Energy mapping of Jalandhar Sports Goods Cluster

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Declaration

I, Neha Bhardwaj, do hereby solemnly declare that the project entitled "Energy Mapping in Jalandhar Sports Goods cluster" is an original work. The contents of this project report reflect the work done by me during the Summer Internship component of the Masters in Business Administration at Indian Institute of Technology, Kanpur from 1st May to 30th June 2008 with "United Nations Industrial Development Organisation".

Place: New Delhi — Neha Bhardwaj

Date: 16th July 2008

Executive Summary

Energy, simply put, is the ability to do work. In today's world energy has gained an unprecedented importance. Rising oil prices and concerns for global warming has brought energy conservation and its allied programmes to the fore-front. Any sector or industry whether big or small is heavily dependent on energy and its shortage can severely affect the business operations. In this scenario, the bigger firms can survive for sometime by reducing dependence on state electricity boards but the crunch is really felt by small scale industries which do not have the resources or know-how to invest in alternate sources of energy. Hence it becomes imperative that developmental agencies focus on the energy issues of SSIs irrespective of energy intensity of that particular industry.

This project is an attempt to map the energy usage of the Jalandhar Sports goods cluster. In the process data has been collected about the actual requirement the cluster has, deficits it faces, how it meets these deficits, what is the cluster's expected energy requirement for the coming years and what are its investments in renewable sources of energy or innovations in the fields of energy. Recommendations have been made which firms can implement to achieve energy efficiency thereby resulting in financial savings. Payback periods for implementing these measures have also been calculated on a general basis so that firms can apply these findings in the nearest future.

Energy and environment bear an interconnection which cannot be ignored. This interconnection directly affects our natural environment and human life as an eventual phenomenon. Emphasis has been laid on the impacts of energy usage on social, economic and natural environment of the cluster.

Organisation of paper

In initial chapters the report compares present methods of cluster development with methods which will not only promote cooperation and competition but also inclusive growth. Thus cluster development benefits do not remain constrained to the firms but spill over to society at large. Next chapter give a brief overview of the Jalandhar sports goods cluster which is a historic cluster and has had a significant role to play in exports of sports articles from India. Next is a snap shot into the methodology applied to map energy in the cluster. It must be kept in mind that energy mapping is very different form energy audit and hence a detailed elucidation of the methodology adopted becomes essential. Subsequent chapter encapsulates all the findings and analysis from data collected in the two months of energy mapping exercise at Jalandhar. It also includes the suggested interventions at firm level, policy level and institution level. Also attached is the questionnaire which was the primary tool for data collection.

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Abbreviations

BEE	Bureau of Energy Efficiency
DIC	District Industry Centre
EE	Energy Efficiency
MSME	Micro Small and Medium Enterprise
NSIC	National Small Industries Corporation
PCB	Pollution Control Board
SDC	Swedish Agency for Development and Cooperation
SEB	State Electricity Board
SEU	State Electricity Utility
SIDBI	Small Industry Development Bank of India
SME	Small and Medium Enterprise
TERI	The Energy Research Institute
UNIDO	United Nations Industrial Development Organization

Chapter 1: Introduction

1.1 Clusters: An introduction

Following the fall of regulations in 1991, India started up a massive modernisation process through privatisation, investment inflows and international trade. Many investments have been directed towards the Indian economy, following the disappearance of political constraints, privatisation of state assets and foreign trade liberalisation. Policy makers and developmental agencies have taken up numerous initiatives to spark a high interest towards building industrial clusters. Linkages among enterprises replaced the *"atomised"* structure of the early 1990s and formed so-called regional clusters, which have become the focal point for many new policy initiatives in the last few years and has opened a range of new location possibilities for investment. In both industrialised and developing countries, there are increasing evidences that micro, small and medium enterprises (MSMEs) can boost their competitiveness through networking and that this process is easier and more sustainable if the firms are situated and work very closely with one another in "clusters". Outside the city boundary, the effect of clustering gradually diffuses into the larger economy, a phenomena that is called "*ripple effect".*

Studies on industrial clustering date back to Alfred Marshall's contribution on localization economies (Principles of Economics, 1920). The term cluster has many connotations and has been defined in many forms in various literatures.

Cluster...

…a group of firms engaged in similar or related activities within a national economy ***(Porter, 1990);***

…a group of enterprises belonging to the same sector and operating in close proximity to each other ***(Schmitz, 1992);***

…a geographical concentration of interconnected firms and institutions in a particular sector ***(Porter, 1998)***;

…a set of complementary firms (in production and service sectors) public, private and semi-public research and development institutions, which are interconnected by labour market and/or input-output and/or technological, links ***(Steiner and Hartmann, 1998)***.

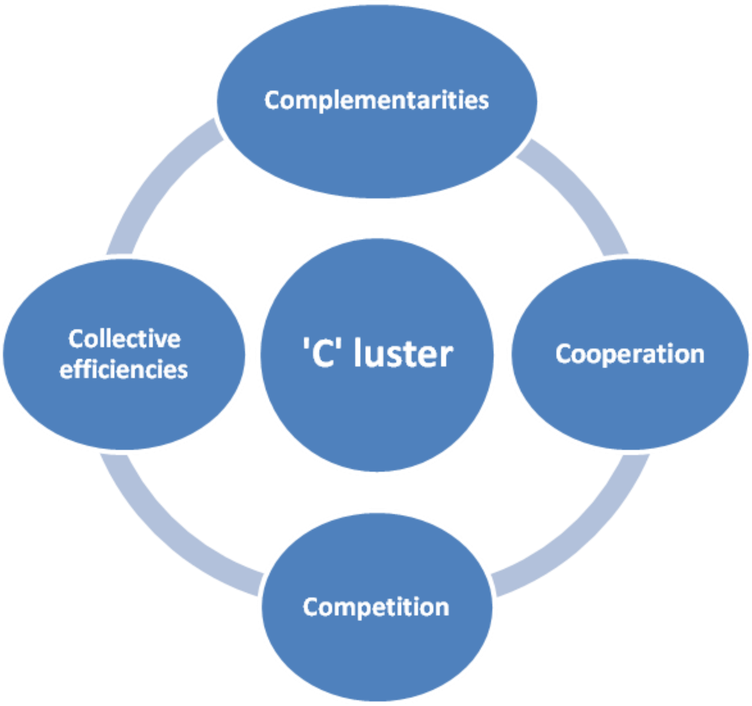
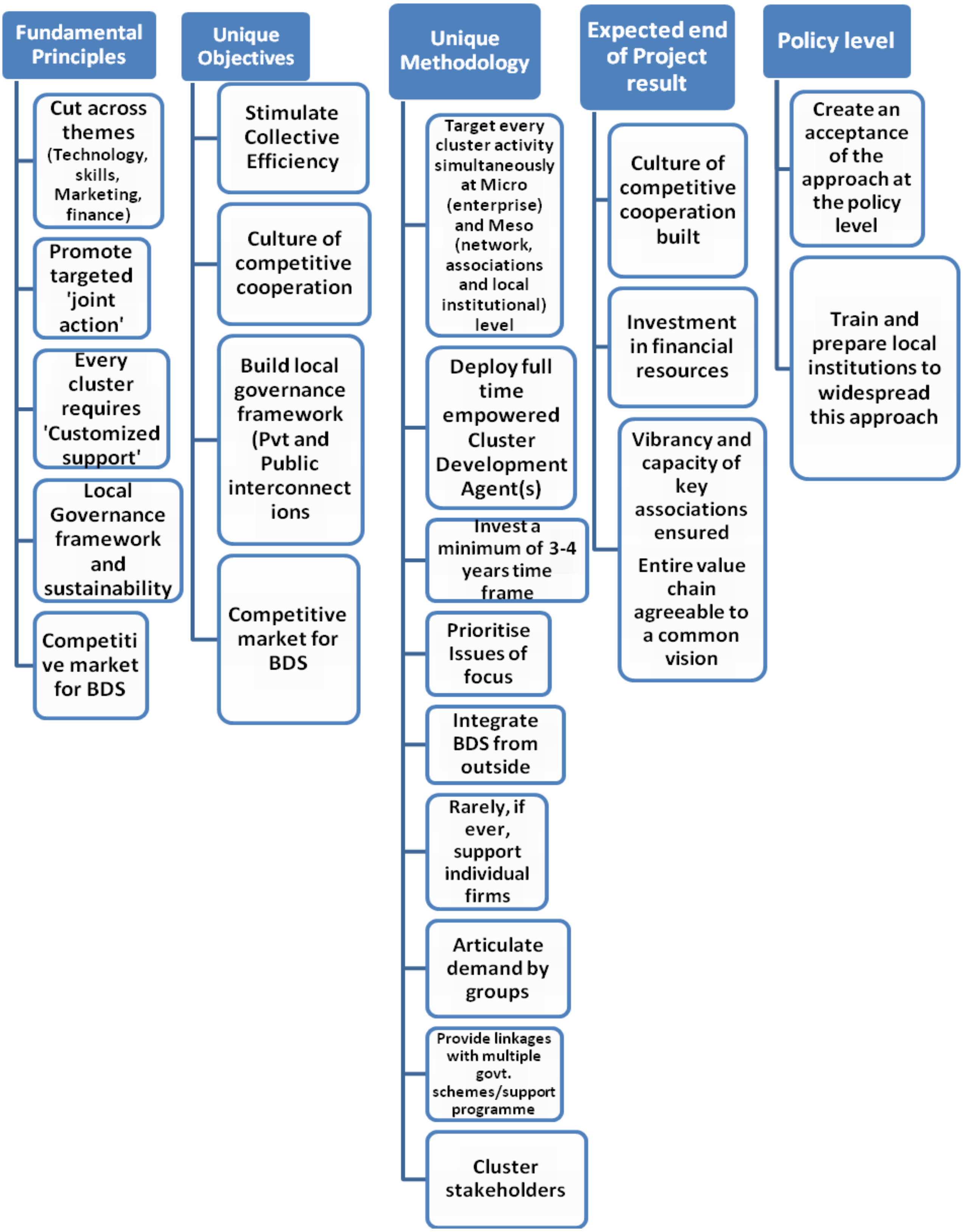


Figure 1: Features of a cluster

Small enterprises individually have little capacity to respond to competitive pressure and to generate factors for expansion. Clustering can help SMEs to mobilise human and financial resources. Clusters are seen to exhibit gains through collective efficiency - comprising external economies and joint actions that facilitate growth and competitiveness of small-scale industries. The forms of co-operation between agents within the cluster in terms of sharing of resources, information, technical expertise and knowledge helped to reduce transaction costs. This in turn can strengthen the competitiveness as well as facilitate learning and technical innovation (Schmitz, 1995).

1.2 Present Methodology of cluster development

UNIDO Cluster Development Approach



UNIDO along with the Office of the Development Commissioner Small Scale Industries (DCSSI), Government of India, as also in partnership with a host of central/state governments and institutions has worked towards an agenda of ***"growth and competitiveness"*** in 24 clusters. As is evident from the above figure world-wide cluster development has been focussed primarily on cluster firm owners that are the top of the pyramid in a cluster set up. The other levels in this pyramid, i.e. Labour, families of labourers, other members of society and environment are thought to benefit in terms of 'ripple effects' created by these interventions. This leads to a need of shift in focus from cluster firms alone to society and environment at large.

Many factors play a role in the development of the whole value chain in a cluster and also the society that is directly or indirectly related to it. Literature suggests that primarily 6 factors come into picture when focusing on the development of clusters. These are depicted as gears of growth in the figure below.

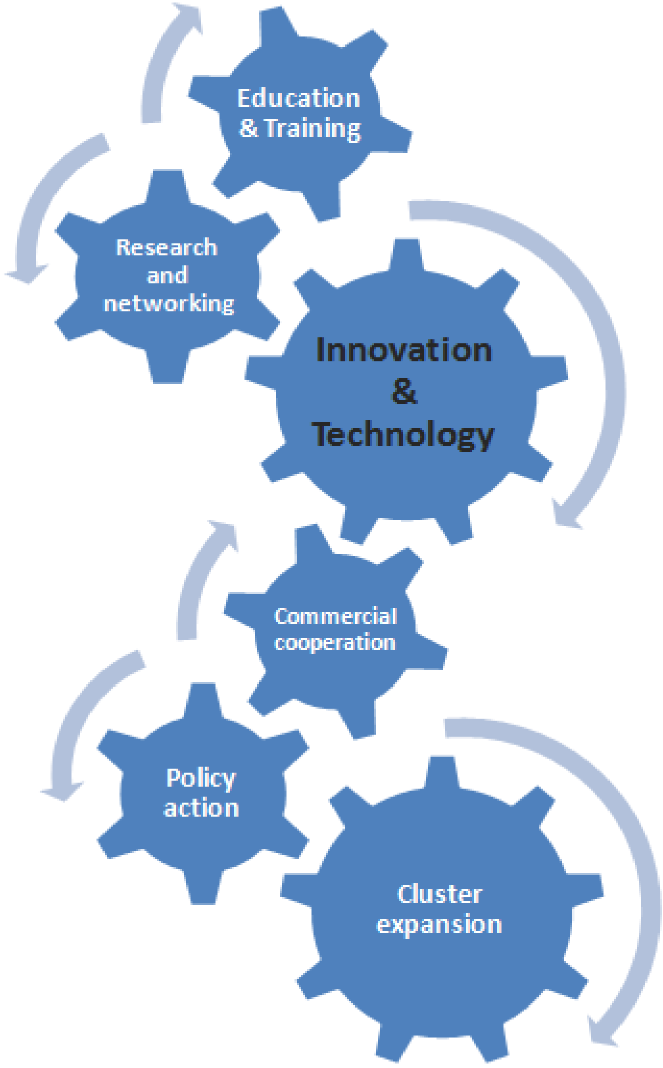


Figure 2: Factors affecting development of a cluster

1.3 Moving from economic growth to inclusive growth in clusters

Inclusion is central to the Indian political process. It is part of the project of nation building. Inclusion seeks to address older and deep rooted social hierarchies.

India, has had poverty reduction as the central goal of policy over the last 60 years, and has recently switched to a new development strategy focusing on two basic goals: ***Raising economic growth and making growth more inclusive*** *(Planning Commission of India 2006).* We are moving towards the concept of 'inclusive democracy' which re-integrates society with economy, polity and nature. The central focus of the 2006 World Development Report (World Bank 2006) is the pursuit of equality of opportunity emphasizing the paramount importance of inclusive growth, i.e., creating economic opportunities through sustainable growth and making the opportunities available to all including the poor.

