WORKING PAPER 08/2011

Approach to energy efficiency among micro, small and medium enterprises in India:
Results of a field survey

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

DEVELOPMENT POLICY, STATISTICS AND RESEARCH BRANCH
WORKING PAPER 08/2011

Approach to energy efficiency among micro, small and medium enterprises in India: Results of a field survey

Duke Ghosh
Director
Bitscrape Solutions Pvt. Ltd.
Kolkata

Joyashree Roy
Professor of Economics
Coordinator-Global Change Programme-JU
JU-SYLFF Project Director
Jadavpur University

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna, 2011

Acknowledgements

This working paper was prepared by Duke Ghosh, Director, Bitscrape Solutions Pvt. Ltd. and Joyashree Roy Professor of Economics, Coordinator - Global Change Programme - JU and JU-SYLFF Project Director, Jadavpur University as background material for the UNIDO Industrial Development Report 2011, under the supervision of Ludovico Alcorta, Director, Development Policy, Statistics and Research Branch, UNIDO.

Table of contents

List of figures

List of tables

List of boxes

1 Introduction

In a world where anthropogenic-led climate change is drastically altering the geological, social, economic and political status quo, sustainable development has become the key to modern development strategies. In 1987, the United Nations World Commission on Environment and Development decreed that development is sustainable when it meets the needs of the present without compromising the ability of future generations to meet their own needs. Thus, sustainable development (SD) argues in favour of implementing development goals that promote intergenerational equity (Solow, 1991).

In the contemporary world, the concept of SD is applicable to almost all socio-economic entities including small and medium-sized enterprises (SMEs). In this context, the question whether SMEs are inhibitors or facilitators of SD deserves scrutiny. SMEs contribute to the process of SD by generating employment opportunities that help alleviate poverty. However, there are instances when the goals of SD are forfeited in favour of survival. Often, many SMEs sacrifice corporate social responsibility to ensure their survival. The high cost of ensuring corporate social responsibility is often too expensive for small business entities. Furthermore, lack of knowledge makes SMEs indifferent to the goals of SD.

The question that consequently arises is whether synergy exists between the objective of SD and the competitiveness of SMEs or whether it inhibits SME growth. SD aims to make business entities environmentally friendly and entails investments in resource-saving technologies. It calls for a culture of environmental awareness and promotion of resource conservation. It also calls for the adoption of “green technology” which might endanger the competitive advantage of MSMEs and hence inhibit the sector from embracing the goals of SD. On the other hand, if the sustainability agenda promotes the competitive advantage of MSMEs, then we have to explore why there is resistance among MSMEs to accept “green business”, particularly in developing countries like India, where overall awareness of the sustainability agenda is low.

The ‘greening’ of business entails, among other things, achieving energy efficiency. Traditional energy sources emit greenhouse gases that adversely affect the environment while simultaneously depleting scarce energy sources. It is increasingly being realized at the global level that achieving energy efficiency in business is a compelling and cost-effective means to attain energy sustainability. To this effect, India’s National Action Plan on Climate Change recommends the promotion of energy efficiency goals in the industrial sector through the trading of energy saving certificates among industries, the propagation of energy incentives like

reduced taxes on energy saving appliances and financing of public-private partnerships to reduce energy consumption.

2 SMEs and the Indian economy

In India, the term "MSME" is relatively new — the government only adopted the official definition of MSME in 2006, comprising micro, small and medium enterprises[1]. Table 1 represents the definition of MSMEs as stipulated in the Micro, Small and Medium Enterprise Development Act (MSMEDA) of 2006.

Table 1 Definition of micro, small and medium enterprises in India

Nature of the Enterprise	Micro Enterprise	Small Enterprise	Medium Enterprise
Manufacturing sector	Investment in plant & machinery does not exceed INR 2.5 million	Investment in plant & machinery more than INR 2.5 million but does not exceed INR 50 million	Investment in plant & machinery more than INR 50 million but does not exceed INR 100 million
Service sector	Investment in equipment does not exceed INR 1.0 million	Investment in equipment is more than INR 1.0 million but does not exceed INR 20 million	Investment in equipment more than INR 20 million but does not exceed INR 50 million

The new definition proposed in the MSMEDA of 2006 ensures that a larger number of industrial units are brought under the scope of developmental policies targeting MSMEs.

Like elsewhere in the world, SMEs make a special contribution to the economy in India. The contributions have multiple facets and dimensions. SMEs generate new jobs in the economy and thereby positively contribute to employment generation and poverty reduction. Further, these enterprises require a relatively lower investment in capital compared to large enterprises. Therefore, SMEs have a lot of relevance for economies like India which are characterized by surplus labour and low investible resources.

Since the inclusion of "medium" industries in the small scale sector in India is a relatively recent phenomenon, there is very little data available with respect to medium-sized enterprises. Therefore, to assess the size of the small scale sector in the country, we consider data on small scale industries published by the Ministry of Micro, Small and Medium Enterprises,

[1] During the earlier years, the term small scale industries was used. There was no official definition for medium-sized enterprises.

Government of India. According to the 3rd All India Census of Small Scale Industries of 2001–02 (GoI, 2004)[2], there were about 10.52 million small scale industrial units in the country. About 55 percent of these units were based in rural areas.

