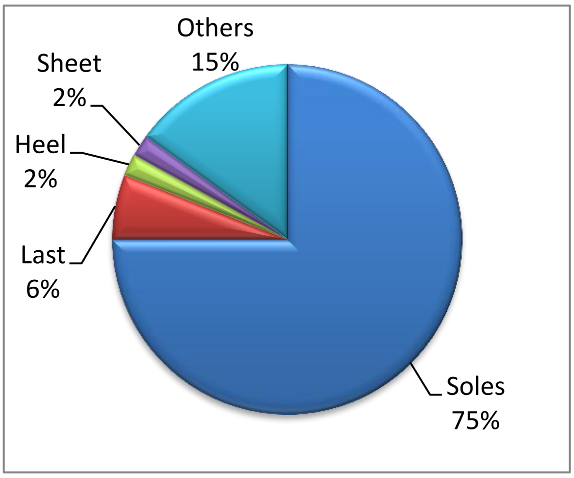
The footwear component industries cater to a wide range of end-use industries in footwear sectors located within Agra as well as other parts of the country such as Kanpur, Kolkata and Chennai. The main products from Agra footwear cluster include the following.

- Soles
- Lasts
- Rubber and plastic sheets
- Heels
- Top lifts

Agra footwear industries

- Laces
- Thread
- Belt
- Assorted raw material

About 85% of the units are engaged in making four primary products such as soles, lasts, heels and shoe sheets. The production and installed capacity of industries engaged in similar type of products vary from one unit to another. The actual production from a unit depends on market conditions and hence varies widely. Table provides approximate details on number of units, aggregate production and energy consumption by a particular type of product in the cluster.



Product share

Production of footware

Product	Number of units	Production (tonne/year)
Plastic sole	150	37,200
Shoe last	12	3,402
Leather sole	3	12,85,200
Plastic heel	20	48,00,000
Shoe sheet	20	4,740
Total	205	61,30,542

Energy scenario in the cluster

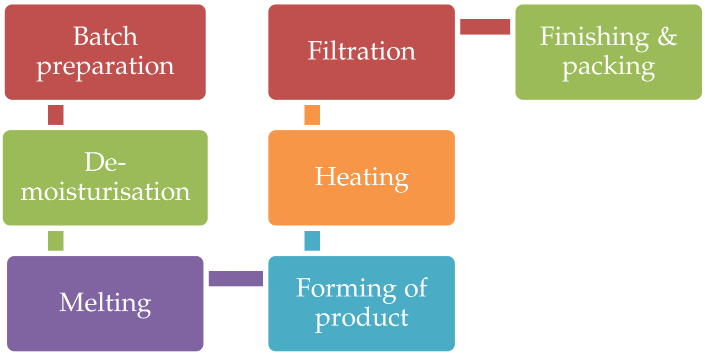
Electricity is the main are the major sources of energy in steel rerolling mills in Mandi Gobindgarh. Coal is sourced from Assam. Grid based electricity is used by rerolling units, supplied by the Punjab State Power Corporation Limited.

Prices of major energy sources

Type	Price
Coal	Rs 14,000 per tonne
Electricity	Average Energy charge : Rs 6.10 per kWh

Production process

The shoe component products are made using intermittently through moulding process – either injection moulding or press moulding. In moulding process, the ready-to-shape batch material is injected into the pre-shaped mould to produce the target products in one step. In press moulding, batch preparation and initial forming to prepare the ready-to-shape sheet material takes place in dispersion needle and mixing mill before it is given a final shape by hydraulic press. Both methods follow broadly similar primary steps such as preparation of ready-to-shape batch, forming and finishing operations. The generic process steps of manufacturing plastic footwear components products are explained below. The generic production steps for plastic products are shown in figure.



