Cluster Profile
Chandigarh engineering industries

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Promoting Energy Efficiency in SMEs
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TERI team is indebted to Industries Association of Chandigarh (IAC), Chamber of Chandigarh Industries (CCI) and Chandigarh Screw Manufacturers Association (CSMA), for providing support and information related to engineering units in Chandigarh. TERI also places on record the support provided by Mr Arun Mahajan (Ex-President, IAC), Mr Naveen Manglani (General Secretary, CCI), and Mr B S Saini (General Secretary, CSMA) for organizing field visits and interactions with entrepreneurs from auto and tractor parts, wire drawing, railway components, fasteners, bathroom fittings and electronic components during the study. TERI is also grateful to the Department of Industries, Chandigarh and the Chandigarh Electricity Department for providing data related to the engineering units of the cluster.

Last but not least, our sincere thanks to MSME entrepreneurs and other key stakeholders in the cluster for providing valuable data and inputs that helped in cluster analysis.

Chandigarh engineering industries

Overview of cluster

Chandigarh is a city and union territory that serves as the capital of two states, Haryana and Punjab. It is also a prominent engineering cluster as it hosts over 600 MSME units manufacturing various kinds of products such as auto and tractor parts, sheet metal components, railway components, fasteners and so on. The setting up of major engineering plants such as Swaraj Enterprises (Punjab Tractors, Swaraj Mazda, Swaraj Engines, Swaraj Combines) in the region during 1970's led to the basic industrial development in the cluster. Today, most of the engineering units are ancillaries/ vendors of large tractor/ automobile manufacturers (Original Equipment Manufacturers) and Indian railways. The major OEMs being catered to by the engineering cluster include Mahindra & Mahindra (earlier Punjab Tractors), Swaraj Enterprises, Sonalika Tractors, Preet Tractors and Combines; other automobile and agricultural components manufacturers; and Indian Railways Rail Coach Factory (Kapurthala) and Diesel Loco Modernisation Works (Patiala).

Engineering industry

The Chandigarh SME cluster was initially developed around 1960 for maintenance work like machining and welding of the then existing heavy industries in the region. The industrial cluster of Chandigarh is primarily divided in two large industrial zones. The fasteners industry of Chandigarh deserves a special mention as Chandigarh is one of the India's and in fact Asia's largest hub for production of fasteners. With about 220 units, manufacturing a range of nuts, bolts, screws, rivets, washers, etc., fasteners industry is a major engineering segment in Chandigarh. The fasteners industry caters to the demands of automobile, general industry, railways and other government departments dealing in towers and transmission. The fasteners industry in Chandigarh attributes its emergence and growth to setting up of an administration run steel depot by Chandigarh Industrial and Tourism Development Corporation Limited (CITCO) in early 70s. The depot is situated in the industrial area itself and provides iron and steel raw material (mainly steel wires/ rods) to the fasteners units of Chandigarh at subsidized prices.

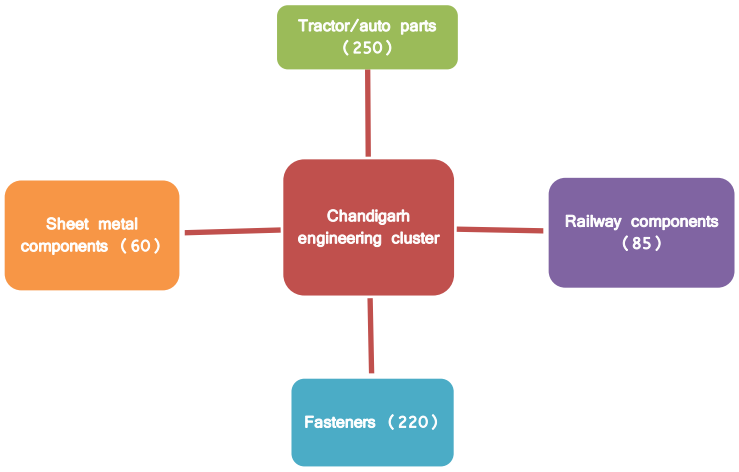
Industries Association of Chandigarh (IAC), Chamber of Chandigarh Industries (CCI) and Chandigarh Screw Manufacturers Association (CSMA) are major industry associations in the cluster with over 200 members each. The associations address issues related to welfare and grievance redressal of member industries.