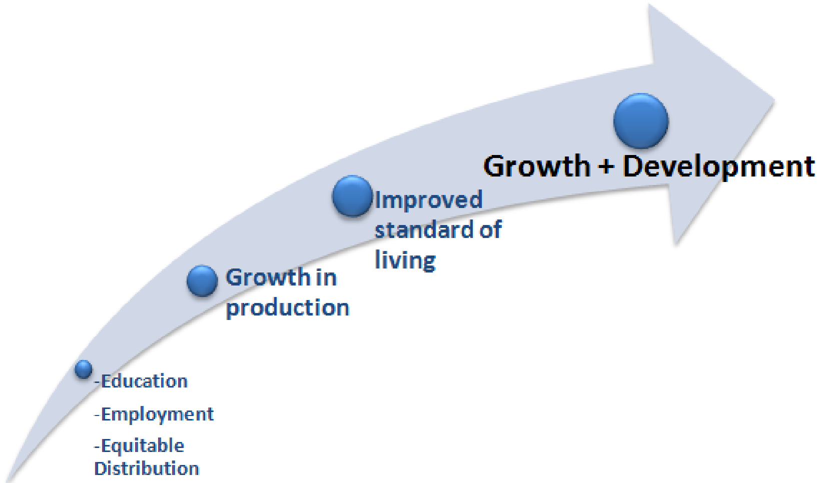


Figure 3: Inclusive growth in a cluster

Inclusive growth starts with pre-requisites like education, employment and equitable distribution. This in turn leads to an increase in levels of production which in turn generate more buying power thereby improving standard of living. The doctrine of inclusion thus leads to stable growth coupled with equitable development. Inclusion involves autonomy and accountability of local bodies and grass root organisations, combating corruption, and poverty alleviation which will lead to larger benefits like end of terrorism and drug addiction.

Clusters are drivers of the nation and employ over 41 million people. Thus their reach and penetration into the society is larger compared to larger firms and MNCs. Hence it becomes imperative to include inclusive growth in the ongoing and planned cluster interventions.

1.4 Role of energy in inclusive growth in clusters

The Energy Scene of India

India is one of the poorest consumers of energy in the world. It is interesting to note, on the other hand, India may appear to be more energy efficient having an energy intensity of GDP of 0.16 Kg. per PPP$ of 2003 income, while it has been 0.23 for China, 0.22 for US, the world average being 0.21. However, this impression is not true. These data only reflect inadequate access of a large section of households of India to commercial energy, inadequate development of infrastructure and the manufacturing industrial sector.

Countries	GDP per capita (PPP $2000)	Poverty Ratio (national poverty line)@	TPCES intensity of GDP (Kgoe/ PPP 2000$	Electricity Intensity of GDP (Kwh / PPP 2000$	Share of Industry in GDP (percent)	TPCES per capita (Kgoe)	Electricity Consumption per capita (Kwh)
China	4838	4.6	0.23	0.29	53	1090	1379
India	2732	28.6	0.16	0.20	26	439	553
USA	35487	-	0.22	0.37	23	7835	13066
World	8180	-	0.21	0.31	28	1688	2429

Notes: TPCES-Total Primary Commercial Energy Supply
@ The figure for India is from National Sample Survey 1999-00 and for China the figure for 1998
Source: Planning Commission , 2006 b and World Development Report 2005

Mtoe: million tonnes of oil equivalent

Table 1: Selected Energy indicators for 2003

As the commercial energy (electricity) intensity of industry is the highest among all the sectors, the average energy intensity of GDP in the economy may not decline if the targets have to be achieved and if energy conservation and efficiency of energy use and supply do not substantively improve. In view of such growth perspective, the Integrated Energy Policy Document of the Planning Commission has projected the requirement of massive growth of total primary commercial energy supply and electricity of the country, which are summarized in table.

Year	Population Million	TPCE	TPNCE	TPE	Total Electricity at bus bar
2003-04		324	-	-	51.00
2006-07	1114	397	153	550	55.00
2011-12	1197	546	169	715	83.00
2021-22	1347	1011	181	1192	173.00

TPCE= Total Primary Commercial Energy, TPNCE= Total Primary Non-Commercial Energy, TPE= Total Primary. **Source: Planning Commission (2006b)**

Table 2: Energy requirements of India for 9% GDP growth

In order to resolve the problem of poverty in a sustainable manner, the sectoral distribution of GDP growth of India requires a change, which may not allow any further significant decline in value-added or GDP elasticity of commercial energy or electricity for some time.

Energy and inclusive growth in clusters

As energy is both a consumption item for the household and a crucial input for sustaining the growth of production activities, which provide employment and income, we need to identify carefully the priorities in policy making which would be important for providing direct and indirect support for energy transition for the common people of India. The best way to stimulate a long term and self-sufficient development is to create a good business environment. This environment is characterised by a high awareness and availability of information in combination with well functioning firms. However, this is in many cases not disseminated to individual firms due to several barriers such as lack of understanding and information and limited resources for marketing and information activities. At this juncture clusters together play a significant role by reducing information and implementation costs. Moreover clusters having a deeper penetration into the population and can tackle energy issues in a way that brings forth the larger benefit of society and environment. They are thus the critical mass which can help reduce barriers between development agencies, government, firms and thereby the society.

1.5 Environment and Energy: Interdependences

There is interaction among energy, environment and sustainable development in an economy. As most of the environmental problems are associated with energy use and economic development without energy use is difficult, there is an “energy trilemma” involving energy consumption, economic development and environmental impact ***(Khan, 1992)***. It is very difficult to come out of this vicious circle especially for developing countries with their expanding economic activities causing amplified energy consumption. Of agriculture, industry, commerce, transport, and residential sectors, the industrial sector is the largest energy consumer in most developing countries ***(Ross, 1997)***. At the global level, the industrial sector is the largest energy-consumer accounting for about 32% of total energy use ***(IEA, 2004)***.

A study of environmental pollution by SSI clusters in Karnataka has identified labour skill levels, owner qualifications, and technology levels as important factors in explaining the energy consumption and environmental impact of SSIs (Subrahmanya and Balachandra, 2002). The figure below outlines the multiple factors that affect energy usage and its efficiency in SMEs.

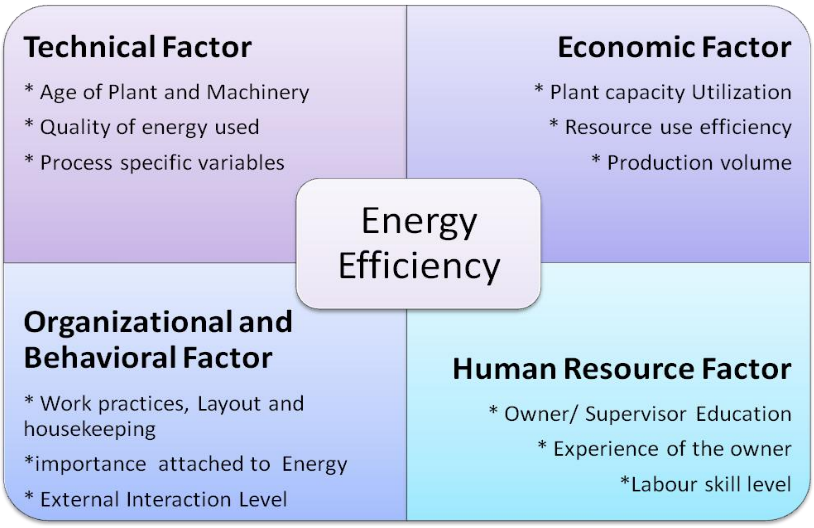


Figure 4: Factors Influencing Energy Efficiency in the SSI Clusters

Thus, it is implied that while the need for technology up gradation to enhance Energy Efficiency and hence sustainability of MSMEs clusters is undisputable, this alone cannot succeed in meeting the goal either. But, human resource, economic, organizational and behaviour issues of SSIs also need to be properly addressed for fruitful results.

1.6 Cluster approach for mapping energy

Characteristics	Registered MSME Sector	Unregistered MSME Sector	Total MSME Sector
No power needed	3, 60,611(26.23 %)	38, 55,035 (42.15%)	42, 15,646 (40 %)
Coal	28,841 (2.10 %)	2, 95,165 (3.23 %)	3, 24,006 (3.1 %)
Oil	40,401 (2.94 %)	5, 55,416 (6.07 %)	5, 95,817 (5.66%)
LPG	7,222 (0.53 %)	55,237 (0.60 %)	62,459 (0.59 %)
Electricity	8, 99,657 (65.43 %)	40, 25,262 (44.01%)	49, 24,919 (46.8%)
Non-conventional energy	7,142 (0.52 %)	60,539 (0.66 %)	67,681 (0.64 %)
Traditional energy/ Firewood	31,100 (2.26 %)	2, 99,562 (3.28 %)	3, 30,662 (3.14 %)

Source: Third All India Census of SSI, Ministry of MSME (reference period 2001-2002)

Table 3: Distribution of main sources of power

The above table clearly indicates that:

- A large percentage of MSMEs (40%) do not require any power and these are mainly micro enterprise based rural clusters as most of their operations are manual. Very little energy is utilised for lighting or heating purposes.
- Among the registered MSMEs, majority of them utilise electricity as their main power source and this category the traditional manufacturing industries including the service industries are the major consumers.
- It may be noted here that non-conventional energy sources are highly underutilized where only 0.64% of the MSMEs are using this form of energy.

A cluster approach for mapping energy is followed for the simple reasons cited below

- ***There exist a large number of clusters in our country and in spite of their miniscule individual consumption, as a collective they amount to almost 35% of total energy consumption.***
- ***Clusters are pockets of energy consumption because of geographical concentration of firms.***
- ***Possibility of a joint action for energy efficiency increases manifolds in a cluster when compared to other forms of industrial setup***
- ***Once the benefits of reduced energy consumption have been demonstrated to a few units in a cluster, the other units tend to follow and adopt the suggested measures.***

1.7 Current status of energy related interventions in Indian clusters

Studies carried out by researchers of various institutes around the world suggests that in the fast growing industrialised nations, policies are required to be framed with proper attention towards energy issues. It is also stated that there is a positive relation between energy intensity and value of output but a negative relation between energy intensity and factor productivities and therefore it is required to have a ‘energy efficiency improvement’ focus for enhancing SSI competitiveness.

The ongoing and completed interventions on Indian clusters can be categorised into two broad categories from the energy related interventions perspective:

1. **Classical Cluster Development Approach**: The classical cluster development approach focussed on holistic development of the clusters as such lot of effort was on joint action around various themes. Accordingly, the focus was not on energy intensive clusters. In the energy intensive clusters, the energy related interventions were largely short term in nature (pressure points) emerged as during diagnostic studies. The prominent programmes in this category are UNIDO’s Cluster Development Programme and MSE CDP of DC MSME.
2. **Focus on technology upgradation and energy efficiency**: Some of the cluster development programmes e.g. SBI Uptech focussed on technology upgradation and energy efficiency in the clusters, however remained limited to about 15 out of total 25 clusters. The clusters selected for intervention were highly energy intensive, e.g. Foundry, and Handtools. In these programmes the classical cluster development approach was not adopted wherein CDAs were not deployed and each agency adopted its own programme management structure. Three programmes that attached greater significance to energy are SBI UPTECH, SDC – TERI and UNIDO Handtool

Chapter 2: Jalandhar Sports Goods Cluster- a profile

2.1 Past and Present

The Indian Sports goods industry has its origins in Sialkot, Pakistan. During partition between India and Pakistan in 1947 many Hindu artisans moved from Sialkot to Jalandhar, Batala and Ludhiana. Jalandhar is now the major centre of India's sports goods industry. Meerut in Uttar Pradesh is the second and Gurgaon in Haryana is the third. Most of India's sports goods are exported to the United Kingdom, The United States of America, Germany, France and Australia.

Figure 5: Jalandhar, Punjab and Sialkot, Pakistan

The sports goods industry in India has witnessed a phenomenal growth over the past five decades and now occupies a place of prominence in the Indian economy in view of its massive potential for employment, growth and export. There has been an increasing emphasis on its planned development, aimed at optimal utilisation of resources for maximising the returns, particularly from exports.

2.2 Economic Profile

The following diagram shows the trend in export growth after liberalisation of the Indian Economy in 1991.

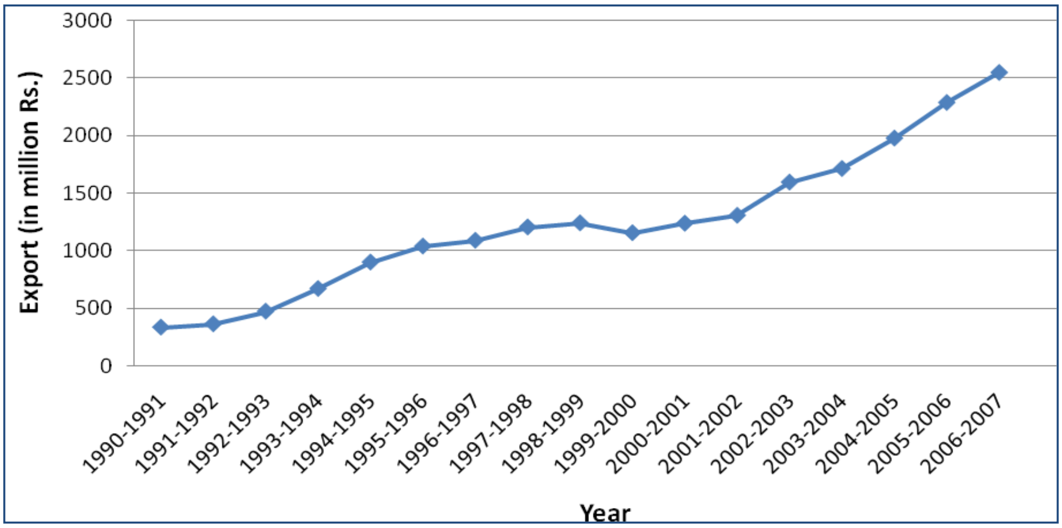


Figure 6: Sports goods Exports from India

Source: *Sports Goods Export Promotion Council of India*

The Indian sports goods industry manufactures 318 items. However, major items that are exported are inflatable balls, hockey sticks and balls, cricket bats and balls, boxing equipment, fishing equipment, indoor games like carom and chess boards and different kinds of protective equipment. It is a highly labour intensive industry which provides employment to the weaker sections of society and also employs a large number of women. Skilled labour is highly valued in this sector especially in the manufacturing of bats, shuttle cocks and stitching of match quality footballs.
In Jalandhar, three kinds of establishments are usually found:

i. **Big establishments**: These are generally geared to exports besides catering to the domestic market. They also have an in-house R&D facility for development of improved products. With almost all facilities inside its site, the company has little interaction with the other core cluster actors except probably the job workers i.e. ball stitchers. But again these workers are sufficiently engaged by the company, thus making them captive workers for the company. However, being at the leading edge of the technology, the company surely acts as a trendsetter for products and technologies in the cluster.

ii. **Small establishments**: These usually manufacture sports goods for the domestic market. Both the big establishments as well as the small establishments are registered either under the Factories Act, 1948, or under the Shops and Establishment Act of the state of Punjab.

iii. **Unregistered units**: These are found particularly in the urban pockets of Jalandhar. These units are mostly small home-based units which are usually run by the family members, but at times with the help of a couple of hired employees. These units do not have a direct access to market. It has been seen that many a times when the big establishments - especially exporters - are not able to cope with large orders from their foreign clients, distribute a share of the production to these small unregistered, home- based units.