Table 2 Contribution of micro and small enterprises in the Indian economy

Sl. No.	Year	No. of Firms (Million)	Fixed Investment (Rs. Million)	Production at current prices (Rs million)	Employment (million persons)	Exports (Rs. million)
1	1990-91	6.79	935550	788020	15.834	96640
2	1991-92	7.06	1003510	806150	16.599	138830
3	1992-93	7.35	1096230	844130	17.484	177840
4	1993-94	7.65	1157950	987960	18.264	253070
5	1994-95	7.96	1237900	1221540	19.14	290680
6	1995-96	8.28	1257500	1477120	19.793	364700
7	1996-97	8.62	1305600	1678050	20.586	392480
8	1997-98	8.97	1332420	1872170	21.316	444420
9	1998-99	9.34	1354820	2104540	22.055	489790
10	1999-00	9.72	1399820	2337600	22.91	542000
11	2000-01	10.11	1468450	2612970	23.873	697970
12	2001-02	10.52	1543490	2822700	24.933	712440
13	2002-03	10.95	1623170	3148500	26.021	860130
14	2003-04	11.40	1702190	3645470	27.142	976440
15	2004-05	11.86	1786990	4297960	28.257	1244170
16	2005-06	12.34	1881130	4978860	29.985	1502420
17	2006-07	12.84	2132190	5851120	31.252	1776000
18	2007-08*	13.37	2389750	6951260	32.228	NA

***** Projected

Source: Annual Report, 2008-09, Ministry of Micro, Small and Medium Enterprises, Government of India

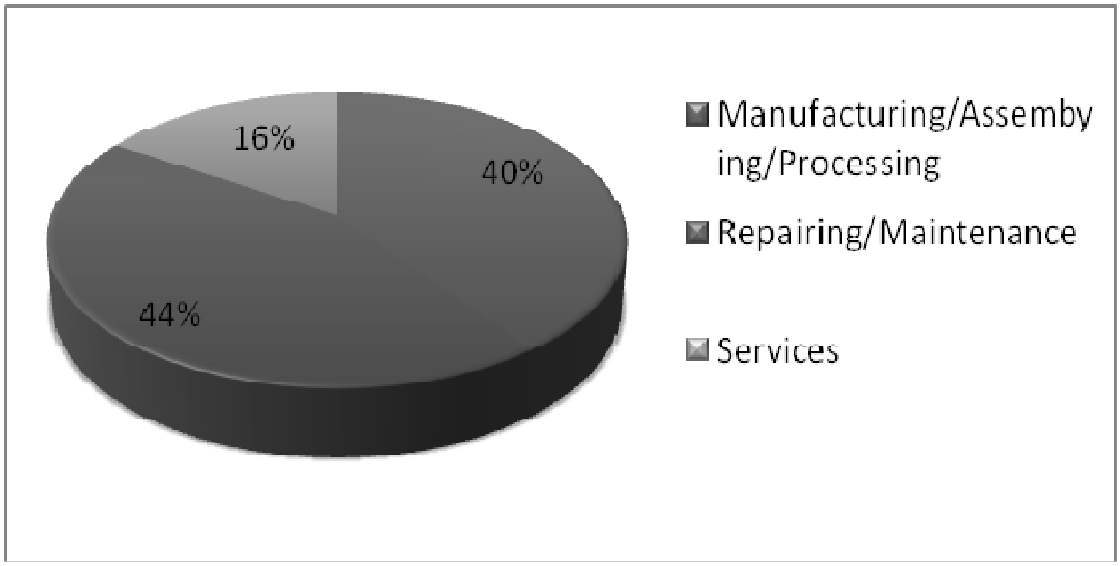
Only 14 percent of these units were registered as small scale industrial units[3]. Almost 96 percent of them were proprietary organizations and about 2 percent were partnerships. There were less than 1 percent organizations registered as companies under the Companies Act of 1956. These

[2] Available at: http://www.laghu-udyog.com/publications/books/fcensus.htm

[3] The units are registered with the Directorate of Industries (DIC). The registration with the DIC is a voluntary option and 86 percent of the SSI units chose not to exercise the option. The main reasons for non-registration are bureaucratic procedures and lack of awareness.

small industrial undertakings undertake a huge range of activities. The census established three broad classes of activities: Manufacturing/processing/assembly, repairing/maintenance and services. The distribution of small scale units across these activity groups is presented in Figure 1. The sector produces over 6,000 items (GoI, 2009). On average, the sector contributes about 40 percent of the gross industrial value added in the Indian economy. According to an estimate of the Ministry of Micro, Small and Medium Enterprises, Government of India, an investment of Rs. 1.00 million in fixed assets produces approximately Rs. 4.62 million worth of goods and services.

Figure 1 Activity-wise distribution of small business in India



During the period 1991-92 to 2005-06, the growth rate (in terms of output) of the small scale sector remained well above the overall industrial growth rate of the economy. The small business entities generate an entrepreneurial mind-set in society, which, in the long run, contributes to overall economic growth and development. At the same time, SMEs facilitate technology transfer and innovation which are key determinants of success for an economy in an era of globalization. Another important function of SMEs is that they promote competition within the economy while also providing for diversification of activities in the overall industrial structure. Competition and diversification are essential factors for spearheading greater economic dynamism. Diversification also helps the economy adjust to economic shocks with increased speed and lower costs.

Studies by David Birch (1979, 1987) indicate that small businesses are engines of job creation in most economies[4]. In India, the small business sector absorbs a sizeable share of the working age population. According to the 3rd census, the per unit employment in the small scale sector was 2.37 persons. The sector also exhibits an impressive growth rate in employment. The 10th National Plan asserted that the small scale sector will continue to create new job opportunities for the growing workforce (GoI, 2002). While 1.43 million new jobs would be created by the large enterprises, the small scale sector would create 3.86 million new jobs. Together, various programme-based activities in small scale industrial clusters would generate 0.55 million additional new jobs by 2007. Thus, the small industries sector in India is a major driver for employment generation in the economy.

However, an aspect of caution is that given the high mortality rate in the small industry space, a sizeable number of jobs might be "destroyed" every year. "Net job creation" is therefore more important than gross job creation. In many economies, it has been found that it is the large corporations which contribute more positively to net job creation as compared to the small business segments.[5] Another aspect of concern is the quality of jobs created by these small scale industrial units, particularly with respect to the wage differentials. Wage differential between large firms and SMEs for similar job categories has been found to be about 35 percent in developed countries (Brown, Hamilton & Medoff, 1990) and about 50 percent in developing countries (The World Bank, 1995). Large enterprises also offer better benefits – pension plans, life, health and accident insurance and possibly a better welfare for employees.

In India, the small scale sector contributes to more than 30 percent of total exports and the share of the small scale sector in total exports is continuously increasing (GoI)[6]. The small industries have continued to play a crucial role in exports, thereby earning crucial foreign currency – directly or indirectly. High transaction costs in dealing with the international markets might have deterred some small firms to export directly (Nooteboom, 1993), as they face the burden of

[4] Birch's study on the US economy shows that in the 1970s, firms with less than 100 employees had generated 80 percent of new jobs.