Product types and production capacities

The units in Chandigarh manufacture a wide range of engineering products. Most of the engineering units are manufacturing tractor/ auto components and are vendors to large OEMs located in the cluster. Other industry categories include steel fabrication, railway components and fasteners as shown in the figure. There are about 600 MSME units in the cluster. The breakup of units is given in table.

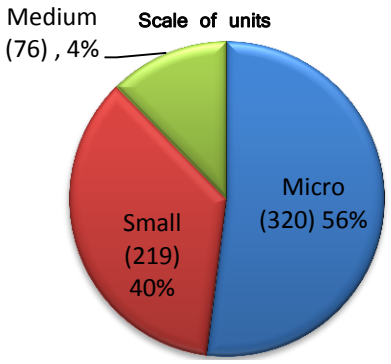
Distribution of engineering units in Chandigarh cluster

Product category	Number of units	Micro (%)	Small (%)	Medium (%)
Tractor/ auto parts	250	50	40	10
Steel fabrication	60	40	50	10
Railway components	85	20	40	40
Fasteners	220	70	25	5
Total	**615**			



Product types in Chandigarh engineering cluster

The engineering units in Chandigarh cluster can be classified into micro, small and medium. Micro units contribute for about 50% of total number of units as shown in the figure. Each unit manufactures around 50 different type, sizes and shapes of components. Some of the major components/ products are given below.



Distribution of units based upon scale of operation

(i) Tractor/auto parts

Tractor and auto parts include components for tractors, buses, various machines, earth moving equipment mainly axles, gears, transmission components, tie rod end, stub axle assembly, rocker link assembly, front axle bracket, bearing blocks, flange, block bushes, housings body parts, engine parts, engine mounting & compressor mounting brackets, steering assembly, brake systems, towing parts, cover plates for tractors, etc.

(ii) Steel fabrication

Steel fabrication comprises sheet cutting, sheet metal fabrication, railway coach fabrication, tractor equipment fabrication, combined body fabrication, sub-assemblies for earth moving equipment.

(iii) Railway components

Various parts produced include bogie (coach) bolster, hand brake set, brake beams, brake heads, lower spring arrangement, levers, water tanks, hydraulic lift assembly, fuel tanks, railway track fittings, etc.

(iv) Fasteners

A variety of fasteners produced include steel screws, rivets, bolts, nuts, special screws with washers, and hex bolts of all sizes. These fasteners are classified into mild steel (MS) and high tensile (HT) fasteners. MS fasteners are hexagonal bolts of full thread/ half thread and are used to join plates/ angles in structural steels where the tensile load is low. HT fasteners are made from special alloy steel in various sizes & shapes such as hexagonal bolts (HT) of full thread / half thread and are used specially in machines where the load is high. MS fasteners constitute about 60% of the market size and are mainly produced by the micro scale units, whereas HT fasteners are produced primarily by the small and medium scale units.

The nature of the cluster and type of products manufactured are such that it is difficult to estimate the quantum of production in terms of tonnage. The units are engaged in production of a variety of products but record only the number of pieces manufactured; hence the units maintain only turnover figure in value terms. The total turnover of the cluster is estimated to be about Rs 3,500 crore.

Raw material usage in cluster

The major raw material used by all types of engineering units is steel. It is used in the form of wire rods, rounds, castings, MS sheets and plates. The type of materials used include stainless steel, alloy steel, aluminium, copper, bakelite powder, plastics, etc. The raw material constitutes the major component of total cost of production (almost 70%). The main sources of procuring steel in the cluster are given below.