The Jalandhar cluster is characterized by units which process the raw material to produce and subsequently market the finished product themselves. This may indicate the individualistic approach to business in clusters or no scope for division of units, as the different stages of production are confined to a unit itself. (UNIDO)

2.3 Cluster Map

Specification	Category	Details
Turnover	Approximately Rs. 7500 million	
Employees	Rural	1048
	Urban	4811
No. of firms	Rural	168
	Urban	714
Major Export markets	U.K, U.S.A, Australia, New Zealand, Italy, France, South Africa	
Major products	Inflatable Balls, Cricket bats, Hockey sticks, Protective Equipment	
Labour Intensity	High	
Technology Intensity	Low	
Energy Intensity	Low	

***Source**: DIC (District Industry Centre)*

Table 4: Snap shot of the Jalandhar Sports Goods Cluster as on 31st March 2006

It is important to iterate that the figures regarding number of firms and number of employees are based on the data from registered firms. This data does not reflect the true picture of the cluster as there are many firms which operate as house hold units and do not undergo registration. Cluster stakeholders and UNIDO estimates that the real employment figure falls between 55,000 to 60,000.

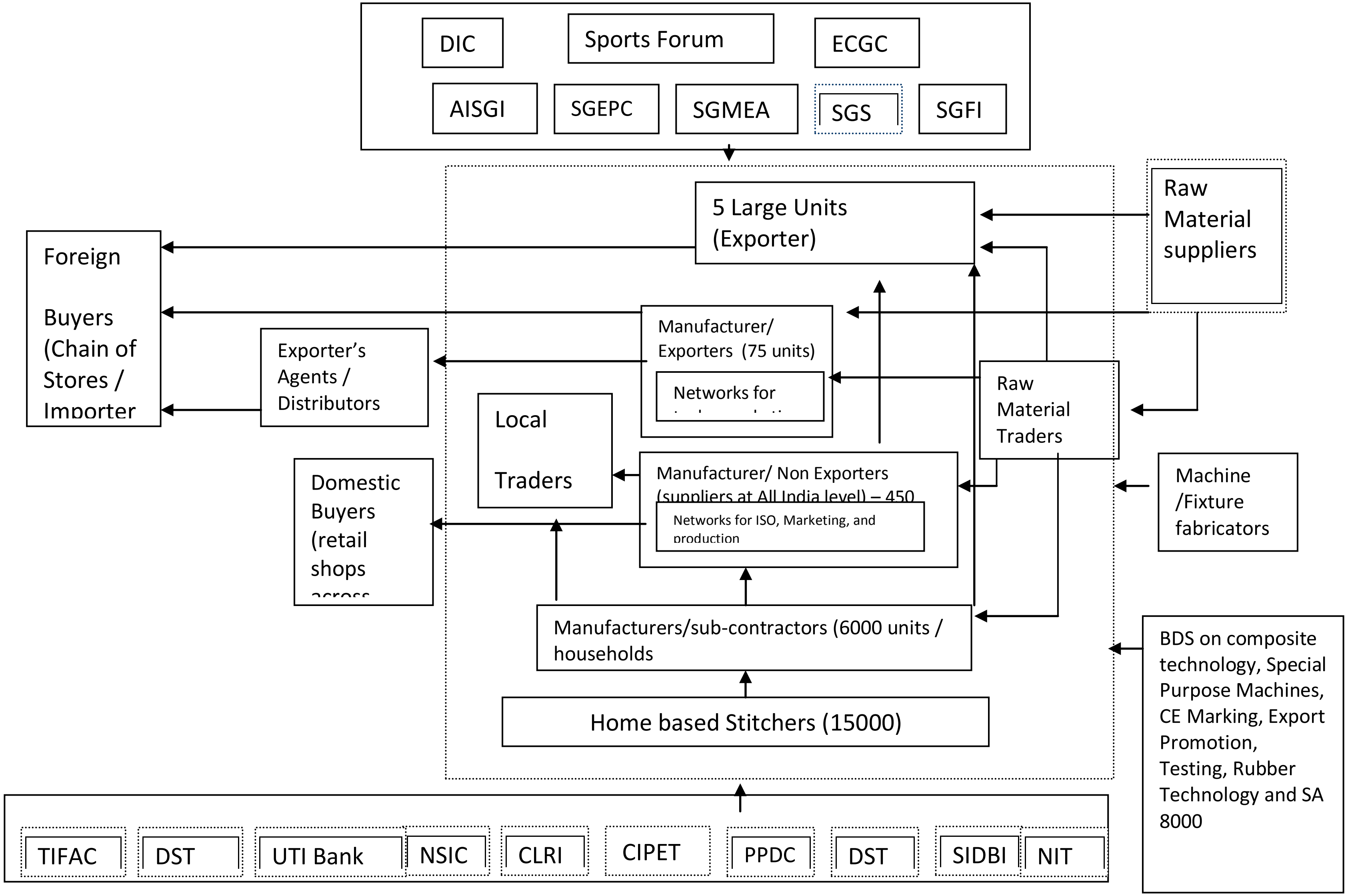


Figure 7: Cluster map of Jalandhar sports Goods Cluster

Chapter 3: Methodology

3.1 Methodology: A roadmap

Figure 8: Methodology road map

3.2 Exploratory Research

Exploratory research is a type of research conducted because a problem has not been clearly defined. Exploratory research helps determine the best research design, data collection method and selection of subjects. It could be in the form of secondary research such as reviewing available literature and/or data, or qualitative approaches such as informal discussions with stakeholders, and more formal approaches through in-depth interviews, focus groups, projective methods, case studies or pilot studies. Thus to gain an insight into the processes followed, points of energy consumption and saving, production rates, sources of energy employed, in the Jalandhar Sports Goods Cluster an exploratory research was carried out under which 3 firms were visited and secondary data was collected on the internet and through discussion with

- National experts
- Energy experts (professors, state electricity board officials, energy auditors)
- Firm owners
- Technicians

3.3 Problem Definition

A typical research begins with the identification and definition of problems and opportunities that exist. In the case of energy mapping of the Jalandhar spots Goods cluster the following problems were identified

- Sources of energy in a cluster
- Consumption areas
- Deficits faced by the cluster
- Actual requirement at cluster level
- Prediction of energy consumption for next 5 years
- Geographical location in the cluster with concentration of high energy consuming firms
- Impact on environment
- Possibility of a remedial intervention

3.4 Identification of data types and sources

Secondary data

It is essential to make a check for secondary data available with stakeholders before embarking on primary data collection. An attempt was made to collect secondary data of the following nature

- Energy related data of the sports goods cluster from the internet
- Publications of government departments like DIC, NIC, Ministry of Power, Ministry of Commerce, and Ministry of MSME
- Internal data from the firms in the form of previous energy audits

Primary Data

Primary data can be obtained by communication or observation. In the case of energy mapping observation method was preferred over communication as the data collected by observation is reasoned to be more reliable. Although observation can incorporate usage of sophisticated instruments for measurement, it was deemed beyond the scope and time of this project. All the primary data was collected by first-hand visits to the firms. Depending on the process involved and scale of the firm, observation schedules ranged from 1 to 2 hours.

3.5 Design of data collection questionnaire

The questionnaire is an important tool for primary data collection. Poorly constructed questionnaires can result in large errors and invalidate the research data. Hence a lot of effort and research was put in designing the questionnaire to be administered to respondents. The questionnaire was tested and checked on the following

Sports Industry firms: 2
Electrical appliance firm: 1
Electrical Engineering professors: 2
Mechanical Engineering professor: 1
Energy Auditor: 1
Details about the above respondents have been mentioned in annexure.

3.6 Sampling

3.6.1 Population definition

A focused problem definition is the most important step of any research project. Typically, an action is sought to be taken on a population. This project spent considerable time in making the population of concern precise. In this case the population of interest is the entire Jalandhar Sports Goods industry.

3.6.2 Sampling Frame

In the most straightforward case, it is possible to identify and measure every single item in the population and to include any one of them in the sample. However, in the more general case this is not possible. Imprecise populations are not amenable to sampling; therefore, as a remedy, we seek a *sampling frame* which has the property that we can identify every single element and include any in our sample. In defining the frame, practical, economic, ethical, and technical issues need to be addressed.

In the case of Jalandhar Sports Goods Cluster a frame has been selected keeping in mind the following limitations

- **Time**
- **Scattered location of industries**
- **Absence of a definite database of the industry at a single point**

The most pragmatic approach was to select industry associations as a sampling frame. Hence the secretariats of the following associations were approached

- SGMEA
- SGEPC
- AISGI
- SGFI

3.6.3 Sampling Method

Quota sampling

In **quota sampling**, the population is first segmented into mutually exclusive sub-groups, just as in stratified sampling. Then judgment is used to select the subjects or units from each segment based on a specified proportion. It is this second step which makes the technique one of non-probability sampling. In quota sampling the selection of the sample is non-random according to some fixed quota.

The first step mentioned above was followed by dividing the population into sub-groups of

Inflatable Balls
Wood Based Products
Protective Equipment

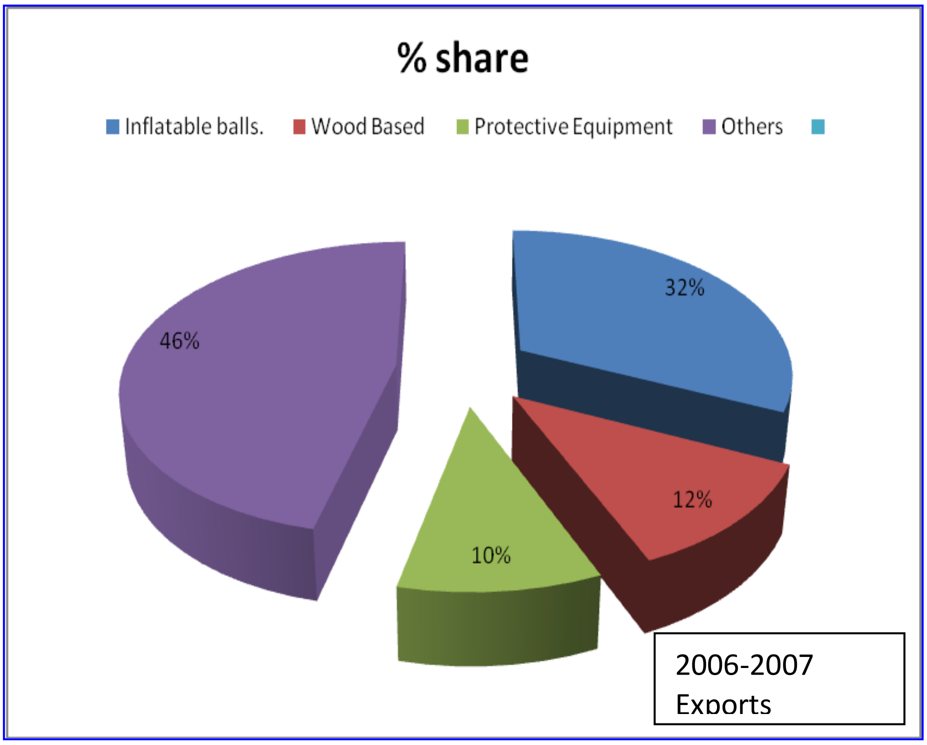


Figure 9: Percentage share of various sports goods in total exports from India

The second step incorporates selection of subjects based on a proportion and herein the categorization was done on basis of turnover. This is

Medium units (50 to 500 million)
Small units (0.5 to 50 million)
Micro units (upto 0.5 million)

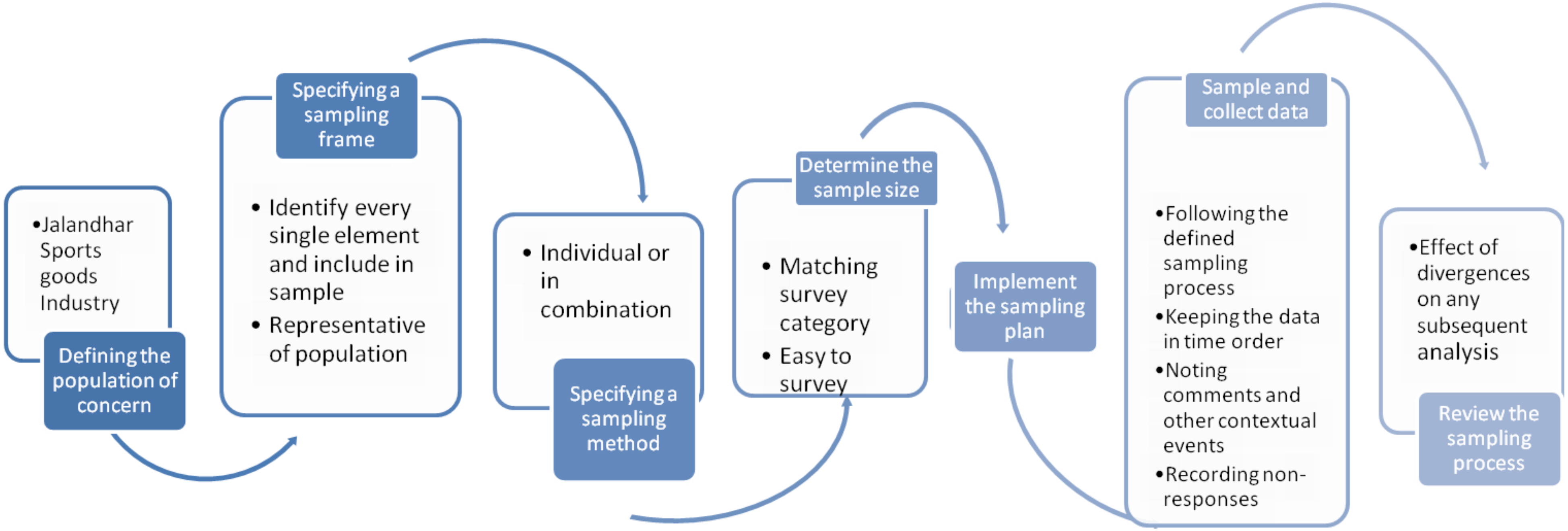


Figure 10: Diagrammatic representation of sampling process

3.7 Collection of data

To obtain clear, unbiased and reliable results, collection of the data was done adhering to the objectives and rules associated with methods and techniques. As mentioned above most of the data was collected using observation however in some cases it was essential to conduct interviews. Actual data collection can introduce some errors called non-sampling errors, which may be on part of interviewer who may introduce a bias by leading the respondent to a certain response or on part of respondent who may not respond correctly following several reasons. In the execution of energy mapping thorough care was taken to avoid leading firm owners and technicians to respond in a biased way. Care was also taken of the fact that respondent understands the question well, does not resort to guessing and is not fatigued or distracted while answering.

3.8 Analysis and interpretation of data

Before analysis was performed, raw data was transformed into right format. The data was tabulated to count the number of samples falling into various categories. The Jalandhar Sports goods cluster is different in the sense that a firm may manufacture more than one product in different capacities throughout the year. The production is also not constant as the industry is seasonal depending on the ongoing tournaments and cups. Also the micro enterprises do not produce a whole product and usually operate as sub-contractors. Taking cognizance of these facts it was most appropriate to arrive at a consolidated figure of total energy consumption and deficit based on the number of units produced in each product category per year. This number was verified a number of times from cluster stakeholders, market experts, export figures and national experts from UNIDO.