[5] See Biggs and Shah (1998) where the authors discuss surveys in the five countries of sub-Saharan Africa, which show that over a three-year period in the early 1990s, large enterprises with over 100 employees were a dominant source of net job creation in the manufacturing sector. These were mostly countries in which there had been net job addition during the period. In Ghana, 56 percent of net job creation was by large enterprises, in Kenya, the figure was 74 percent, in Zimbabwe it was 76 percent and in Tanzania, the figure was 66 percent. Only in Zambia, where there was net job decrease during the period, the small firms performed better than their large counterparts.

[6] Government of India, Ministry of Micro, Small and Medium Enterprises, Annual Report, various issues, New Delhi.

costs of acquiring and processing information and have difficulty coping with the export opportunism and other contract enforcement problems. However, as indirect exporters, the SMEs add critical flexibility and provide "just-in-time" benefits to the supply chain of the larger exporters, thereby reducing the overall cost of the value chain. This cost efficiency is a critical success factor for the competitive advantage in the international markets.

The goal of implementing a sustainable development programme poses various challenges for an economy, i.e., implementing sustainable income generation measures, reduction of inequality and inequity, achieving a strong and sustainable agro-industry linkage, establishing an "order" in the unorganized sector and fostering an attitude of entrepreneurship. In a developing country like India, the SME sector is huge and well spread out across the country. SMEs play a crucial role in the success of the country's developmental aspirations.

3 Present study

The present study attempts to determine approaches to energy efficiency in SMEs in India and the set of drivers and barriers that govern these firms' decision to adopt energy efficient technology. It is often claimed that embracing energy efficient production processes enhances a firm's profit margin by reducing the cost of production. If this argument is true, then MSMEs – which are generally burdened by escalating cost overruns – stand to gain by adopting energy efficient processes. However, empirical evidence proves otherwise. In India, energy efficient MSMEs constitute a negligible share of the entire MSME population. There may be several reasons for this non-adoption, e.g., too long payback periods, asymmetric information regarding energy efficient technology, cost of adopting such processes, infrastructure bottlenecks to adoption, etc. This study tries to analyse the set of reasons that guide the strategy of non-adoption (or adoption) of energy efficient processes among MSMEs in India.

4 Methodology

An exploratory research methodology has been adopted for the study. The research instrument has been formulated on the basis of discussions with various experts – entrepreneurs, consultants in the area of energy efficiency, academics, etc. The preliminary discussions revealed that in the MSME segment it may be difficult to find projects which have specifically been undertaken to improve energy efficiency. The firms in the MSME segment are likely to undertake (and implement) projects aimed at cost reduction and/or compliance with the pollution control norms without any specific objective of becoming energy efficient. But many of these projects help firms improve their energy efficiency. It was therefore decided that the

study would also cover those firms which have implemented projects that have indirectly resulted in improving the firms' energy efficiency.

4.1 Research instrument

Since the present study aims at determining the drivers and barriers small firms face if they are to become energy efficient, the most suitable method for interviewing the firms are personal interviews using a structured questionnaire. While the questionnaire gives "structure" to the interview, the interviewer holds additional discussions with the respondent to capture as much qualitative information as possible. The questionnaire was designed to ensure that respondents express their opinions on all topics (and sub-topics) that have been found to be relevant for answering the research question. The research instrument was finalized after consulting (and receiving inputs from) experts, both from India and abroad. The instrument aims to provide structure to conducting interviews of SMEs.

While designing the instrument, the following points were considered:

(a) Energy efficiency may be achieved by reducing the energy consumption per unit of output
(b) Energy wastage can lead to the impairment of energy efficiency
(c) Energy efficiency may be achieved by changing the source of energy – from conventional sources to non-conventional sources
(d) Energy demand can be influenced by both the production process and housekeeping practices
(e) It is not only the change in technology but also changes in practices and processes that can bring about energy efficiency in firms
(f) There are visible and invisible factors that shape the energy consumption (and saving) practices followed by a firm.

The research instrument deployed for the study has the following primary objectives:

(a) Understanding the level of awareness in firms on issues like environment friendliness and different ways of achieving energy efficiency
(b) Understanding the attitude of firms towards monitoring energy usage and dissemination of energy usage information across the organization
(c) Understanding the willingness among firms towards investments in alternate technologies that would improve energy efficiency

(d) Understanding the reasons for implementation and non-implementation of projects for achieving energy efficiency.

4.2 Sectors under study

The study has been conducted among the small firms in three different industries – iron and steel, textiles and food processing. Various subsectors that are included in the study are presented in Table 3. The distribution of sample firms is presented in Table 4.

Table 3 Different types of industries covered by the present study

Food Processing	• Rice Mills • Edible Oil Mills • Pickle and Ketchup Processing Units • Confectioneries • Food and Vegetable Cold Chains • Juice & Pulp Manufacturing
Iron & Steel	• Forging Units • Casting Units • Rolling Mills • Sponge Iron Plants • Steel Rods and Bars Manufacturing Plants
Textile	• Garments Manufacturing • Dyeing Units • Printing Units • Machine Embroidery Units • Hosiery Manufacturing