Generic process steps in plastic industries

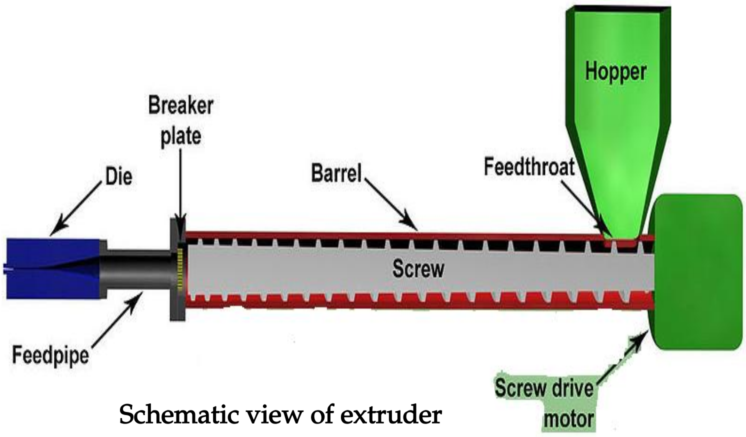
- *Batch preparation*: Fresh raw material - granules, recycled shop floor reject material, colouring batch master and relevant additives are mixed and appropriately grinded.
- *De-moisturising:* The moisture from prepared batch is removed in this step. The final batch composition is transferred either manually or automatically to hopper.
- *Filtration:* Contamination present, if any, in the batch is removed using both filtering element and demagnetiser. Filtration is also carried out again after melting of raw material batch before being fed into the barrel.
- *Melting and heating:* Temperature of dry composition is increased to change the solid phase to liquid phase while it is conveyed through barrel with the help of barrel screw. Temperature of the molten batch is further increased to pre-set temperature with the help of PID based automatic electrical heater placed on the barrel surface.
- *Forming:* Depending upon the end product, forming is done using appropriate shaping mechanism such as injection moulding or press moulding and drawing.
- *Finishing:* It includes all operations carried out after forming to final product such as stretching, sizing, burr removal, printing & embossing, flattening, lamination, stitching, etc.
- *Packaging:* The final marketable products are packed as per marketing and despatch.

Technologies employed

The plastic footwear component industries use product based forming technology like injection mould, press moulding and extruder (for granule production from recycle material) along with connected auxiliary equipment as required for smooth operation of these machines. Apart from forming machines, thermic fluid heater, air compressor, chiller, cooling tower, electrical heating elements, printing and lamination machines are used in footwear manufacturing. Some of the primary process technologies are explained below.

(i) Heating coils for melting and heating

The electrical heating elements are placed over the heating barrel to achieve set temperature with built in control mechanism - either on/off or PID (thyristor based) controller. Most of the conventional electrical heaters are poorly insulated leading to higher surface heat losses. One of the energy efficient heating



Schematic view of extruder

Source: *https://en.wikipedia.org/ wiki/File:Extruder_section.jpg* coils is PID controlled barrel band type with better and compact insulation.

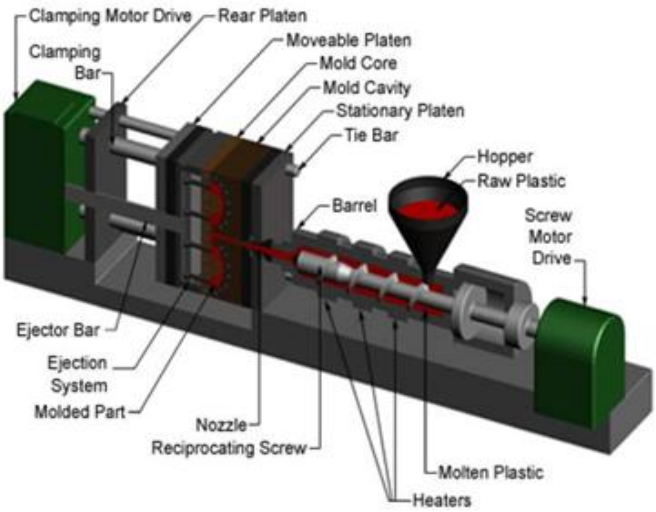
(ii) Granule extruder

Extruder primarily consists of two sections namely extrusion and calibration & strengthening. Extrusion includes hopper, screw, barrel, heating assembly and forming die (figure). The other section has calibration and quenching tank, traction or caterpillar haul-off, cutting arrangement with limit switch and belt conveyor. Screw movements control transport of liquid plastic to dies for extrusion process. The formed plastic product cools under blown air or in water bath and gets hardened on a moving belt. High-end advance extrusion machines have built in programmable automatic controlling panel, which is highly efficient.