(i) CITCO Steel Depot

CITCO, a Chandigarh administration's undertaking is the main procurer and supplier to industries in Chandigarh for raw materials such as MS wire Rod, Round, Sheet, Plates, H.R Coil and C.R Coil from its sales depot situated in industrial area, Chandigarh. These raw materials are supplied at subsidised prices to micro units and thus CITCO plays a crucial role in controlling of price of raw materials. CITCO supplies raw materials to units whose annual demands are less than 600 tonne per annum (tpa). CITCO also runs an Industrial Development cum facility centre/ quality marking centre for testing quality of raw materials and finished products (mechanical and chemical).

(ii) Rashtriya Ispat Nigam Limited (RINL), Vishakhapatnam

The main raw materials supplied by RINL in the cluster are wire rod and Si-Mn steel for railway components through its regional sales depot at Chandigarh, Faridabad and Ludhiana.

(iii) Steel Authority of India Limited (SAIL)

The main raw materials supplied to cluster is MS plates, sheets, rounds, and cold/ hot rolled (CR/ HR) coils through its regional sales depot at Chandigarh, Faridabad, Mandi

Gobindgarh and Ludhiana. Both RINL and SAIL supply raw materials directly, if the minimum demand of the units is 600 tpa.

(iv) Local distributors

The local distributors are also a major source of raw materials for units in Chandigarh. They supply special types of steel sheets of different grades such as EN-8, SAE-8620 etc.

Energy scenario in the cluster

Electricity is the major energy form used in the cluster. Electricity is supplied by Punjab State Power Corporation Limited (PSPCL). Diesel is used in DG sets for power backup and is procured from local market. Other energy forms used in the cluster are furnace oil and LPG. The details of major energy sources and tariffs are shown in table.

Prices of major energy sources

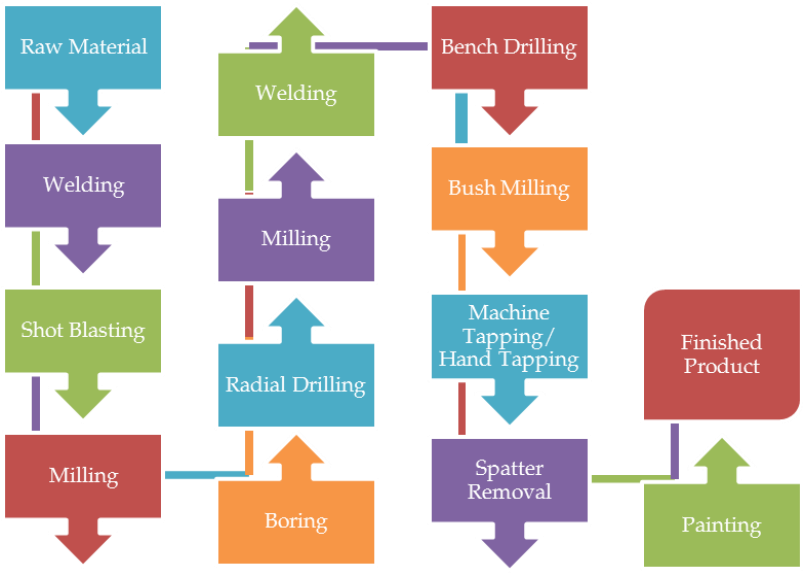
Source	Remarks	Price
Electricity	General industry Seasonal industries	Rs 5.85 per kWh & Minimum monthly charges of Rs 157
	- Seasonal rate	Rs 5.85 per kWh & Minimum monthly charges of Rs 574
	- Non-seasonal rate	Rs 6.90 per kWh & Minimum monthly charges not applicable
Furnace oil		Rs 30 per litre
Diesel	From local market	Rs 50 per litre
LPG		Rs 56 per kg

Production process

Although a large variety of products are manufactured in each category of units, the processes followed by these units broadly remain the same. Most of the vendors manufacture the components based upon drawings provided by OEMs. The production process for each category of engineering product is mentioned below.