Table 4 Distribution of sample firms across different industries

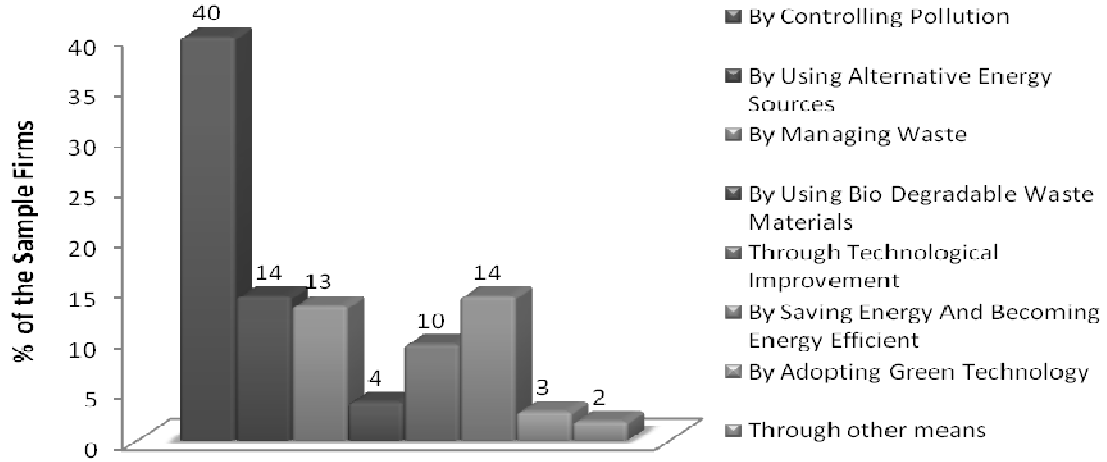
Sector	Number of Firms	Percent of Sample
Iron & Steel	28	32.00
Textile	21	24.00
Food Processing	37	43.00
Others	1	1.00
Total	**87**	**100.00**

Following the definition of MSME in India, 22 percent of the firms surveyed belong to the "micro" category while 65 percent of the firms can be termed "small". The remaining 13 percent are "medium-sized" firms.

5 How, according to SMEs, can they become environmentally friendly?

Environment is one of the three pillars of the "business contribution" to sustainable development (Williamson, et. al., 2006). Norberg-Bohm (1999) suggests that apart from reducing production and consumption-related emissions, the "zero waste" principle should also be an inclusive goal of firms to become environmentally friendly. In a bid to discharge their responsibility towards the environment, firms must forego end-of-the-pipe thinking and invest heavily in the design of the products and processes which demonstrates their concern for the environment (Norberg-Bohm, 1999). Do SMEs in India recognize all these measures as means to become environmentally friendly? To the question as to how a firm can become environmentally friendly, 40 percent of sample firms mentioned that firms must try to control pollution (Figure 2). Nearly 60 percent of these firms (which claim that controlling pollution is important for becoming environmentally friendly) did not recall any other means on how to become environmentally friendly. A handful of firms mentioned other measures such as the use of alternate energy sources, the use of energy efficient machinery and prudent waste management, etc. as means to become environmentally friendly. However, these responses did not enjoy the same degree of top-of-the-mind recall as pollution prevention.

Figure 2 How can firms become environmentally friendly?



Continuous dissemination of information (through various forms of media) about the ill effects of pollution and the need for collective responsibility of society to reduce pollution is making people sensitive to the issue of pollution. In this regard, the role played by the regulatory authorities (e.g., pollution control board, etc.) is also important. Such authorities exert regulatory pressure and sensitize firms to reduce pollution. On the other hand, SMEs do not seem to be aware at all of other means of becoming eco-friendly.

Only 14 percent of the responding firms recognize that firms can become environmentally friendly by saving energy and becoming energy efficient. It appears that awareness programmes on energy efficiency have had a limited impact on SMEs. It could also be true that such awareness programmes have failed to reach the grassroots. Therefore, there is very little initial recall that being energy efficient can make a firm environmentally friendly and contribute to the cause of protecting our precious environment.

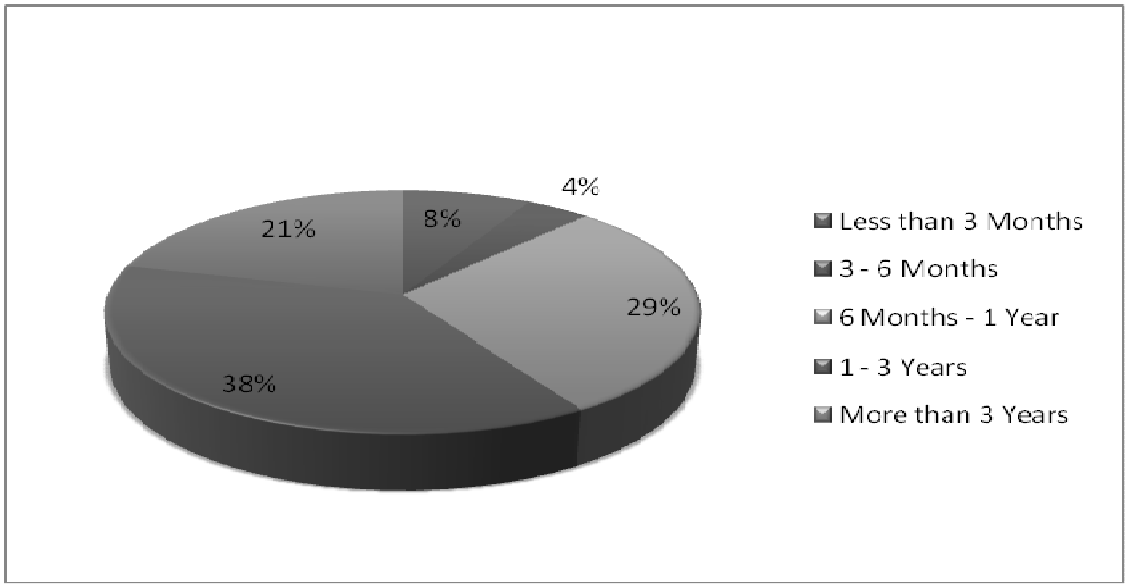
6 SMEs outlook on energy efficiency

Industrial energy efficiency plays a significant role in environmental protection. It is estimated that the manufacturing activities around the globe account for about 75 percent of the world's coal consumption, 44 percent of the natural gas consumption and about 20 percent of the world's oil consumption (IEA, 2004). Hence, it is imperative that the manufacturing industries across the world undertake measures that are aimed at improving their energy efficiency, conserving energy, reducing GHG emissions and safeguarding the environment. This is particularly true for firms in India, as the number of MSMEs in the country is high and the technologies employed by most are not yet energy efficient. There are two driving factors that can make firms embrace the principle of energy efficiency - first, if becoming energy efficient increases the firm's profitability, there is an economic incentive that induces the firm to adopt energy efficient technologies (or practices). Second, if responsibility towards protecting the environment is an important issue on a firm's agenda, then the firm will employ energy efficient technologies as part of its programme. The survey tried to explore Indian MSMEs' outlook on energy efficiency based on these two perspectives. Subsections 6.1 and 6.2 discuss some of the findings.