Plastic granule extruder

(iii) Injection moulding

Injection moulding machine is used to form different plastic footwear products like sole, last, heels etc. with the help of appropriate mould in place, similar to extruder. It operates with hydraulic pressure provided by hydraulic power pack. Injection moulding has primarily two sections viz. (1) injection section (includes hopper, barrel, screw, barrel heaters, hydro motor) and (2) clamping section having movable platen (core), fix platen (cavity) and clamping shutter arrangement. Hydraulic system of injection moulding system is equipped with one of the pressure generation and control mechanism out of variable displacement pump (VDP), variable frequency drive (VFD) for hydraulic pump and servomotor for hydraulic pump. Servomotor arrangement is one of the most energy efficient systems.

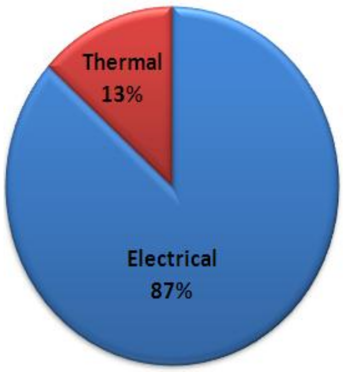


Injection moulding system

Source: http://www.custompartnet.com/wu/InjectionMolding

Energy consumption

Electricity is the main source of energy for most of the plastic footwear units in the Agra cluster. It accounts for about 87% of total energy consumption in the cluster. Almost all the units are dependent on electricity from grid. The average connected load of a footwear unit depends on type of products and installed capacity of the plant. Majority of the units have LT connection with connected load varying between 50 kVA to 215 kVA.



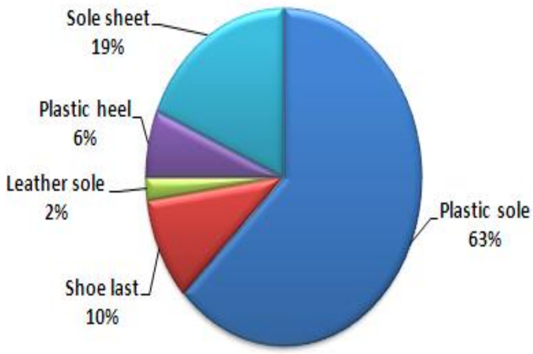
Energy consumption share in Agra footwear cluster

A majority of the footware units have installed DG sets (either HSD or natural gas (NG) operated) to meet part of their loads when grid power is not available. However, power failure is not very common in the cluster and the power situation has significantly improved in Agra over the past few years. HSD and NG are also used in thermic fluid heaters in rubber sole production units. The estimated annual energy consumption of the cluster is 8,624 toe. The energy consumption by different energy sources in the cluster is shown in table.

Energy consumption of Agra footware cluster (2014-15)

Type	Unit	Quantity	Equivalent toe	Share (%)
Electricity	million kWh	59	5037	58
HSD	kL	2880	2481	29
Natural gas	million Sm^3	1.2	1105	13
Total		8,624		

Plastic sole industries account for more than 60% of total energy consumption at cluster level. Plastic sole industries also account for about 75% of total number of units in the cluster. The breakup of estimated energy consumption of different types of footware industries within the cluster is shown in the table.

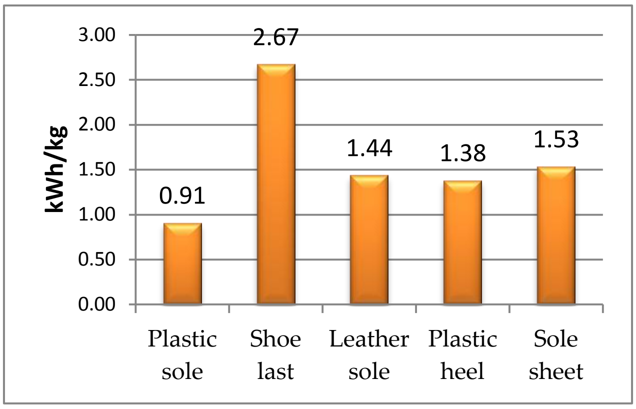


Energy consumption in Agra footwear industries

Break-up of energy consumption by footware industries

Industry sector	Energy consumption (toe/yr)
Plastic sole	5429
Shoe last	848
Leather sole	190
Plastic heel	555
Sole sheet	1602
Total	8624

The specific energy consumption (SEC) of different footware units vary between 0.91 kWh/kg to 2.67 kWh/kg. highest SEC level was observed in shoe last units, which produce heavier product than other types of units. While in industries like plastic soles, the average weight of a pair of product is about 0.4 kg, the weight of product from a shoe last unit is about 2 to 2.2 kg per pair.