3.9 Interim presentation

An interim presentation was conducted in the presence of UNIDO and MSME foundation national experts to cement any gaps found in the analysis or data collection. Keeping in mind their feedback, a review was done which could aid in shaping the final report in a desired manner.

3.9 Preparation of research report

The format of an energy mapping report can vary with the nature of products, energy intensity of the cluster and needs of the organisation initiating energy mapping.

Table 5: **Summary of sampling**

Category	Sample	Population	Sample as a percentage of population
Medium	11	35	32%
Small	9	130	7%
Micro	10	330	3.5%
Total	30	495	6%

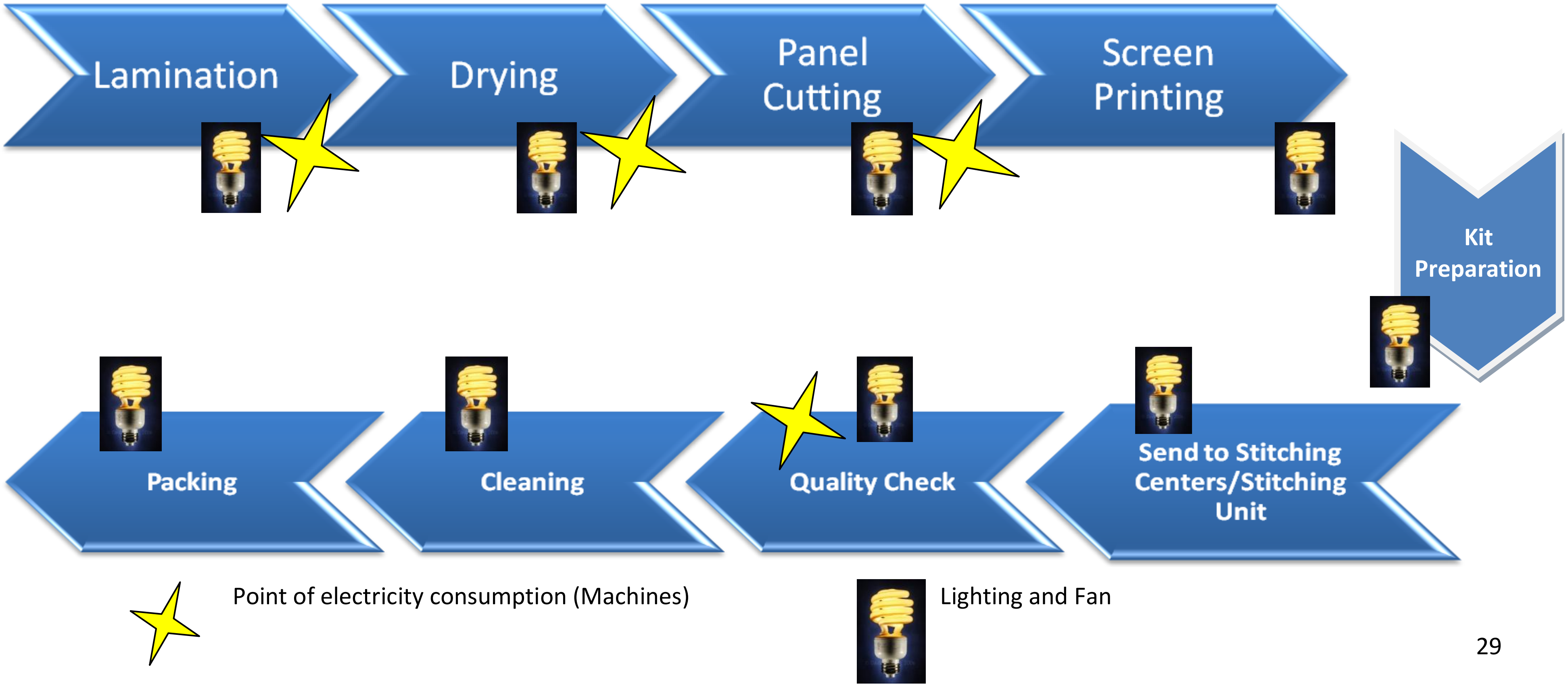
Chapter 4: Findings and Analysis

4.1 Process Flow

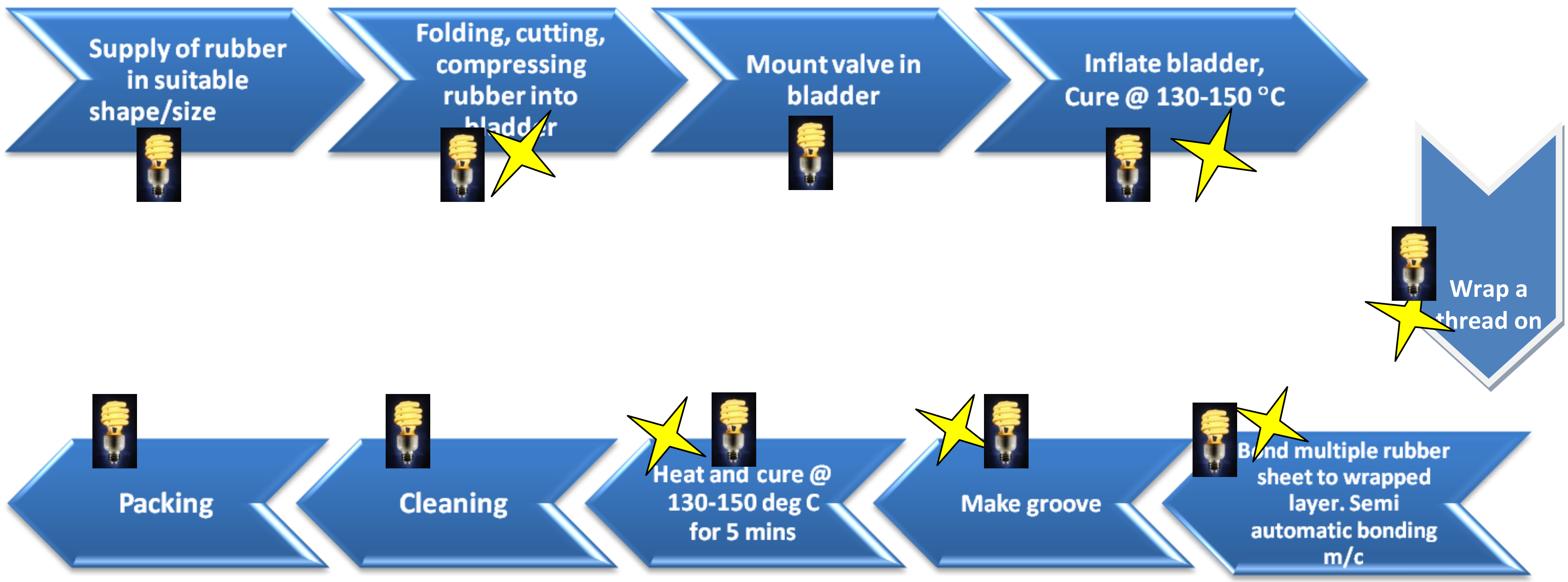
4.1.1 Soccer Ball manufacturing process

The production process of a hand-stitched soccer ball can be classified into following three major processes; each of which comprises of several sub processes:

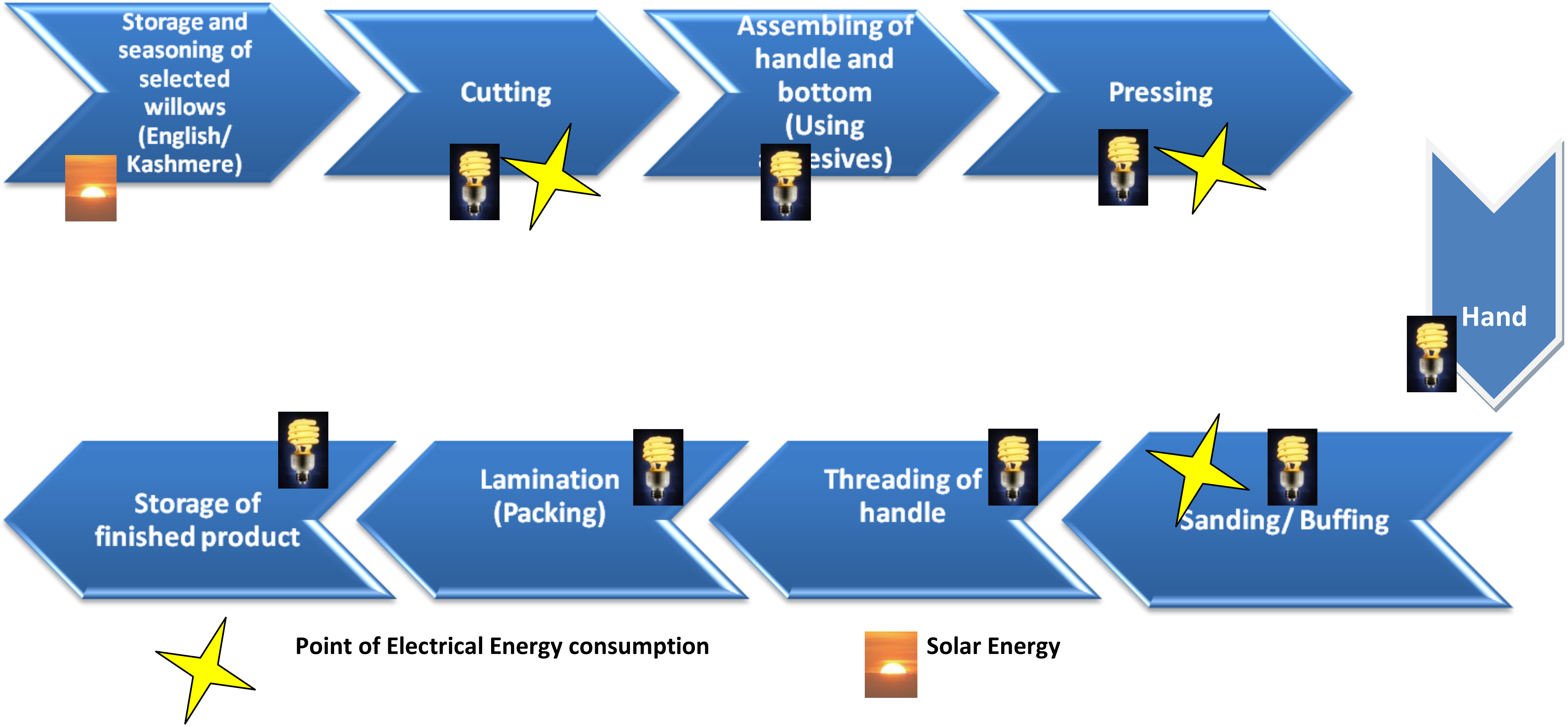
i) Pre-processing (Lamination, Drying, Panel cutting, Screen printing, kit preparation)
ii) Stitching (at stitching centres in house or in households)
iii) Packing and shipment (QC, Cleaning, Packing)



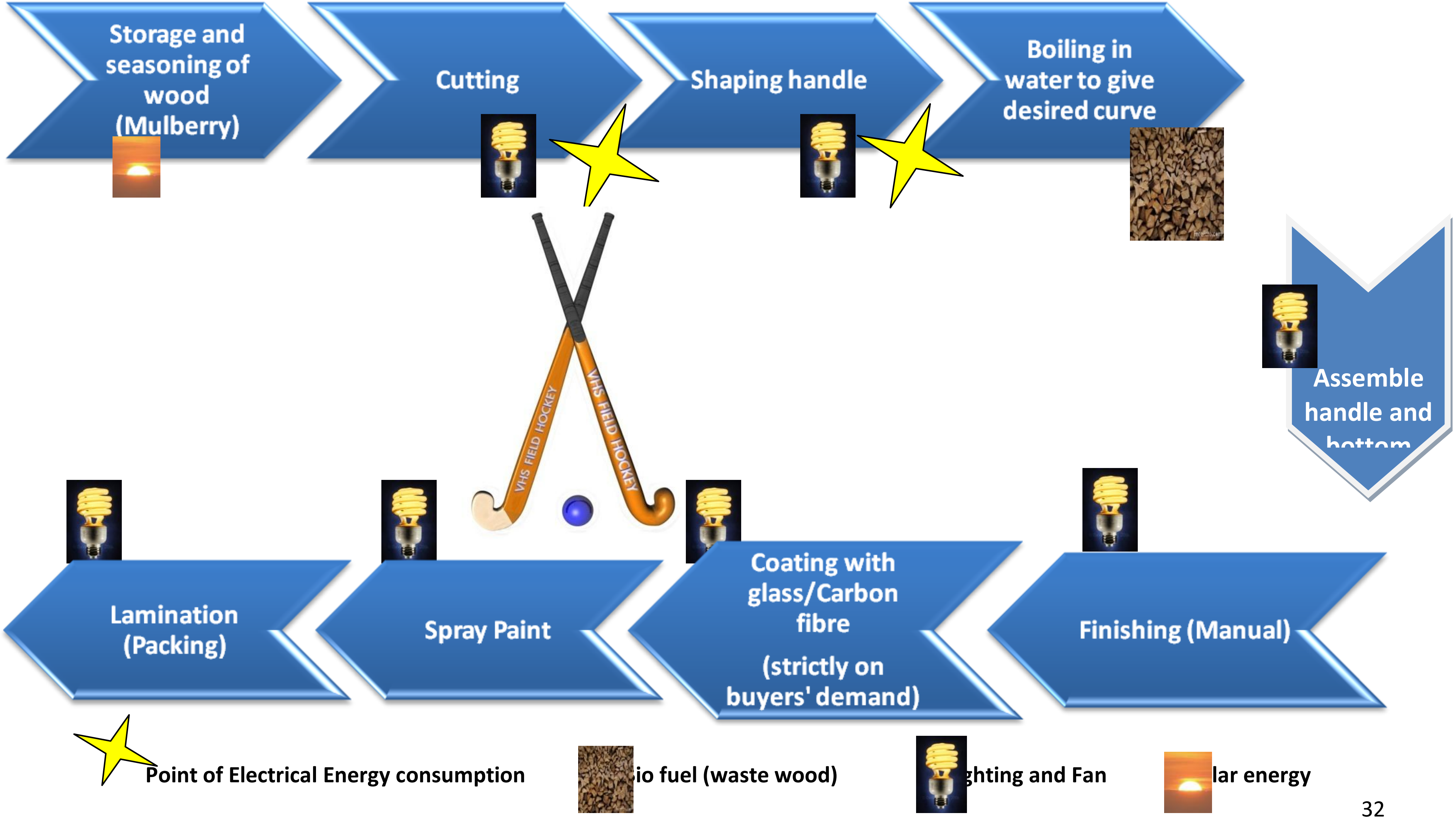
4.1.2 Basketball manufacturing Process



4.1.3 Cricket Bat manufacturing process



4.1.4 Hockey Stick manufacturing process



4.1.5 Protective Equipment manufacturing process

4.2 Energy Consumption pattern

4.2.1 Source Wise

Thirty units were visited for data collection where detailed Energy Mapping was carried out. All the Energy sources being utilised were identified and quantified through Activity Based Energy Mapping. This was done for all the product categories. In case a firm is manufacturing two or more product types, they were treated as separate for energy mapping. At the same time, the firms total consumption was kept in mind to cross check with the results obtained from activity based mapping. For comparing their contribution in the total Energy consumption the Energy value of various energy sources was converted to a common unit (KWH). Various Energy sources and their daily consumption at cluster level are shown in the table below:

S. No.	Energy Source	Total Quantity	KWH Equivalent
1	Electricity	35349.3 KWH	35349.3
2	Diesel	1050 litres	11308
3	Solar		1500
	Total Energy Consumption		**48157.3**

Table 6: Cluster wide daily consumption for the months of May-Jun-July 2008

S. No.	Energy Source	Total Quantity	KWH Equivalent
1	Electricity	47657.3 KWH	47657.3
2	Solar		1500
	Total Energy Consumption		**48157.3**

(Approximated per day consumption)

Table 7: Cluster wide daily consumption for rest of the year

The source wise distribution of energy is calculated based on the following assumptions

i) Approximately 35,000 kWh of electrical units are available from state electricity utility throughout the year.

ii) The industry faces a deficit of about 11,000 units due to power cuts in the summer months of May-June-July. This deficit is supplied by Diesel generator which the medium and small firms have in-house.

iii) The industry faces almost no deficit for rest of the nine months and hence its requirement of total 48,000 units (app.) is fulfilled by the state electricity utility.

iv) Wood based products require solar energy for cleft seasoning which is available free of cost.