6.1 Profitability from energy efficiency projects: SMEs' perception

The present study found that energy efficient technology is an issue of importance for all SMEs surveyed. 100 percent of SMEs surveyed for the study confirmed that profitability increases when adopting energy efficient technology. However, only 37 percent of the sample firms have adopted energy efficient technology. Others have not been able to adopt such technology not because they feel such investments are unprofitable, but because of several other factors which are discussed in the subsequent sections.

Figure 3 **Expected payback period on investment in energy efficiency improvement projects**

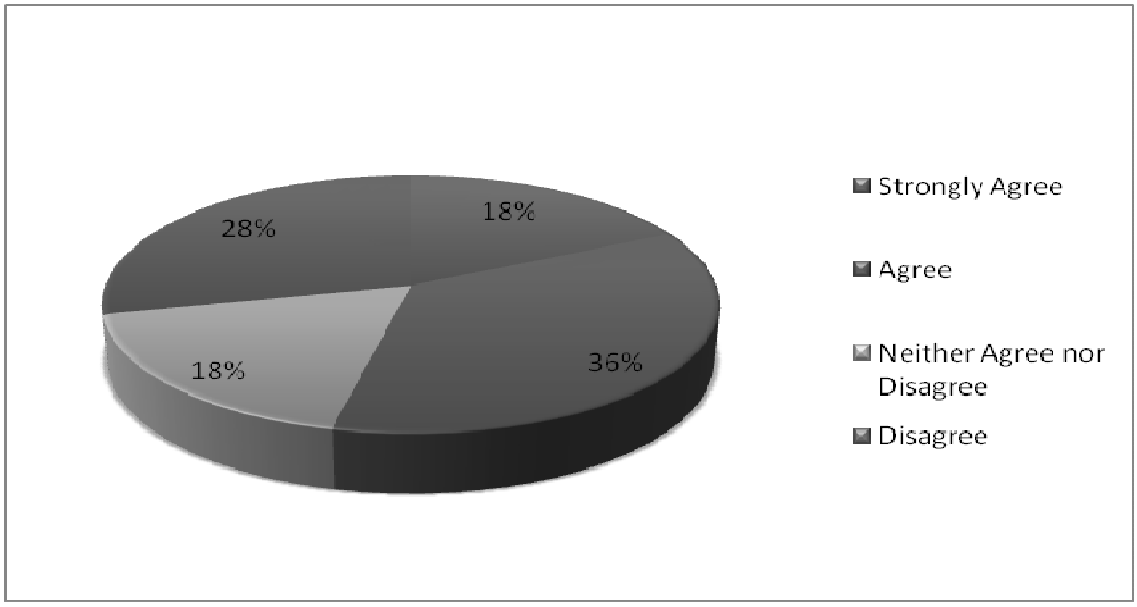


Literature on investment decisions under uncertainty indicates that a reasonable payback period on investments is a major determinant for undertaking an investment project (Dixit and Pindyk, 1994). For many MSMEs, the simple concept of payback period is easy to understand[7] and therefore, the concept is widely employed by many entrepreneurs while deciding on the scope and nature of investment. The findings from the field survey indicate that the majority (almost 67 percent) of MSMEs which have already adopted an energy efficient technology or are planning to implement such projects expect the payback period on their investment to be between 6 months to 3 years (Figure 3). For about 12 percent of the surveyed firms, the payback period is less than 6 months. Only 21 percent of the sample firms expect a payback period of more than 3 years. This long range in the expected payback period is associated with the varied range of technologies that have been considered for adoption. Depending on the industry and scale of operations, MSMEs can choose one or more technologies from a wide ranging technology portfolio. In such a scenario, an optimal technology choice – involving initial cost, lifetime of the technology and periodic returns – is critical for firms to profit from such investments. It is therefore important to provide SMEs with a support system that helps them make an optimal choice with respect to technology for improving energy efficiency. Without such a support system in place, the probability of SMEs that generally lack expertise and knowledge to arrive at the crucial decision to adopt energy efficient technology reduces.

[7] The concept is easier to understand than other measures such as Net Present Value (NPV) or Internal Rate of Return (IRR).

The interviews during the survey period also revealed that there is a strong perception among MSMEs that the initial investments required to adopt energy efficient technology are substantial (Figure 4)[8]. This perception represents a major deterrent for these firms whose capital base is often not adequate enough to undertake such investments. 40 percent of non-adopting firms in the sample further reported that though they are aware of the long-term profitability gain in adopting energy efficient technology, they face considerable obstacles arranging for the funds required to meet the high initial investment.

Figure 4 **Compared to other projects, investments required for energy efficiency projects are larger**



Hence, although energy efficiency is perceived as a profitable proposition by MSMEs, high initial investments, constraints in arranging funds and lack of knowledge about optimal technology can act as important barriers for the firms to undertake such projects.

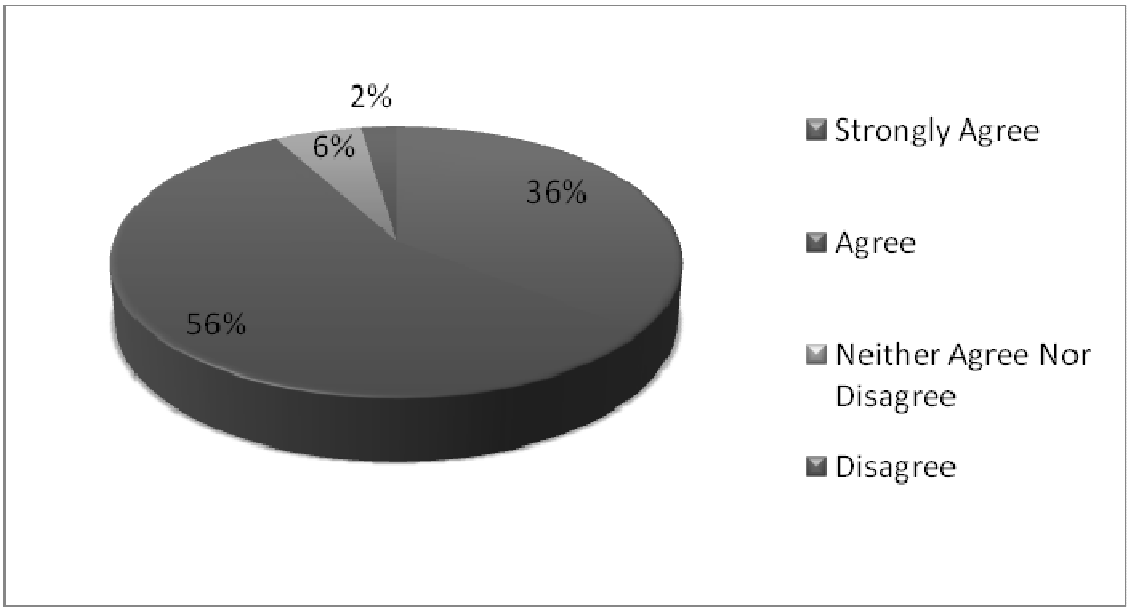
6.2. Responsibility towards the environment as a driver for energy efficiency projects