(i) Tractor/auto/railway part units

The raw material is welded first in the welding section. If the material is having rust on its surface then it goes for shot blasting where the air and small iron particles are forced on material to clean the surface. Based on requirements, processes such as milling, boring, radial drilling operations are done. If required, the process such as welding is carried out. Depending on the type of parts to be manufactured,

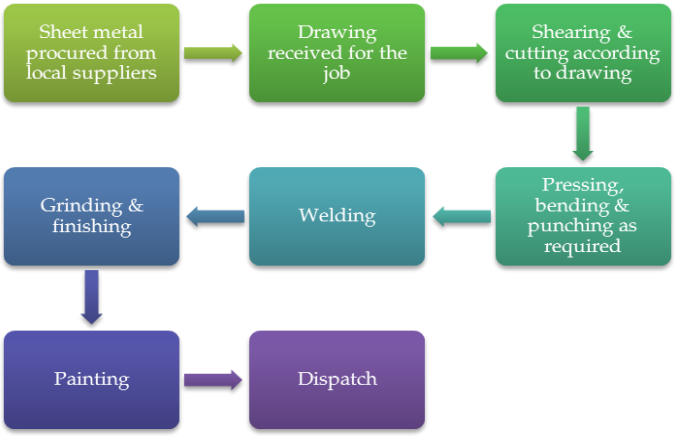


Process flow-chart for tractor/auto components

bench drilling and bush milling are carried out. Spare spots are developed over materials which are welded which are later removed by hand filling. Then it goes to blower painting booth for painting and is then dispatched.

(ii) Sheet fabrication units

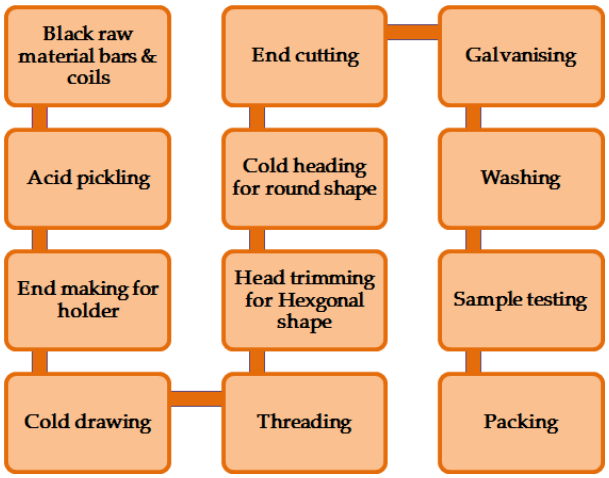
These units use metal sheets as raw materials (to produce different auto/ tractor/ railway components) which are bent into desired shapes according to the customer requirements. Production is carried out though a number of processes such as shearing, bending, welding, punching, pressing, grinding and painting which account for maximum energy consumption in steel fabrication units.