Hence total electricity consumption for a year is calculated as follows:

- (35349 units for 102 days + 47657 units for 204 days)= 13327626 are provided by state electricity utility
- (11308 units for 102 days)= 1153416 are provided by diesel generation
- (1500 units for all 306 days)= 459000 are provided by solar energy

Source	Units (kWh) consumed per annum	As a percentage of total
Electricity	1,33,27,626	89%
Diesel	11,53,416	8%
Solar	4,59,000	3%
Total	1,49,40,042	100%

Table 8: Source wise per annum consumption of energy (in electrical units)

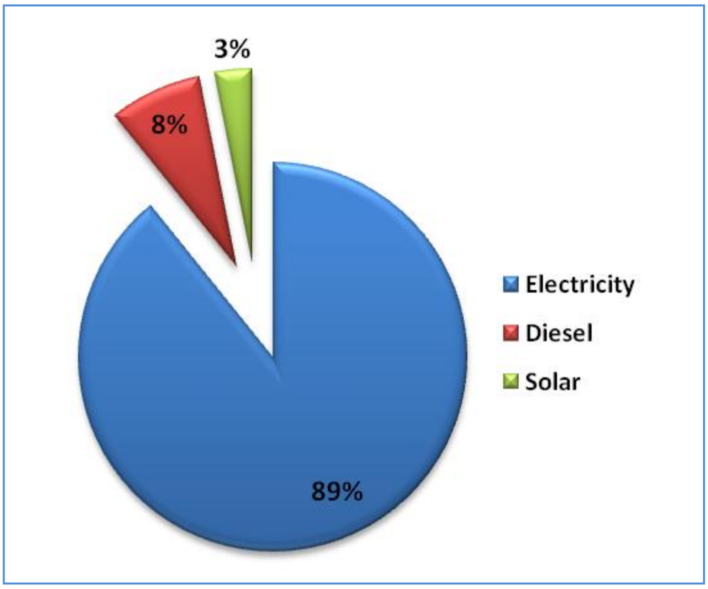


Figure 11: Source wise distribution of total energy consumed per annum

4.2.2 Process Wise

At this juncture it becomes essential to know that what product category (process) in the sports goods consumes how much percentage of the total energy consumption. As is already mentioned in this study we have taken three product categories namely Inflatable Balls, Wood Based Products and Protective Equipment. Someone might argue how far this categorisation is correct and hence here the author wishes to emphasize that a close scrutiny of most products manufactured in the Jalandhar cluster also reveals that the 3 products mentioned above are the ones which have most energy intensive processes. The other products are generally manufactured by hand and hence do not contribute to the energy consumption pie in a significant way. An estimate can hence be drawn to what is the total contribution of each process based on the number of units produced per year in that product category.

The following table sums up each process's output and energy consumption over a year.

Product	Cost of energy per unit (Rs.)	Approximate no. of units produced per year (million)	Total cost of energy per year (Million Rs.)
Football	2.5	15	37.5
Basketball/Rugby Ball	6.9	0.3	2.07
Cricket Bat	1	0.5	0.5
Hockey Stick	0.37	0.011	0.004
Protective Equipments	0.5	10	5

Table 9: Process wise energy consumption

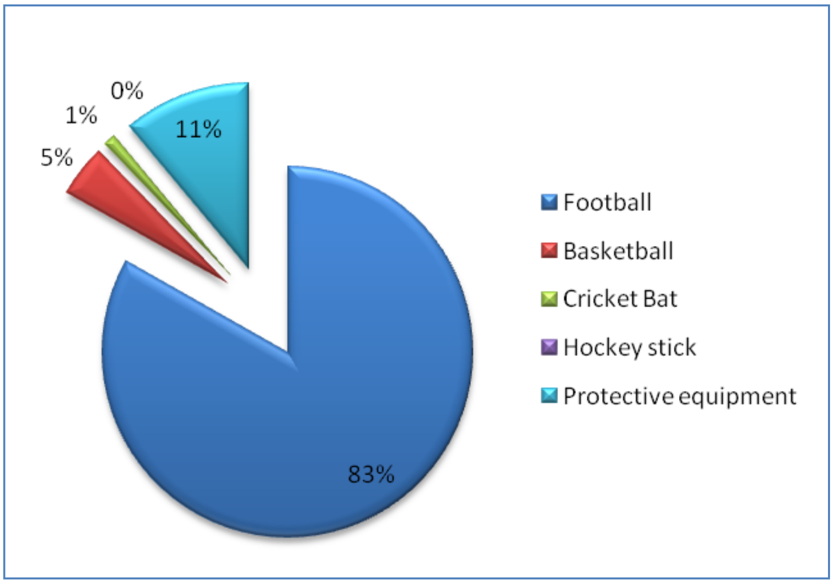


Figure 12: Process wise distribution of energy consumption

4.2.3 Activity wise

As mentioned at the beginning of this chapter, total energy consumption has been calculated by breaking each process into smaller activities in the value chain such as

- Light and fan load at all levels
- At in bound logistic
- Handling
- Processes
- Output product handling
- Out bound logistic
- Any other process involved

Based on the above parameters, the following diagrams depict the energy consumption share of activities in the value chain.

4.2.3.1 Soccer Ball

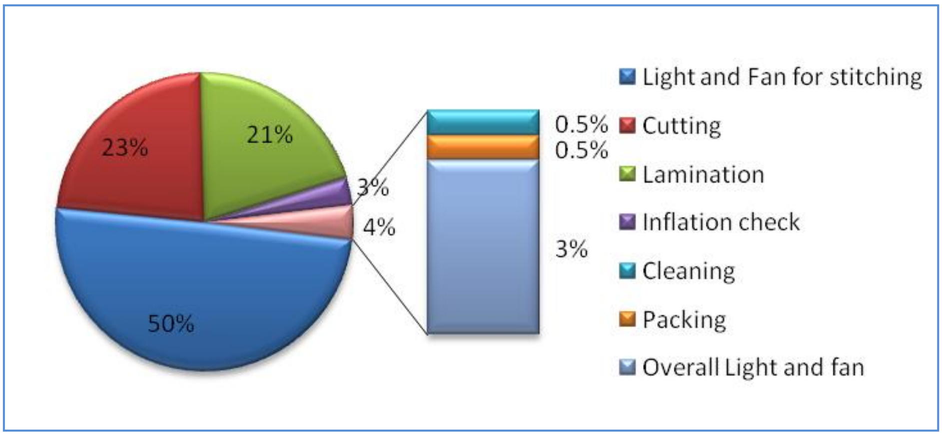


Figure 13: Activity based distribution of energy consumption for Soccer ball manufacturing process

4.2.3.2 Basketball

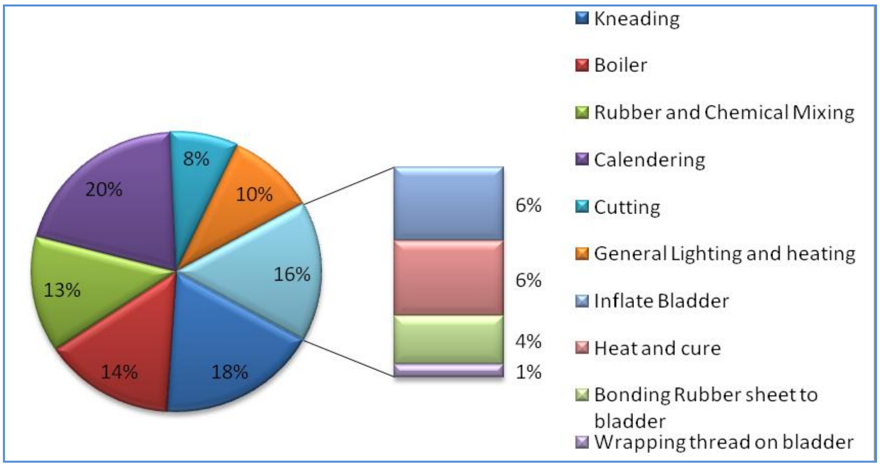


Figure 14: Activity based distribution of energy consumption for Basketball manufacturing process

4.2.3.3 Cricket Bat

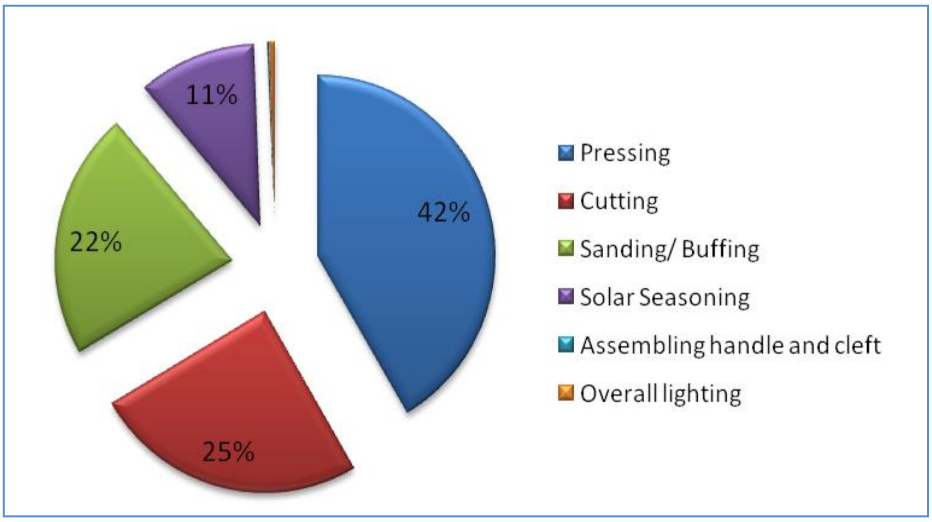


Figure 15: Activity based distribution of energy consumption for Cricket bat manufacturing process

4.2.3.4 Hockey Stick

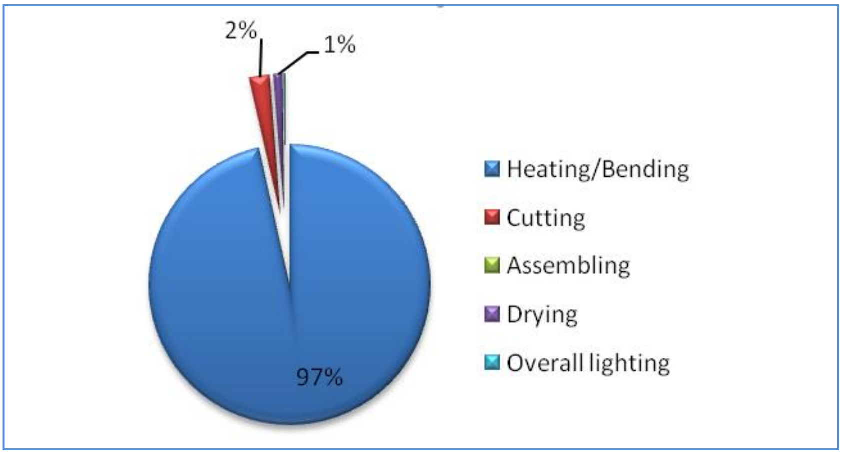


Figure 16: Activity based distribution of energy consumption for Hockey Stick manufacturing process

4.2.3.5 Protective Equipment

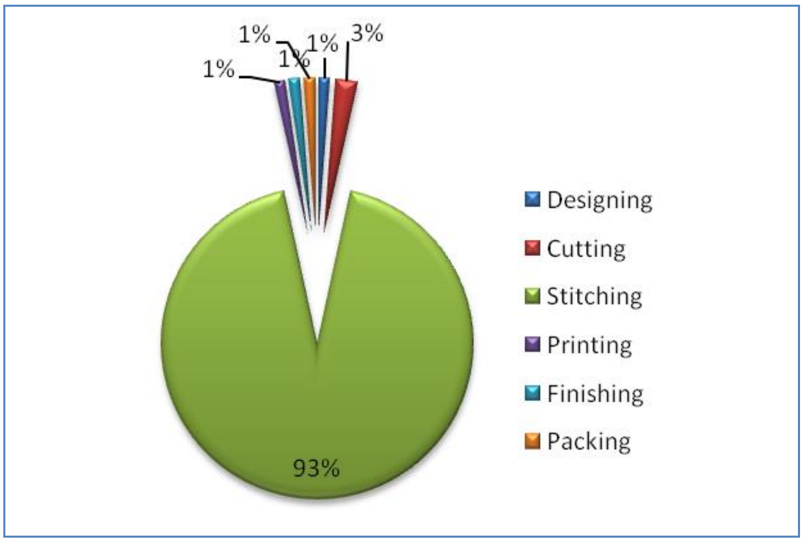


Figure 17: Activity based distribution of energy consumption for Protective Equipment manufacturing process

4.3 Energy cost analysis

As electricity from state utility is used throughout the year most of the energy cost is attributed to it. The other major component is diesel cost which the firms use when they face power cuts. Diesel is put to use mostly in the summer months when electricity is in short supply due to its diversion to agriculture loads. Solar energy and biomass firewood) are available free of cost.