The present study attempted to assess this issue by recording the reaction of respondents to the following statement: "Achieving energy efficiency is an integral part of becoming environmentally friendly – do you agree or disagree?" The responses were captured by a 5-point Likert scale (with "strongly agree" represented by the value 1 and "strongly disagree"

[8] The responses were recorded on a 5-point Likert scale. It is interesting to note that none of the sample firms strongly disagree with the statement that, compared to other projects, investments required for energy efficiency projects are larger.

represented by the value 5)[9]. Most respondents agreed with the statement. The response profile is illustrated in Figure 5. The mean value of the response is 1.75, signifying that SMEs, although their representatives' recall of possible energy efficiency measures for becoming more environmentally friendly is not particularly high, are aware of the fact that energy efficiency can contribute positively to the overall objective of protecting and preserving the environment. Thus, it is imperative for policies and actions to be aimed at ensuring that the small business sector acknowledges the need to become more energy efficient and to make it a corporate philosophy.

Figure 5 Response profile: Energy efficiency and protection of environment



An equally important question is how, according to MSMEs, can they become energy efficient? The respondents were prompted with five alternative options[10]:

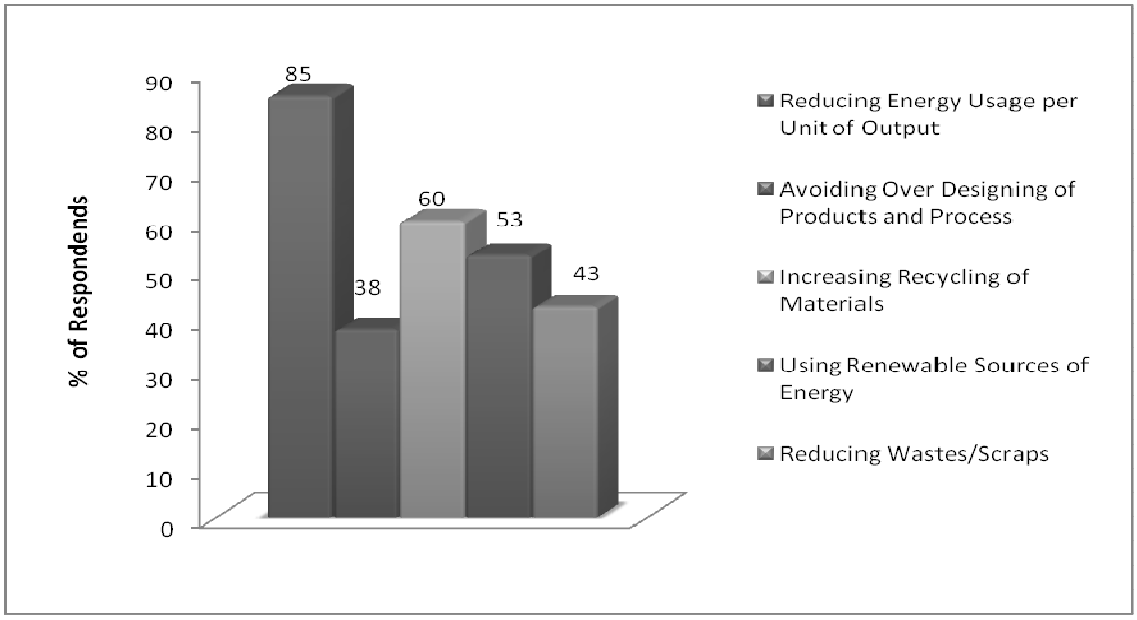
(a) Reducing energy usage per unit of output
(b) Avoiding over-designing of products and processes
(c) Recycling of materials
(d) Using renewable sources of energy
(e) Reducing waste and scrap.

The study reveals that an overwhelming majority (85 percent) of respondents consider producing the same (or more) output by consuming less energy as the most suitable means to

[9] For a more detailed discussion, see Green, et al. (1998).
[10] Each responding firm was given the option of choosing at least one alternative. Hence, the cumulative response is more than 100 percent (of respondents)

achieve energy efficiency. Those firms that do not consider that energy efficiency can be achieved by reducing the consumption of energy per unit of output follow a more traditional type of processing and believe that any effort to decrease energy consumption may lead to the loss of "quality" of the processed product *(see Box A)*.

Figure 6 Response profile: How can firms become energy efficient?



Deterioration in quality will damage the marketability of the product. Such firms also feel that the process they adopt is a time-tested one and that there is no alternative process that can guarantee similar quality.

In literature a broader definition of energy efficiency is presented which includes issues such as reduced dispersion of toxic materials, improved recyclability, use of renewable resources, greater durability of products, etc. (Lovins, 2008). Many of the firms included in the study recognize the importance of some of these alternative means, but this acknowledgment is not spontaneous[11]. On probing deeper, it was found that most of the firms are unsure of how these alternate means of achieving energy efficiency can be applied in their individual businesses.

[11] Recognition of alternatives was only evident after prompting and explaining the concepts.