Process flow chart for sheet metal fabrication

(iii) Fasteners

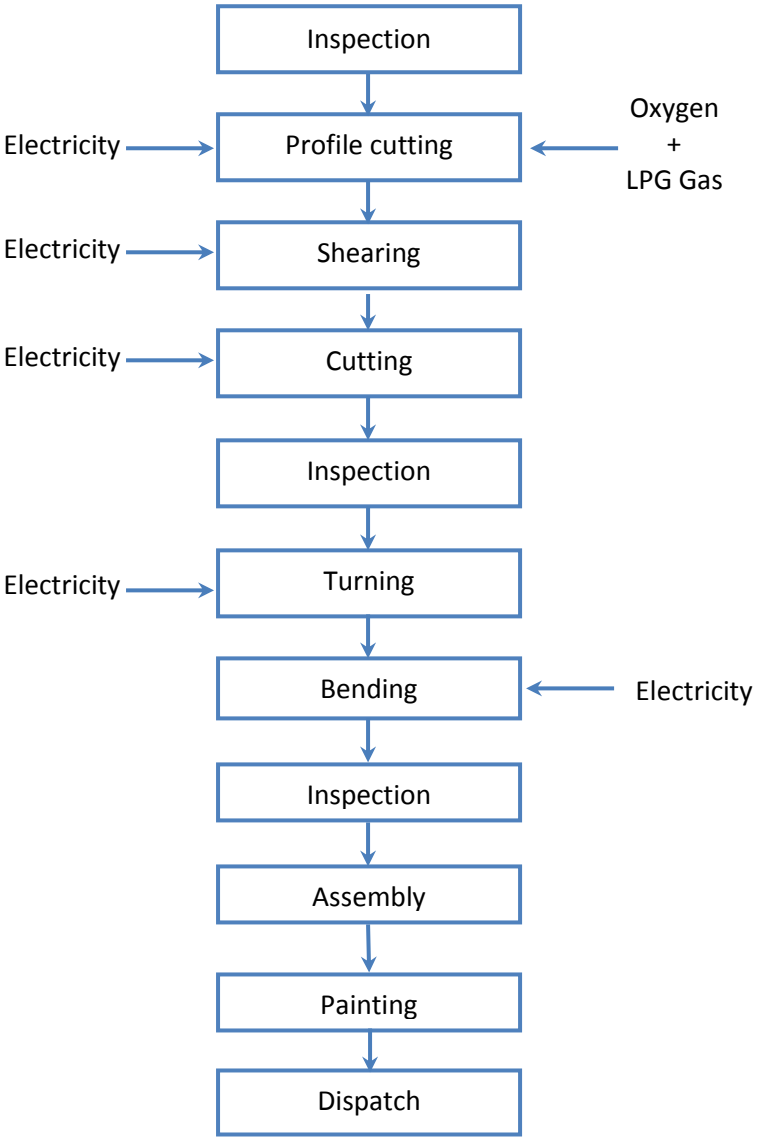
The production of fasteners such as is given below.



Production process for nuts/ bolts

(iv) Railway components

The process for manufacturing railway components is not much different from that of tractor parts. The major railway components like bogie bolsters, body bolsters, brake beams go through various production steps that include gas cutting, shearing, bending, punching, milling, boring, welding, etc. are carried out. The production process for railway components is presented below.



Production process of railway components

Technologies employed

The majority of the tractor parts and railway components manufacturing industries in the cluster use conventional manufacturing technologies such as lathes, milling (horizontal and vertical) machines, profile cutting machines, drilling, hacksaw, shaping/ shearing machines, power press, MIG (metal inert gas) and TIG (tungsten inert gas) welding, and different kinds of grinding machines to manufacture their products (for operations like gas cutting, shearing, bending, punching, milling, boring, welding). However, some of the progressive units (about 30%) have adopted modern technologies such as Computerized Numerical Control (CNC) and Vertical Milling Centre (VMC) machines.


Steel fabrication units and machining units have overlapping capabilities, but fabrication units generally concentrate on the sheet cutting, welding and assembly while the machining units are more concerned with the machining of parts. Most of the sheet cutting in the cluster is done manually in the absence of any high technological automatic sheet cutting facilities.

The fasteners units use wire drawing processes to manufactures various types of screws, nuts and bolts. Fasteners are classified into mild steel (MS) and high tensile (HT) fasteners. Conventional machines like cold header, threading machines, slotting machines, hot forged headers etc. are used for finishing the products. For galvanising and reheating of materials, furnaces are being used.

Header machine for fasteners industry

The major utilities attached to these machines are motors (which are mainly old and rewinded) and air compressors. Compressed air generated at a pressure of about 7.5-10 kg/ cm^2 is used in CNC machines as well as cleaning. Due to ageing of these compressors and inherent inefficiencies in internal components, free air delivered is usually less than design value.

Energy consumption

Electricity is the single major source of energy for most of the engineering units in Chandigarh cluster. With over 85% of total energy consumption, almost all the units in tractor/ auto parts, steel fabrication, railway components and fasteners categories are dependent on electricity from grid to meet their energy requirements. The average connected load per unit is about 90 kVA. Other types of energy used in the cluster are Furnace Oil (FO), Liquefied Petroleum Gas (LPG) and High Speed Diesel (HSD). FO is mainly used by a few fasteners units in galvanising furnaces. The railway component units use LPG in profile cutting machines for cutting material as per required specifications. HSD is used in DG sets only during power failure. The power availability is good in Chandigarh and hence there is not much dependence on DG sets. On an average, one unit uses DG sets only for 25-30 hours in a month.