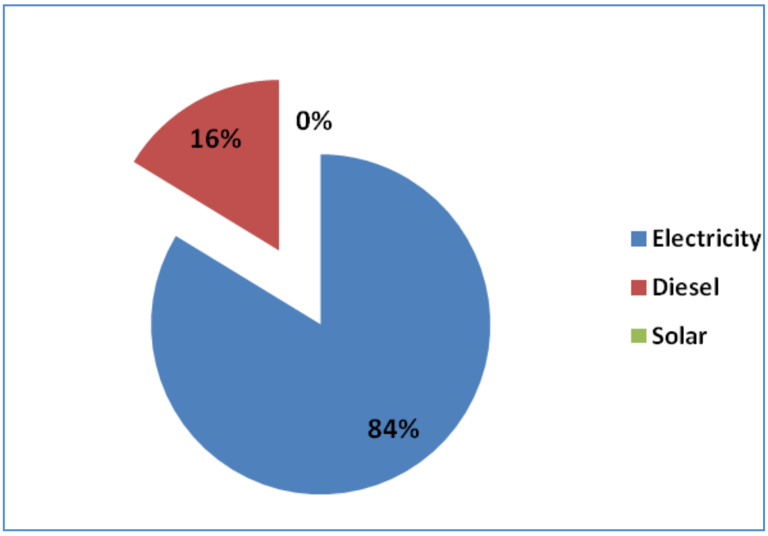


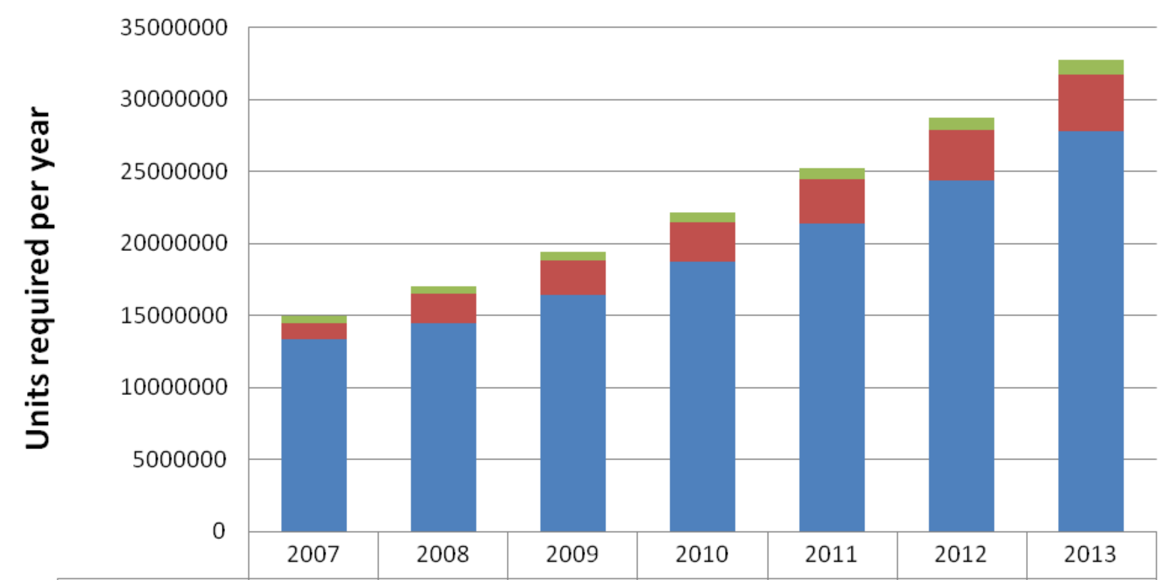
Figure 18: Distribution of total energy cost on different sources of energy

4.4 Projections

Toys and Sports have always been a major part of any person's childhood and grown up life, especially in western countries. The advent of media has been responsible in promoting sports as a religion rather than an activity to remain fit. More and more people all across the globe are purchasing sports equipment for personal use and also for promotional purposes. Jalandhar Sports industry has also witnesses a stupendous growth in its turnovers in almost all years of its existence. Exports have registered a double digit growth for most of the last 20 years. The same is true for domestic market as government is promoting sports as a subject in school education. This trend is expected to continue for years to come. As the production increases so does the demand for energy required to produce bigger volumes of products. Keeping in mind this upward trend energy requirement of the Jalandhar sports goods cluster has been projected with due consideration of the following assumptions.

Assumptions

1) 15% growth in production as per past trends
2) 5% increase in energy deficit per year
3) Deficit met by Diesel generation*



	2007	2008	2009	2010	2011	2012	2013
Solar units	459000	523260	596516.4	680028.7	775232.7	883765.2	1007492.
Diesel Units	1153416	2074568.	2365008.	2696109.	3073565.	3503864.	3994405.
Electrical Units	13327626	14433819	16454554	18758191	21384338	24378145	27791086

Figure 19: Energy demand projections for next five years

*****_Talks with cluster firms and stakeholders revealed that in the coming year's deficits are to be met by diesel generation alone. Firms are averse to idea of investment in non-conventional sources like solar and wind because of the high investment cost and also because energy is not a high priority area for a business of this nature. Therefore calculations are done based on the assumption that all deficits will be met by diesel generation facilities within the firms' premises._

4.5 Environmental Impact

Industry has emerged as the major energy-consuming sector in India as well, with a share of about 42% of the total energy consumption ***(Reddy and Balachandra, 2003)***. Even though India's industrial sector comprises both small and large-scale enterprises, the former accounts for a lion's share of total number industrial units.

Studies have shown that compliance to adhere to environment norms remains poor in the MSMEs. The enforcement of regulations and relocation of industries are difficult tasks, due to large number of geographically dispersed units involved as well as the social and political dimensions associated with closure or relocation. Other reasons for poor compliance include (i) lack of off- the shelf technological solutions; (ii) lack of awareness in the industries; (iii) fear of reduced profits. ISO-14001 certification is almost negligible in the small-scale sector. A study during 1999-2000 reported that all the 25 small and medium (SME) units certified to ISO-14001 belonged to the category of medium-sized enterprise. The same has been found to be true for the Jalandhar sports Goods cluster with only 10-15 of the firms being ISO certified. The study identifies lack of awareness, lack of management commitment, prohibitive cost of certification etc. as the main reasons for low ISO- 14001 certification level in SME sector. The experience from the work carried out during energy mapping of Jalandhar sports goods cluster shows that an approach based only on conventional command and control regulation will not work for environmental management in MSMEs. Also since this project focuses only on energy mapping it tries to show various socio-economic and natural environmental impacts at different points of energy consumption. The matrices I, II, III, IV, V and VI in appendix list out the impacts of different activities and the source of energy being utilised for the same. The matrices are broken down based on product categories.

A summary of the detailed environmental impacts is as follows:
Occupational hazards of the following kinds are observed in processes which involve usage of electricity and diesel as a source of energy

- Noise Induced Hearing Loss
- Respiratory Problems
- Exposure to chemicals,
- Posture
- Damages due to inadequate lighting

Environmental impacts of the following kinds are observed in processes which involve usage of electricity and diesel as a source of energy

- Air Pollution
- Noise Pollution
- Solid waste generation

Usage of solar energy leads to the following impacts

- Saving conventional sources of energy
- Reduced costs as solar energy is available free of cost

4.6 Geographical concentration of high end energy consuming firms in Jalandhar Sports Goods Cluster

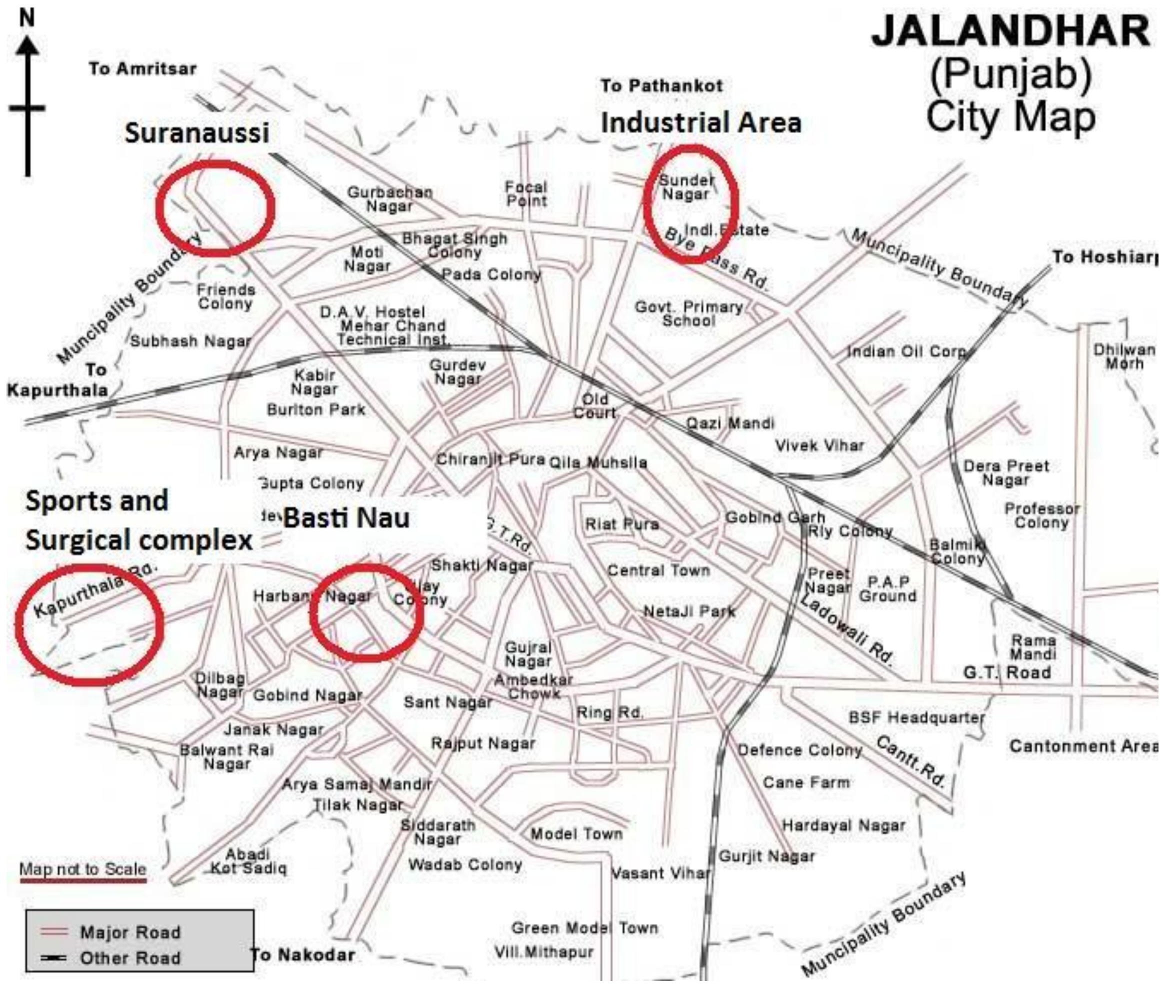


Figure 20: Jalandhar City map with concentration of high energy consumers

Area	Approximate No. of high energy consuming firms*	Approximate consumption per day (kWh)
Basti Nau	15	5000 units
Industrial Area	12-15	6000 units
Kapurthala road (Suranaussi)	10	5000 units
Sports and surgical complex	15	7500 units

All of these firms are medium sized firms

Table 10: Distribution of high energy consuming firms across the Jalandhar Sports goods Cluster and their approximate consumption per day

4.7 Factors affecting Energy Efficiency

4.7.1 Technological Factors

In the Jalandhar Sports Goods Cluster, most of the bigger units i.e. with more than Rs. 50 million turnovers have good quality machines which are maintained under preventive maintenance schedules. Moreover the units have recently shifted to new facilities in Leather Complex and Sports & Surgical Complex. The units are 6-9 years old and hence in much better condition than the older factories.

In case of the small and micro enterprises there lies much need and scope for improvement in terms of machine up gradation and maintenance.

4.7.2 Economic factors

The sports goods industry in Jalandhar is a very labour intensive industry. Only a few products like rubber-based products and some parts of other products use conventional sources of energy in production. Sports industry is facing tough competition from Chinese products. The Jalandhar industry is specially feeling the heat because of higher taxes in Punjab when compared to other states like Uttar Pradesh. As a result owner-managers are more concerned about the cheapest fuel available so that the product is price-competitive to stand the cut-throat competition from abroad and within India.

4.7.3 Organizational and behavioral resource factors

Energy is not a high priority area for improvement and also due to lack of mechanization in most of the processes there is very less focus on energy issues. This is mainly due to the fact that total energy cost is a very small part of the total manufacturing cost which is dominated by labor and raw material costs. There is virtually no energy policy in most of the firms.

4.7.4 Human resource factors

Although the technicians do not understand the concepts behind energy efficiency, they have developed an unwritten code of operation which aids in energy efficiency achievement. Much needs to be done as most of these measures are driven by experience rather than knowledge.

4.8 Scope of energy efficiency

4.8.1 High priority areas

As is evident from the figure below, more than half of the energy consumption in Jalandhar Sports Goods cluster is on account of motors. The micro and small firms usually have only lighting and fan loads connected but in case of medium firms machines utilizing motor power are found to be present in sufficient number to contribute to more than 50% of the energy cost incurred. The following diagram gives a cluster wide picture of the distribution of points of energy consumption, based on cost of energy consumption.

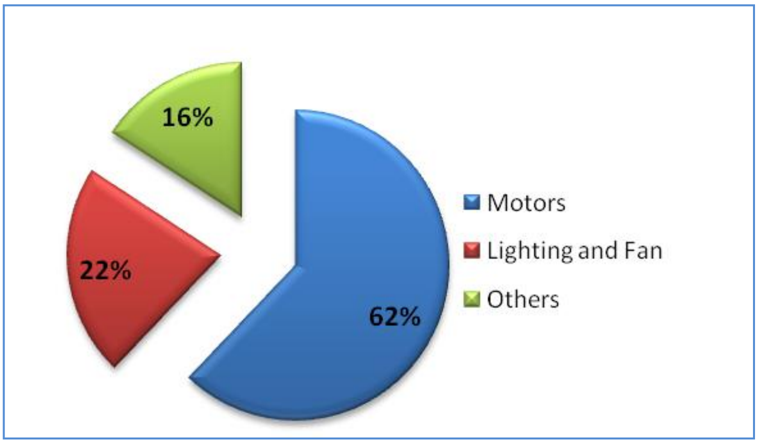


Figure 21: Percentage distribution of points of energy consumption

Although electric motors are responsible for major costs incurred, the author wishes to focus on lighting and fan as a high priority area for implementation of energy efficient measures. This is for three simple reasons

i) Implementation of energy efficient measures related to lighting and fan is easiest to execute
ii) Costs are least when compared to additional costs incurred in other machines
iii) The micro and small sized firms primarily have light and fan loading

4.8.2 Energy efficient measures: Lighting and fans

Lighting accounts for a significant portion of electricity use in all countries and in all sectors. In India, lighting accounts for an estimated 13 % of electricity use, including approximately 28 % of residential sector use, 50 % of commercial sector use and 9 % of industrial sector use in India. A recent analysis prepared for the World Bank estimated that cost-effective measures could reduce lighting energy use by 35%. (**Nadel et al, 1991)**

Valia (2005) studied about lighting industry in India and found that during the last five years of

the 20th century, the lighting industry in India has seen several changes – in terms of turnover, energy requirement, style and architecture of the products, demands from professionals and end users, system approach rather than product approach and so on.
An analysis of the total lighting load in the Jalandhar sports Goods cluster gives the following findings.