7 Energy management practices in MSMEs

For a firm to become energy efficient, the "entire" organization must respect the idea of conserving energy. The study looks at the existing energy management practices in the selected MSMEs. The issue of energy management encompasses activities such as monitoring energy usage and/or leakage (energy audit), business process reengineering to reduce energy usage and dissemination of information of energy usage across the organization. The importance of energy audits in energy management is universally recognized. Energy audits are a fundamental "first" step of an energy conservation programme in any industrial unit (Bhattacharya, 1992). On the basis of the results of an energy audit, a firm trying to conserve energy has to adapt its business processes and replace machinery to minimize energy consumption. An integral part of energy management practice is the proper dissemination of energy usage data to various members of the organization – the sharing of data sensitizes the users and initiates suggestions (for better practices) from the end users of energy.

7.1 Monitoring energy usage

Personalized management is perhaps the most defining characteristic of an MSME. Most SMEs are established by a single entrepreneur or a small group of people. The owner (or the owner group) actively participates in all aspects of management of the business and in all major decision-making processes. Therefore, there is very little delegation of authority in such firms (Ritchie, 1993). Ang (1991) argues that the managers in SMEs tend to have general rather than specific expertise. The majority of SMEs run on thin manpower – they are 'cash starved' and it is therefore usually not possible to hire managers with specialized skill sets. Given this characteristic of SMEs, it may be necessary for them to seek external support on technical (and technological) issues such as energy management. The study examines to what extent SMEs rely on external experts to monitor (and audit) their energy usage and devise ways to reduce the consumption of energy.

It is an established practice in India for firms to engage "consultants"[12] to study the usage of energy and suggest ways and means to improve energy efficiency. The present study finds that only 14 percent of the respondent firms have employed an energy consultant and conducted a detailed process study with a focus on energy usage. Further investigations suggest that the majority of these firms have either implemented the process to reduce the costs associated with energy consumption or to ensure uninterrupted power supply. Becoming energy efficient was definitely not the motivation for these firms to hire consultants to study their energy usage. It is

[12] In our study we have defined such consultants as entities other than energy auditors.

also important to note that 33 percent of the firms which appointed a consultant to monitor energy usage did not implement the recommendation(s) by the consultants. These firms deemed that the recommendations by the consultants were not firm-specific and too expensive to implement. Most of the SMEs had not ever hired an energy consultant. The main reasons for this include:

(a) Most consultants are unaware of the specific processes the firms follow and hence suggest means which are generic in nature.
(b) The management follows the "best practice" possible with respect to energy usage monitoring and there is no reason why an external individual is required to advise management on this issue.
(c) The quality and integrity of the consultants is doubtful. Many consultants are "tied" to certain equipment manufacturers and try to "push" for the equipment to be purchased under the guise of professional advice.

However, most firms (85 percent) deem it necessary to regularly monitor energy usage. These firms not only monitor energy consumption in production process but also in general housekeeping activities. 15 percent of the firms included in the study felt that given the nature of their activity, energy cost is not a significant share of the overall costs and, hence, energy usage does not merit close scrutiny. These firms do not regularly monitor energy consumption.

The study also revealed that only 5 percent of the firms have hired an "accredited" energy auditor and have conducted a formal energy audit. The motivation behind energy audits in these firms is both internal and external:

(a) One of the firms carried out this exercise following the direction of its bank with which it had a line of credit. The bank sought to identify cost saving opportunities in the firm through better energy management practices.
(b) Another firm reported that it faced severe power shortages and therefore carried out an energy audit at the behest of a technology consultant to determine ways to alleviate the problem. As a consequence of the audit, power factor correction units were installed. However, according to the firm, the results are far from satisfactory.
(c) Two other firms conducted energy audits as a voluntary exercise. The owners of these firms were found to have a "technical" mind and felt that such audits would help them devise ways to conserve energy and reduce costs. Both companies engaged international

experts and feel that they have benefitted immensely from the recommendations (*see Box F*).

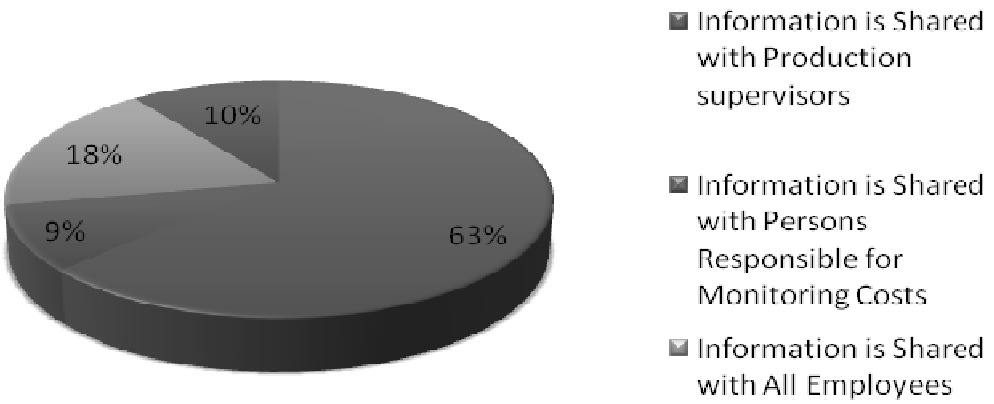
Most of the firms included in the study had almost no or little knowledge about energy audits. Many of them (particularly the smaller firms) felt that energy audits are a process which involves officials from government departments and the pollution control board and, therefore, energy audits implied external interference in their business. Many of them feared penal and legal action as a consequence of the audit and hence expressed serious aversion to energy audits. When the reasons for the need and utility of energy audits was explained, a few respondents expressed that they would like to look at the outcomes of such audits in larger firms and only then would form an opinion about them.

The survey findings are corroborated by the observations of energy auditors interviewed during the course of this study. Most energy auditors feel that the most important reason why SMEs avoid energy audits is the pronounced lack of knowledge or information about them.

7.2 Dissemination of energy usage data

The study aimed to determine the degree of dissemination of energy usage data across the organization[13]. The pattern of responses is presented in Figure 5.

Figure 7 How firms disseminate information on energy usage



[13] Three firms did not respond to the relevant questions.