Average connected load in units

Segment	Connected load (kVA)
Micro	50-80
Small	80-120
Medium	120-200

The details of energy consumption in the cluster are highlighted in tables.

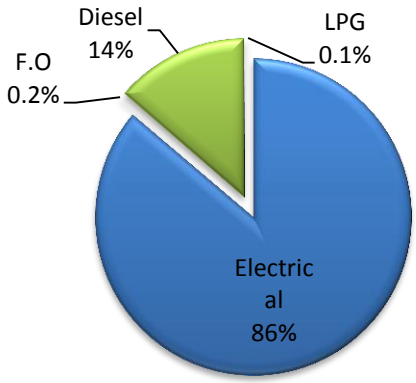
Details of energy consumption in Chandigarh cluster

Energy consumption (unit/month)	Tractor/ auto parts	Steel fabrication	Railway components	Fasteners
Electrical (million kWh)	4.70	1.16	2.18	3.35
Furnace oil (kilo litre)	-	-	-	19.00
Diesel (kilo litre)	67.20	16.60	31.20	47.90
LPG (kg)	-	-	570	-

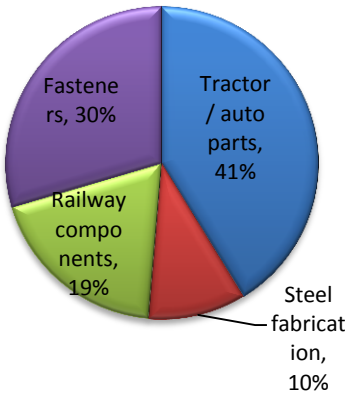
Energy consumption by primary industries in Chandigarh cluster

The total energy consumption of Chandigarh engineering cluster is 13,655 toe. The tractor/ auto parts and fasteners segment together contribute to about 71% of total energy consumption in the cluster (table). Electricity is the single major source (about 86%) as shown in the figure

Industry sector	Consumption (toe/yr)	Share (%)
Tractor/ auto parts	5,623	41%
Steel fabrication	1,385	10%
Railway components	2,617	19%
Fasteners	4,030	30%
Total consumption	13,655	100%



Share of energy sourced in Chandigarh engineering cluster



Energy consumption by primary industries

Share of energy source in Chandigarh cluster

Energy type	Energy consumption	Equivalent energy (toe/yr)	GHG emissions (tonne CO_2/yr)	Annual energy bill (million INR)
Electrical	136.8 million kWh	11,767	134,093	840
Furnace oil	22.8 kL	22	66	0.6
Diesel	1955 kL	1,857	5,356	108
LPG	6.84 t	8	20,417	0.4
Total		13,655	159,932	949

Energy saving opportunities and potential

The Chandigarh engineering cluster offers significant scope for energy saving. With electricity contributing a major share (85%) of energy consumption in the cluster, most of the recommendations focus on reducing electrical loads. The energy savings measures suggested can lead to a reduction of 10-15% in electrical consumption. Some of the energy saving options available for Chandigarh engineering cluster are discussed below.

(i) Electric induction motors

Some of the energy saving options applicable for induction motors are as follows. The envisaged energy saving potential is 15-20%.

- Installation of an 'Automatic Power Factor Controller' (APFC) in main panel
- Selection of proper size motors suitable for applications
- Switch over to permanent star connections in case of consistently under-loaded motors
- Installing 'Variable Frequency Drives' (VFD) to take care of load variations in the processes
- Replacement of inefficient motors with energy efficient motors e.g. IE3
- Replacement of old and worn-out V-belt drives by synchronous belt drives

(ii) Air compressor

The pressure setting of air compressors are often much higher than the actual air pressure requirement in the unit. The typical unload and load pressure settings are 7.5 and 6.5 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%.

(iii) Capacitors

The capacitors in many units have been used well beyond their normal life spans, and are hence not performing according to their rated capabilities. These capacitors need replacement. In some of the units, capacitor banks were inappropriately sized and hence power factor close to unity is not being maintained even after installation of 'automatic power factor controller (APFC). Installing correct size of capacitor banks would help in improving power factor close to unity.