A	B	C	D	E=(B*40*D)+(C*60*D)	F=E*4*10^-3	G=F*306*4.5	H=((B*20*D)+(C*20*D))*306*4.5	I=G-H	Expenditure on the new installations
Scale	**TL (40W)**	**Incandescent Lamp (60W)**	**No. of firms**	**Total wattage consumption (per hour)**	**Units (kWh) consumed (in 4 hours)**	**Per year expenditure (Rs.)**	**Replacement with CFL**	**Savings**	
Medium	300	50	15	225000	900	1101600	514080	587520	2145000
Small	10	4	300	192000	768	940032	411264	528768	
Micro	1	2	4000	640000	2560	3133440	1175040	1958400	
Total					4228	5175072	2100384	**3074688**	**Payback period** 9 months

Table 11: Analysis of lighting load in Jalandhar Sports goods Cluster

Rosenfeld (1991) proposed use of CFL as energy efficient mean; CFLs provide a giant gain in efficiency, producing 2-4 times the light of an incandescent bulb of comparable wattage.
Johnson et al (1993) proposed use of halogen lamps as energy efficient mean; Halogen lamps enclose the filament in a glass capsule filled with halogen gas. As a result the filament burns hotter and more efficiently. Halogen lamps reduce energy use by approximately 10 % compared to standard general service incandescent lamps.

The advantages of using CFLs are four-fold

- **Efficient**: CFLs are four times more efficient and last up to 10 times longer than incandescents. A 22 watt CFL has about the same light output as a 100 watt incandescent. CFLs use 50 - 80% less energy than incandescents.

- **Less Expensive**: Although initially more expensive, money is saved in the long run because CFLs use 1/3 the electricity and last up to 10 times as long as incandescents. A single 18 watt CFL used in place of a 75 watt incandescent will save about 570 kWh over its lifetime. At 8 cents per kWh, that equates to a $45 savings. Reduces Air and Water Pollution: Replacing a single incandescent bulb with a CFL will keep a half-ton of CO_2 out of the atmosphere over the life of the bulb. If everyone in the U.S. used energy-efficient lighting, we could retire 90 average size power plants. Saving electricity reduces CO_2 emissions, sulfur oxide and high-level nuclear waste.

- **High-Quality Light**: Newer CFLs give a warm, inviting light instead of the "cool white" light of older fluorescents. They use rare earth phosphors for excellent color and warmth. New electronically ballasted CFLs don't flicker or hum.

- **Versatile**: CFLs can be applied nearly anywhere that incandescent lights are used. Energy-efficient CFLs can be used in recessed fixtures, table lamps, track lighting, ceiling fixtures and porch lights. 3-way CFLs are also now available for lamps with 3-way settings. Dimmable CFLs are also available for lights using a dimmer switch.

As a generalisation the following table depicts measures for efficient lighting that can be employed at firm level to reduce expenditure on electrical energy

Present	**Wattage per hour**	**Replace with**	**Wattage per hour**	**Saving per annum (kW)**	**Saving per annum (Rs.)**	**Expenditure**	**Payback (Months)**
Fluorescent Tube with conventional choke	38.6	Fluorescent Tube with electronic choke	26.5	29.6	133	260	7
Incandescent Lamp	58.4	CFL	19	96.5	434	200	6
Mercury Vapor Lamp	399	Metal Halide Lamp	249	370	1650	2500	18
Total	496		295	496.1	2217	2960	18

Table 12: Calculated Savings and paybacks on implementation of efficient lighting techniques

4.8.3 Energy efficient measures: Motors

Greenberg et al (1988) found that motors are the largest end users of electricity in most countries in the world. It is estimated that in India 57 % of total electricity use is by motors. Approximately 60 % of this use is in the industrial sector. Motor electricity use can be reduced through use of energy- efficient motors as well as with improvement in power quality, and maintenance practices.

Dreisilker (1987) focused study on motors and found that optimal sizing of motors can reduce energy loss. Furthermore, a good maintenance program can reduce motor electricity use up to 10-15%. Proper temperature regulation and use of a mechanical stripping process during motor rewinding can eliminate further losses.

Krause et al (1988) found that a small number of market failures that limit the acceptance of efficient technologies and efficient industrial processes in both industrialized and developing countries.

Action Taken To Avoid Losses	Total Saving (Watts)	Total Saving Per Annum (Rs.)	Expenditure (RS)	Pay Back (Month)
• Rewinding • Change to roller bearing • Replacement with proper size of copper winding	680	7500	4000	7
	429	4720	5000	12

Table 13: Calculated Savings and paybacks on implementation of energy efficient motor and proper maintenance

4.8.4 Energy efficient measures: Boiler

Hughes (1976) studied the effect of excess air on combustion of coal-fired boiler. He has stated that the excess air varies with the type of fuel and moisture content of fuel. He has reported that 72 % of the heat value of the carbon is lost if carbon is not oxidized completely. He has also found that excess air above 300 per cent reduced the boiler efficiency to less than 35 per cent.

Bosnjakovic (1979) made an important contribution to the formulation of new criteria of performance and techniques of the assessment of thermodynamic perfection of the processes.

Rao et al (1980) stated that in oil fired boiler combustion at proper air supply can be obtained by maintaining O_2 and CO concentration of flue at minimum. He also stated that as percentage of excess air decreased, O_2 decreased to zero and CO_2 increased to maximum. By adjusting percentage of excess air when CO_2 concentration was raised from 4 to 14 per cent, the combustion efficiency increased from 30 to 70 per cent.

Francis et al (1981) studied the effect of air supply rate on oil fired industrial boiler. He stated that O_2 and CO in flue gas could co- exist in measurable quantities when the boiler was operated at deficient air supply rates. He has also stated that maximum combustion efficiency could be obtained when boiler was operated slightly on the excess airside.

Walsh (1981) has stated that for complete combustion of fuel in boilers, the chemical reaction between combustibles of the fuel and oxygen of the air requires certain time, temperature and turbulence. These three factors depend upon moisture content of the fuel and air – fuel ratio.

No.	Action Taken To Avoid Losses	Anticipated fire-wood savings per annum		Expenditure (Rs.)	Payback period (months)
		kg	Amount (Rs.)		
1	Providing Proper Insulation	810	2430	5,000	24
2	Reducing excess air in exhaust gases	21759	65279	NIL	NIL
3	Reducing steam pressure	2049	6148	2,000	4
4	Using heat of condensate	13857	42000	55,000	15
	Gross Saving	**38475**	**115857**	**62,000**	**24**

Table 14: Calculated Savings and paybacks on implementation of energy efficient measures in boilers

4.9 Intervention models

The recommendations for making the above stated EE options possible and viable are presented below:

4.9.1 Unit level

Medium Sized units

1. Since the Energy cost does not account for a significant share in the total cost of production, expecting that the units have a clear cut *Energy Policy and Energy Efficiency* targets is not viable. The least that can be done is that the medium sized firms get themselves energy audited so that small flaws become conspicuous and a remedy can be sought.
2. The units should look into the EE measures suggested in previous sections as per the technical suitability to their scale of operation and the investment option available with them.
3. Studies carried out by researchers of various institutes around the world suggest that Labour Skill Level is an important factor which influences the Energy Efficiency. Hence the medium scale units should have regular training programs/workshops on skill development of the Technical Staff involved in the operation.

Small Sized units

1. Small scale firms which have only 4-5 machines for manufacturing process should first focus on maintenance of these machines so that substantial savings can occur without much maintenance.
2. Subsequently the firms can focus on investment in new machinery depending on options available with them.
3. Small sized firms should look at EE measures in lighting and fan systems as that is the easiest to implement and can result in substantial savings.
4. The scale of production and number of employees being low in small units they cannot afford to have formal training sessions for employees to edify them about EE measures. Hence the firms should regularly engage in informal sessions with employees educating them about measures of energy safety and conservation.

Micro firms

4.9.2 Cluster level

1. It is seen that the firms have to bear the brunt of paying double cost of electricity in case of power-cuts from the State Electricity Utility. To overcome this problem the medium sized firms can go for collective initiatives like a captive power plant. This option is viable for the firms located in proximity to each other, for e.g. in Sports and Surgical complex, Industrial Area and Basti Nau. Total investment required for installing the captive power plant can be made in the ratio of Electricity requirements of the partnering units. Also the operation, management and distribution can be outsourced to a third party to ensure the transparency. The Captive Power Generation, Transmission and Trading issues have already been liberalized in *Electricity Act 2003*.

2. Since the smaller firms do not have the resources to initiate an investment like a captive power plant, the medium sized firms can collaborate with the adjacent smaller units where the surplus electricity can be shared among the collaborating firms.
3. As discussed in previous sections Labour Skill Development is very important. For this purpose and other technical assistance NIT, Jalandhar can be an ideal institution which has not been utilised by the cluster. NIT has partnered various knowledge programmes and workshops along with government agencies like TIFAC for technical up gradation of the cluster and hence it is a good idea to seek their technical expertise also on fronts like Energy efficiency.

4.9.3 Policy level

1. State Electricity board should purchase surplus Electricity available with the units where Captive Power Generation is installed. This will this will act as an encouraging factor for other units to invest in the Captive Power Generation from Waste Heat Recovery. In this attempt Energy Security and Energy Efficiency in the Units will be achieved.

2. Facilitating credit for SIS firms for the adoption of clean technologies

3. Formulation of realistic and practicable emission regulations and improving the implementation by the strengthening of regulatory agencies (e.g. pollution control boards)

4.9.4 Institutional Level

1. Institutes involved in Cluster Development Programmes like UNIDO, SIDBI, TERI and SBI should take interest in spreading awareness among the SMEs about the CDM projects, and provide assistance in the Development of CDM projects as there are numerous opportunities of developing CDM projects under the *Energy Efficiency* in the cluster

   A comprehensive approach for environment management in MSMEs can consist of:

   - Development and demonstration of appropriate clean technological solutions in collaboration with industry thereby utilising the available traditional know-how;
   - Formation of a technology provider network for making available the developed technological solutions to the end users;
   - Creating awareness among the owners about the environmental concerns and available solutions;
   - Training workers in the new technologies and creating awareness among them regarding the health risks involved with existing technologies;
   - Facilitating credit for SIS firms for the adoption of clean technologies;
   - Mobilising community pressure on the polluting industries to adopt clean technologies;

4.9.5 Strategy for interventions on the basis of do ability

- Which can be taken care with in 1 year
    - Replacement of incandescent with CFL and electronic starter tube lights
- Which can be taken care within 1 to 3 years
    - Investment in R&D processes to improvise processes so that they become more energy efficient and cost effective
    - Favouring applied and demonstrative research activities
    - Promotion of both information activities and the awareness of the final users
    - Promoting the qualification of the operators through professional education activities
    - Investment by leading firms in a captive power plant to reduce dependence on SEB.
- Which can be taken care beyond 3 years
    - Investment in renewable sources of energy like solar (for effective drying and water-heating) and biomass
    - To prepare and implement plans and programmes for the efficient use of energy and the renewable energy sources valorisation

Chapter 5: Energy Mapping Framework

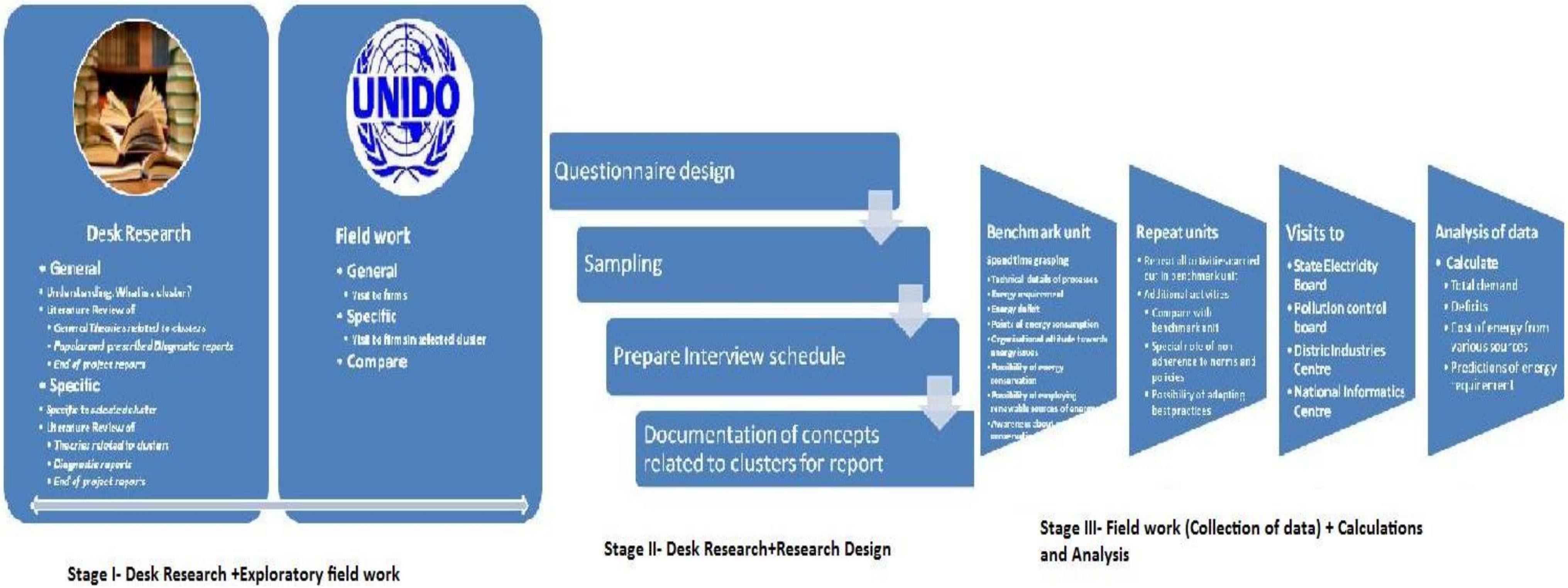


Figure 22: Stages of energy mapping in a cluster

Appendix

I. Environmental impact of wood based industries

Wood Based Processes	Cutting		Finishing (Sanding and Buffing)		Drying		Boiling Water for heat treatment of wood	
Source of Energy	Social and Economical	Environmental	Social and Economical	Environmental	Social and Economical	Environmental	Social and Economical	Environmental
Electricity	• Occupational Health Hazards (Respiratory Problems)	• Air Contamination • Noise Pollution • Solid Waste Generation	• Occupational Health Hazards (Respiratory Problems)	• Air Contamination • Noise Pollution • Solid Waste Generation				
Diesel	• Occupational Health Hazards (Respiratory Problems) • Uneconomical for manufacturer	• Air Contamination • Air Pollution • Noise Pollution • Solid Waste Generation	• Occupational Health Hazards (Respiratory Problems) • Uneconomical for manufacturer	• Air Contamination • Air Pollution • Noise Pollution • Solid Waste Generation				
Solar					• Reduced costs • Low Quality product	• Saving conventional sources of energy • Risk of Fire		
Wind								
Biomass							• Uneconomical for manufacturer	• Deterioration of soil quality • Solid Waste Generation