Specific energy consumption of footwear products

Energy saving opportunities and potential

Different types of footware industries in Agra offer considerable scope for energy saving. Some of the major energy-saving opportunities in the plastic units in the cluster are discussed below.

(i) Radiant barrel heater band

Barrel heating is one of the largest energy users at most facilities. Conventionally, it is done with the help of ON-OFF type electrical heating system with improper insulation on its surface. Accuracy of ON-OFF type temperature controller was also not observed to be good. Improper or poor insulation on barrel surfaces results in higher heat losses from the surfaces leading to higher power consumption. Thyristor base temperature controllers with appropriate insulation can help in reducing power consumption in barrel heating. The latest radiant heater band design is one of the most promising solutions. The radiant heat is quite easy to install and maintain. The innovative design of radiant heater hastens warm-up times and can make cool-down systems more effective and efficient. Facilities that have incorporated radiant barrel heater band technology with extrusion machines have seen energy use reduced significantly. Depending on base case potential energy saving could be in the range of 20-30%.

(ii) All electrical injection moulding machines

Most of the injection moulding machines in the cluster is hydraulic-injection moulding machines. These hydraulic based systems are quite energy intensive and can be replaced with "All-electrical injection moulding machines". Use of 'all-electrical' type injection moulding systems can significantly decrease energy consumption by about 50-80%. Electrical injection moulding system has additional control benefits such as enhanced repeatability and precision and improved cycle times resulting in faster and more-efficient production with low rejection levels.

(iii) Multiple production line

Majority of the injection moulding machines are equipped with single production line, which means heating, moulding and cooling processes in the moulding machines are carried out in series, which restrict the overall production capacities as well as effect energy consumption. The units can adopt multiple production line type injection moulding machine in which the barrel acts as holding tank in continuous heating mode.

(iv) Optimum mould design in shoe lasts

The shoe lasts production shows that about 50% of moulded products are machined to produce final required shape for lasts. The shoe lasts units produce different makes, types and sizes of lasts would require use of different moulds each type, which however is not strictly practiced. Non-use of proper moulds would lead to additional energy consumption during all processes and other related machining and finishing operations. Hence suitable mould designs may be used by shoe last industry that would result in significant energy saving and reduce unnecessary recycling.

(v) Application of variable speed drives

Motor driven systems often are oversized and inefficiently controlled. Variable Speed Drives (VSDs) can provide a cost effective method for reducing flow or pressure at the source by varying the speed of the connected load to match the process requirements. Energy savings in VSD applications usually range from 20-50%. Some of the potential applications of VSDs in plastic industry are mentioned below.

(a) Extrusion motors

The barrel screw normally is driven through gearbox at constant speed irrespective of load variations on the screw barrel, which is variable at different stages of operation. Hence use of VSDs can help in reduction power consumption up to 20%.

(b) Injection moulding

Hydraulic oil pressure is used during loading but during unloading phase pressure is released to the tank through return line. Pumping system could be equipped with appropriate arrangement to meet the variable pressure demand in cycle which will result in reducing overall power consumption for a given cycle. This could be achieved with one of the options VSD, servo drive motor for hydraulics or variable displacement hydraulic pump. Out of this, 'servo drive motor' for hydraulics is one of the best options, which could save of about 30%.

(c) Optimization of process cooling circuit

This includes the staging of chillers, reducing condenser water temperature and improving pumping efficiency through the use of VFDs and controls. Depending on the required process temperature and application, some of the chilled water demand can be eliminated by using dry coolers or cooling towers in place of chillers. Very often the pumps used in cooling tower system are inefficient and selection is not correct resulting in higher power consumption. The inefficient pumps may be replaced with energy efficient pumps. Optimizing process cooling can reduce cooling costs by 10-25%.