(iv) Fans

The engineering units use conventional fans that are inefficient. These inefficient fans may be replaced with energy efficient fans that have an energy savings potential of 30-40%.

(v) Inverter based welding machines

Inverter-based power sources allow delivery of more power output from new power electronics technology, resulting in a better performance-to-size ratio. These models also deliver smooth operation with greater efficiency than many older, conventional welding power sources. Old transformer rectifier-based welding machines have efficiency of 67% while inverter-based machines can perform with 87% efficiency with better power factor. Inverter-based welding power sources offer following advantages:

Inverter-type welding machine

- Lightweight and portable
- Able to obtain superior stick welding performance with all electrode types
- Multi process welding output without sacrificing arc performance in any mode
- Quick response to changing arc conditions (e.g., maintains steady weld output)
- Superior control over pulsed welding processes
- Line voltage independent—uses single or three phase input power and multiple input voltages without any manual relinking mechanism
- Better power factor (more efficient use of power from the utility)
- Less susceptibility to primary voltage fluctuations

Inverter based welding power sources can perform high- and low-amperage flux-cored, stick, TIG and MIG welding. Today's re-imagined inverter models deliver multi-process welding capabilities, offering faster arc response, smoother arc action and a more consistent bead appearance. A typical transformer rectifier welding machine (for 160 Amps) may be replaced with an inverter based welding machine requiring an investment of Rs 20,000. With an energy saving potential of 25%, the simple payback period is about 1.3 years.

(vi) Switch over from FO fired galvanising furnaces to energy efficient furnaces in fasteners units

The furnace oil fired furnaces used in fasteners for galvanizing operation are operating inefficiently leading to higher consumption of furnace oil. These inefficient furnaces may be replaced with energy efficient furnaces that will have lower Specific Energy Consumption (SEC). The energy saving potential with energy efficient furnace is about 25-35%. Use of these furnaces would help in improving workplace environment a well.

(vii) Lighting

The engineering units use inefficient lighting system such as conventional tube lights (52W & 46W), high pressure sodium vapour lamps, etc. These lighting can be replaced with efficient lighting system such as LEDs, effective use of day light facility, etc. The energy saving with energy efficient lighting system is 10-15%.

(viii) Other energy saving measures

Other energy saving measures that are applicable for Chandigarh engineering cluster are:

- Operational efficiency of hacksaw machine can be improved by increasing the number of rods available for cutting e.g. 4 numbers to 6 numbers.
- Use of regenerative braking system to recover kinetic energy in CNC machines
- Installation of touch probes to quickly find datum for a task in CNC machines; optical encoders for efficient operation of servo-motors in CNC machines.

Major stakeholders

The primary stakeholders in the cluster are the engineering units based in Chandigarh and the leading industry associations - Industries Association of Chandigarh, Chamber of Chandigarh Industries and Chandigarh Screw Manufacturers' Association. Other important stakeholders include Original Equipment Manufacturers (OEMs), District Industries Centre (DIC), CITCO-Industrial Development cum Facility Centre (CITCO-IDFC) that offers testing and training facilities, CITCO steel depot, Industrial Training Institute (ITI), machinery suppliers, various government agencies, regulatory bodies, academic institutions, testing

and training institutes and Business Development Service (BDS) providers. These stakeholders provide various services to the cluster units, such as training of workers, testing facilities, financial services, technical know-how, regulatory and advisory services, raw materials supply, supply of technologies etc.

Cluster development activities

The Chandigarh cluster has not received much attention from government of donor agencies. Only one major intervention in the cluster is BDS development project (MSMEFDP) implemented by TERI with support from SIDBI during 2009-11. The project objective was to strengthen the access to BDS of SMEs. Various activities such as skill development and employment to unemployed youth, energy efficiency studies, implementation of lean manufacturing tools, marketing/ outreach activities were conducted in the cluster on a pilot basis.

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

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Swiss Agency for Development and Cooperation 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