II. Details of the impacts

Impact	Details
Occupational Health Hazards	Respiratory Problems • Repeated exposure to wood dust particles (<4 µm) can cause chronic bronchitis, emphysema, "flu like" symptoms, and have more dangerous results decades after exposure such as cancer • Particles that are large are not respirable (>10 µm), they are unlikely to negatively impact the health of workers exposed to them.
Solid Waste Generation	• Pieces of wood of various sizes are cut out as a result of cutting procedure. The larger pieces are used as fuel to heat water for boiling. The smaller pieces have no usability in the wood based firms. They are sold randomly to traders who come and collect them from the firms. The pieces are used further for various processes like clogs for nails and by carpenters for some random application. The most common use is as fuel.
Uneconomical for manufacturer	Per unit cost of energy is more due to • Cost of fuel • Inefficient Technique Puts more burdens on the manufacturers in the form of shrinking margins.
Reduced costs	As solar drying does not involve any capital investment, the input costs to manufacturers are reduced.
Low Quality Product	Solar drying does not lead to uniform drying hence the quality of the product does not match international standards. This has a direct implication on the sales of the product especially in international markets.
Air Contamination	Spread of Saw dust in the atmosphere leads to deterioration of air quality
Air Pollution	Pollution as a result of fumes generated due to burning of diesel in the generator
Noise Pollution	The running machines produce a lot of noise. As there is no enclosure in which they are placed the noise severely affects the workers working on the machines or in their vicinity. Workers are usually not provided with ear plugs to prevent damages due to this excessive noise. If they are, they do not find them convenient to use and put them on only when the supervisors are around.
Saving of conventional sources of energy	Left over pieces from cutting of logs are used for this purpose. On one hand it is using the waste but at the same time it is a very inefficient way of boiling water with most of the chambers fashioned in house without much technical expertise
Risk of Fire	Risk of Fire with a huge mass of wood lying unattended most of the times
Deterioration of soil quality	Ash is produced as a result of burning of wood. This ash is usually dumped near factory premises. It deteriorates the soil quality of the dumping ground and finer particles mix with air causing dust pollution

III. Environmental impact of soccer ball industry

Soccer Balls Processes / Source of Energy	Lamination		Drying		Panel Cutting	
	Social and Economical	Environmental	Social and Economical	Environmental	Social and Economical	Environmental
Electricity	• Occupational Health Hazards (Noise Induced Hearing Loss and Exposure to chemicals)				• Occupational Health Hazards (Noise Induced Hearing Loss)	• Solid Waste Generation • Noise Pollution
Diesel	• Occupational Health Hazards (Noise Induced Hearing Loss and Exposure to chemicals)	• Air Pollution • Noise Pollution			• Occupational Health Hazards (Noise Induced Hearing Loss)	• Air Pollution • Noise Pollution • Solid Waste Generation
Solar			• Reduced costs	• Saving conventional sources of energy		
Wind						
Biomass						

Continued….

Soccer Balls Processes / Source of Energy	Screen Printing		Kit Preparation		Quality Check	
	Social and Economical	Environmental	Social and Economical	Environmental	Social and Economical	Environmental
Electricity	• Occupational Health Hazards (Exposure to chemicals, Posture and lighting)		• Occupational Health Hazards (Posture and lighting)			
Diesel						
Solar						
Wind						
Biomass						

IV. Details of the impacts

Impact	Details
Occupational Health Hazards	Noise Induced Hearing Loss (NIHL) • Noise-induced hearing loss (NIHL) - this is hearing loss due to exposure to either a sudden, loud noise or exposure to loud noises for a period of time. A dangerous sound is anything that is 85 dB (sound pressure level - SPL) or higher Exposure to chemicals • The chemicals used for screen reclamation can be some of the most hazardous products in a screen printing facility. Typically, highly volatile solvents are used. These cleaners may contain chemicals that are harmful to the health of employees if inhaled, ingested, or absorbed through the skin. • If they are not disposed of properly, these products may also harm the environment. Posture and lighting • Uncomfortable sitting position throughout the day can cause serious back and spine problems • Inadequate lighting whilst doing minute work, like painting/printing on the balls, can cause ophthalmic ailments
Solid Waste Generation	Each unit produces hundreds of kilos of waste each day which is sold off to traders who further sale it off for fire-fuel purpose. The open burning of waste causes air pollution; the products of combustion include dioxins which are particularly hazardous
Reduced costs	Solar drying does not involve any capital investment; hence the input costs to manufacturers are reduced.
Air Pollution	Pollution as a result of fumes generated due to burning of diesel in the generator
Noise Pollution	The running machines produce a lot of noise. As there is no enclosure in which they are placed the noise severely affects the workers working on the machines or in their vicinity. Workers are usually not provided with ear plugs to prevent damages due to this excessive noise. If they are, they do not find them convenient to use and put them on only when the supervisors are around.
Saving of conventional sources of energy	Since solar energy is used to dry the laminated sheets, there occurs a saving of electricity which otherwise is used to induce heat in a closed room where the laminated sheets are spread for drying.

V. Environmental impacts of the rubber based industry

Rubber Processes / Source of Energy	Kneading		Mixing		Calendering	
	Social and Economical	Environmental	Social and Economical	Environmental	Social and Economical	Environmental
Electricity	• Occupational Health Hazards (Noise Induced Hearing Loss and Exposure to rubber and its by-products)	• Noise Pollution	• Occupational Health Hazards (Noise Induced Hearing Loss and Exposure to rubber and its by-products)	• Noise Pollution	• Occupational Health Hazards (Noise Induced Hearing Loss and Exposure to rubber and its by-products)	• Noise Pollution
Diesel	• Occupational Health Hazards (Noise Induced Hearing Loss and Exposure to rubber and its by-products)	• Air Pollution • Noise Pollution	• Occupational Health Hazards (Noise Induced Hearing Loss and Exposure to rubber and its by-products)	• Air Pollution • Noise Pollution	• Occupational Health Hazards (Noise Induced Hearing Loss and Exposure to rubber and its by-products)	• Air Pollution • Noise Pollution
Solar						
Wind						
Biomass						

Continued…

Rubber Processes / Source of Energy	Pressing		Cutting	
	Social and Economical	Environmental	Social and Economical	Environmental
Electricity	• Occupational Health Hazards (Noise Induced Hearing Loss and Exposure to rubber and its by-products)	• Noise Pollution	• Occupational Health Hazards (Noise Induced Hearing Loss and Exposure to rubber and its by-products)	• Noise Pollution
Diesel	• Occupational Health Hazards (Noise Induced Hearing Loss and Exposure to rubber and its by-products)	• Air Pollution • Noise Pollution	• Occupational Health Hazards (Noise Induced Hearing Loss and Exposure to rubber and its by-products)	• Air Pollution • Noise Pollution
Solar				
Wind				
Biomass				

VI. Details of the impacts

Impact	Details
Occupational Health Hazards	Exposure to rubber chemicals and its by-products • Improper preventive measures like avoiding use of gloves, masks and using chemicals by naked hands can lead to many skin related disorders specially rashes and inflammation. • The smaller particles can enter eyes and ears and cause inflammation and infection • The chemicals are found to have very foul smell which can cause irritation and also respiratory tract infections
Rest of the impacts can be referred in section II and IV of the appendix	

Product Description	*VII.* Sample Plan									Total Sample 30 of 4450
	<u>Medium</u>			<u>Small</u>			<u>Micro</u>			
	Population Size (35)	Sample Size (11)	Name of firm	Population Size (130)	Sample Size (9)	Name of firm	Population Size (330)	Sample Size (10)	Name of firm	
<u>Wood Based Articles</u>										
Bats	15	2	Beat All Sports Ranson Exports	50	2	Amrit Sports, Robinson Sports	150	2		6
Hockey		2	Beat All Sports RK International		2	R K Mahajan Exports (RKMe), Robinson Sports		2		6
<u>Inflatable Balls</u>										
Football	10	2	Sharma Exports Sakay Traders	40	2	Kamal Brother, Hans Raj Mahajan and co.	100	2		6
Basketball/Rugby		3	Savi International Sakay Traders Nivia Synthetics		1	Legend Intnl.		2		6
<u>Protective Equipment</u>										
Protective Equipment	10	2	Ranson Universal	40	2	RK International (manufacturing on a small scale), Hans Raj Mahajan and co.	80	2		6

VIII. Questionnaire

United Nations Industrial Development Organization

1066, Urban Estate Phase-I, Jalandhar, Punjab.

QUESTIONNAIRE

FOR PRELIMINARY ASSESSMENT OF CURRENT INITIATIVES ON

ENERGY AUDIT & CONSERVATION

INTRODUCTION

The United Nations Industrial Development Organization has been in Jalandhar for the past 6 years and has worked on various avenues of the sports goods cluster development. Energy issues are gaining importance by each passing day and hence it becomes imperative for every enterprise to closely monitor its energy requirement, deficit and explore alternate sources of energy.

OBJECTIVE

The objective of the questionnaire is to compile the basic data about the organization, and the status of its existing infrastructure, current level of resource utilization as well as the various initiatives already taken up / implemented towards Resource Conservation & Management. This would help the cluster in realizing its energy requirement, deficits it faces and how it can meet these without much dependence on the State boards or national grid.

CONFIDENTIALITY STATEMENT

The confidentiality of the information provided through this questionnaire will be maintained. The information provided will be used for the purpose of the intended study / service only.

QUESTIONNAIRE

A. ORGANIZATIONAL DETAILS:

1. Name of Unit:

   Postal Address:

2. Telephone:/Fax:
3. E-mail:
4. Name & Designation of CEO/MD:
5. Name & Designation of Contact Person:
6. Major Product (s) / Services:
7. Year of commissioning:
8. No. of Employees: Permanent Part time
9. No. of Shifts:
10. Hours per shift:

B. PRODUCTION CAPACITY (Product wise)

S.No.	Product Description	Design Capacity	Capacity Utilization (%)

B1. Does the production fluctuate considerably across the seasons: **Yes / No.**

B2. If yes, please cite reasons and the range of fluctuations (Max. & Min.)

B3. Please give a brief description of production process indicating the operations involved, raw materials/ resources used, Technology adopted, Critical Process Equipment (Attach Process flow chart)

C. INPUT RESOURCES:

Identify all materials as input to various processes (materials can be grouped by category) and their consumptions for last three years.

Resource	Qty			Annual Bill (Rs.)		
	Year1	Year2	Year3	Year1	Year2	Year3
Coal						
Natural Gas						
Oil						
Electricity (Generated)						
Electricity (Purchased)						
Others 1. 2.						

D. PROCESS UTILITIES

- Contract Demand: (A customer's **contract demand** is the amount of power that a customer agrees to pay to have available at all times. Measured in kilowatts)
- Avg. Demand Charges:
- Min Chargeable Demand:
- Min. Prescribed power factor:

Electrical Utilities

D1. Transformers

No. of Transformers and type	Capacity (KVA)	Location	I/C Voltage	Supply Voltage	OLTC Details	Present load

D2. Capacitors

Average Plant Power Factor	
Total Capacitance Provided (KVAR)	
Location of Capacitors	

D3. Motors:

Size	Kw Rating	Qty	Voltage & Current	Power factor	Operating hours
Large (10 hp and above)					
Medium (5-10 hp)					
Small (less than 5 hp)					

D4. Compressors

Compressor Type	FAD Capacity M3/hr	Motor rating KW	Comp.Air Press Kg/cm2g	Approx energy use for year consumption

D5. Air-conditioning & Refrigeration system

Unit Type & Capacity in TR	Compressor Type*	AHU TR	Desired Condition	Approx. Energy consumption
Air-Conditioning				
Refrigeration				

D6. Rotary Equipments

Type & Nos	Rated			Observed		Type of Flow control*	Application
	Flow, m3/hr	Pres	Motor Kw	Flow m3/hr	Pres		
Pumps							
Fans & Blowers							

* Outlet valve throttling/Speed control (VSD/Fluid coupling etc)

D7. DG Sets

Type x Nos	Capacity, KVA	Fuel used	% Loading	Units Gen/ yr,Kwh	SEGR

D8. Lighting and Fan load:

Lamp/Luminary Type	Lamp W	Type of Work	Method of switching	Operating load W	Operating hours

Fans	Qty	Operating Load	Operating hours

D9. Cooling Towers

Type	Cooling load Kcal/hr	Design Range (°c)	Actual Range (°c)	Pumps			Fans	
				Motor KW	Flow M3/hr	Head M	Motor Kw	Air flow CFM
ID CROSSFLOW								
ID CROSSFLOW								
ID CROSSFLOW								

- SEGR: Specific Energy Generation Ratio

Thermal Utilities

D10. Boiler

- Capacity of boilers (TPH)
- Type of fuel firing:
  - Cost
  - Consumption
- Capacity Utilization (%)
- Outlet steam temp & pressure
- Feed water temperature
- Feed water quality: Hard/Soft
- Fuel firing rate
- Calorific value of fuel, ash content etc.
- Flue gas characteristics (O2, CO, CO2, Temp etc.)
- % Blow down
- Economizer exists for pre-heating feed water? Yes/no
- Air is preheated before entering into combustion chamber. Yes/no

D11. Heat Exchangers/Heat Recovery Units

- Nos. & Types of Heat Exchangers
- Design parameters (inlet & outlet temperatures of hot and cold streams, Area available and rate of heat transfer, Material of construction of Heat Exchanger)
- Operating Parameters
- Allowable pressure drops

D12. Chillers

- Type and nos. of chilling units
- Capacity of chiller
- Chilled water temperature
- Input water temperature
- Steam consumption
- Design & operating COP

D13. Steam Distribution

- Length of Steam Line
- Estimated % loss due to leakage
- No. of steam traps and types
- Steam use for direct heating applications (%)

D14. CHP

Details of Combined Heat & Power Generation System, if applicable

E. ALTERNATIVE SOURCES OF ENERGY

- How long has it been in use?
- Calculated saving in energy because of this source
- Is there space available for installing a solar unit? Specify

F. MANAGEMENT SYSTEMS:

- Please indicate the management systems adopted by your plant: QMS(Quality Management Systems), EMS, OHSAS(Occupational Health and Safety Advisory Service), Social Accountability, Others ....pls. specify
- Do you have Emergency Preparedness/ Disaster Mitigation plans for emergency response, planning and reporting system? Yes/No

G. CAPACITY BUILDING / TRAINING:

1. Please indicate the number of personnel that have been trained on Energy, Environment Conservation & Management in the last two years.
2. Please indicate the Annual Training budget of your plant.
3. Please indicate topics of interest for further training of your personnel.

H. OTHER INITIATIVES:

1. Please indicate initiatives regarding CSR/ESR
2. Please indicate cleaner production/waste management techniques adopted by your plant.

I. OTHER INFORMATION

Please attach the following:

- Plant Lay out diagram
- Process flow sheet and brief description of process utilities
- Single line power distribution diagram
- Single line diagram of water & effluent network
- Compressed Air distribution diagram and details of equipment feeding
- Refrigeration/Air conditioning distribution diagram
- 12 months energy bill copy from SEB with production data
- List of energy conservation measures already implemented.

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