(vi) Compressed air

Compressed air system offers significant energy saving. In some cases, energy savings can be as high as 40% by improving supply side and reducing end-use demands. Opportunities can be found in the supply side by installing new or optimizing existing equipment and reducing the system pressure. Demand can be reduced through improving end uses and repairing leaks. Blow-off nozzles can be upgraded to high-efficiency engineered nozzles or replaced with a low-pressure electric blower. Some of the potential areas of compressor system with specific option are mentioned below

(d) Arresting compressed air leakage

Compressed air is an expensive utility in a plant. However, in most cases, air leakages in piping system are quite high (more than 20%) and go unnoticed. Leakage of compressed air can be reduced to about 5% by adopting best operating practices which require no or minimum investment.

(e) Reduction in pressure setting of air compressor

The pressure setting of air compressors are often much higher than the actual air pressure requirement at the point of use in the plant. The typical unload and load pressure settings are 8.5 and 7.5 bar respectively. Reducing the compressed air pressure as per end-use requirements will result in high energy savings. Reduction of generation pressure by one bar can lead to energy saving of 5-6%.

(f) Retrofitting air compressor with variable frequency drive

During normal operation, screw air compressor operated on unloading position for more than half the time. Installation of VFD in air compressors will minimise the unload power consumption.

(vii) Replacement of rewound motors with energy efficient motors

Rewinding of motors may result in efficiency drop of about 3-5%. It is better to replace old, inefficient motors which have undergone rewinding of three times or more. These motors may be replaced with EE motors (IE3 efficiency class) which would result in significant energy savings with simple payback period of 2 to 3 years.

Major stakeholders

The primary stakeholders in Agra footware industries cluster include as follows. The Indian Footwear Component Manufacturers Association (IFCOMA), Agra Footwear Manufacturers & Exporters Chamber represents the problems of Indian footwear component manufacturers and its affiliates to various government, semi-government and concerned bodies. IFCOMA organizes various activities and arranges participation in trade fairs and buyer-seller meets for its members.

The Central Footwear Training Institute (CFTI), Agra was established in 1963 under Small Industries Development Organization, Ministry of Industry with financial assistance from Ford Foundation. The primary objective of the Centre is to provide young and technically sound personnel to the footwear industry and upgrade the knowledge and skill of the existing staff. Other important stakeholders in Agra footwear cluster include Footware Design and Development Institute and MSME Development Institute (DI)-Agra.

Cluster development activities

There are no major cluster development activities in Agra footwear industries. However, the industries have shown keen interest to adopt Solar Photovoltaics (SPV) based electricity generation at unit or cluster level, since the industries are completely dependent on grid electricity for their production processes.

About TERI

A dynamic and flexible not-for-profit organization with a global vision and a local focus, TERI (The Energy and Resources Institute) is deeply committed to every aspect of sustainable development. From providing environment-friendly solutions to rural energy problems to tackling issues of global climate change across many continents and advancing solutions to growing urban transport and air pollution problems, TERI's activities range from formulating local and national level strategies to suggesting global solutions to critical energy and environmental issues. The Industrial Energy Efficiency Division of TERI works closely with both large industries and energy intensive Micro Small and Medium Enterprises (MSMEs) to improve their energy and environmental performance.

About SDC

SDC (Swiss Agency for Development and Cooperation) has been working in India since 1961. In 1991, SDC established a Global Environment Programme to support developing countries in implementing measures aimed at protecting the global environment. In pursuance of this goal, SDC India, in collaboration with Indian institutions such as TERI, conducted a study of the small-scale industry sector in India to identify areas in which to introduce technologies that would yield greater energy savings and reduce greenhouse gas emissions. SDC strives to find ways by which the MSME sector can meet the challenges of the new era by means of improved technology, increased productivity and competitiveness, and measures aimed at improving the socio-economic conditions of the workforce.

About SAMEEEKSHA

SAMEEEKSHA (Small and Medium Enterprises: Energy Efficiency Knowledge Sharing) is a collaborative platform set up with the aim of pooling knowledge and synergizing the efforts of various organizations and institutions - Indian and international, public and private - that are working towards the development of the MSME sector in India through the promotion and adoption of clean, energy-efficient technologies and practices. The key partners are of SAMEEEKSHA platform are (1) SDC (2) Bureau of Energy Efficiency (BEE) (3) Ministry of MSME, Government of India and (4) TERI.

As part of its activities, SAMEEEKSHA collates energy consumption and related information from various energy intensive MSME sub-sectors in India. For further details about SAMEEEKSHA, visit http://www.sameeeksha.org