Most firms in the study report that the top management shares the data on energy usage with the staff. However, for many of these firms information sharing is not standard practice. The data is only shared when the energy statement suddenly surges and management feels that the costs must be reduced. The interviews also revealed that data on energy usage is usually reported as monetary figures rather than units consumed. The broad objective for the dissemination of such information is to sensitize the employees about the rising costs on account of energy. However, for larger firms which are more "technology intensive", the actual energy usage data are analysed and corrective actions are planned beforehand.

However, about 10 percent of the surveyed firms do not wish to disclose the energy usage data to their employees. All these firms are small firms and consider the data to have no relevance for the employees. It should be mentioned in this context that many small firms in India engage in "energy theft" and may therefore not wish to disclose data on their energy usage.

8 Adoption and non-adoption of energy efficiency projects

What drives SMEs to implement efficient energy management practices and act responsibly with reference to environmental protection and sustainable development?

Is such action voluntary in SMEs or influenced by the pressure of regulation? Williamson et al. (2006) suggest that because of pressures related to survival and the supply chain, SMEs may not adopt such practices on a voluntary basis. Although adoption of such practices increases the reputation of firms in the present scenario, this reputation building exercise based on improving CSR practices is not important for SMEs (Graafland and Smid, 2004). Hence, the fear of loss of reputation may not be a driver to embrace environmental friendliness as a goal. Tilley (1999) advocates a "twin-track approach" which builds on strengthening the regulatory framework to act as a driver for environmental action and simultaneously weakening those forces that resist it.

The present study sought to look at the drivers and barriers for SME implementation of energy efficient projects. The study addresses the issue in terms of three different parameters:

- Nature of projects implemented to increase energy efficiency
- Impetus to adopt projects for increasing energy efficiency
- Drivers/barriers facilitating/inhibiting implementation of projects for energy efficiency.

8.1 Nature of adoption

Firms are referred to as "adopters" if they implement projects that help them become energy efficient. Adoption can either occur in the form of ***reengineering technology*** – with investments in new technology and machinery – or ***reengineering processes*** which supports the reduction of energy usage. Some examples of technology and process reengineering are presented in Table 4. There are firms which have implemented projects incorporating both technology upgrading and processes reengineering. While some of the changes in technology and processes are specifically related to production, another form of adoption can be achieved by streamlining housekeeping practices and saving energy.

Table 5 Examples of mechanisms to achieve energy efficiency

Technology Reengineering	• Replacing the traditionally used source of energy with a new source (coal with diesel/LPG, diesel with LPG, etc.) • Installation of equipment for recycling of heat • Installation of equipment for improving insulation and reducing heat loss • Installation of energy efficient machines • Installation of equipment for reducing leakage of electricity • Changes to existing equipment so that more than one unit of output is processed using the same energy • Replacing CRT monitors with TFT/LCD monitors
Process Reengineering	• Recycling waste organic products and using them as a source of fuel • Using ambient heat for drying • Using natural wind for drying • Altering the timing of shifts to maximize the use of daylight and day temperature
Streamlining Housekeeping Practices	• Using CFL • Using daylight • Use of natural ventilation

There are firms which may not have implemented any project to become more energy efficient, but have a positive attitude towards implementing such projects. These firms are open to new ideas and are willing to evaluate their practices in terms of energy efficiency. Such firms, though they are non-adopters, deserve special classification. In our analysis, these firms are referred to as "non-adopters with positive attitude". The other firms are simply termed "non-adopters" and are not willing to implement any of the above means to become energy efficient in the near future. These firms are either unaware of the energy efficiency agenda or feel that becoming energy efficient is not a priority. Table 6 lists the findings of the study with respect to the adopters and non-adopters.

Table 6 Adopters and non-adopters across different categories of firms

Nature of Firm	Non-Adopters	Non-Adopters with Positive Attitude	Adopters	Total
Micro	4	4	11	19
Small	29	9	19	57
Medium	9	0	2	11
Total	**42**	**13**	**32**	**87**

Table 7 Means of adoption of energy efficiency projects

Nature of Adoption	Number of Respondents	Percent of Adopters
Technology Reengineering	24	75.00
Process Reengineering	18	56.25
Streamlining Housekeeping Process	7	21.88

37 percent of the sample firms are adopters based on the definition used in our study. We find that 75 percent of adopter firms have undertaken some form of technology reengineering while 56 percent of adopters have implemented process reengineering. Only 22 percent of adopter firms have focused on streamlining/adapting their housekeeping practices to achieve energy efficiency.

The results of the study indicate that although 63 percent of sample firms are non-adopters, 15 percent are non-adopters with a positive attitude – these firms acknowledge the significance of energy efficiency and may take up projects which will increase their energy efficiency. The details are discussed later.

8.2 Reasons for adoption and non-adoption

The interviews conducted during the study revealed that the decision to implement projects to achieve energy efficiency occurs "top-down" in all SMEs. If the owner of the firm is convinced about the requirement and usefulness of such a project, the firm has implemented it or is actively considering the decision to implement it. Thus, the owner's (or the owner group's) awareness, perception, knowledge and attitude play a critical role in an SME's decision to become an adopter or non-adopter (*see Box C*).

Analysis of the qualitative inputs collected during the study reveals that the attitude of some firms (actually, of the owner(s) or owner group) which have implemented projects that facilitate energy efficiency can be classified as follows:

- Regular search for the latest technology (imported or indigenous) for increasing productivity, cost reduction and maintaining competitive advantage over rivals
- Continuous search for better and less energy consuming technology or alternative sources of energy in an effort to lower energy costs and/or to decrease energy consumption per unit of output,
- Sincere effort to reengineer existing processes to minimize energy usage or prevent energy loss and wastage.

These firms are generally motivated and have a dedicated person or team to monitor energy usage, who suggest means to regulate/improve the firm's energy consumption. The majority of such firms try to attain cost advantages and productivity gains through technology. Achieving energy efficiency is also an important goal for such firms as they are aware of the costs and benefits of such projects and realize that energy efficiency can also become a source of competitive advantage. Other firms in this group are concerned about their reputation as socially responsible corporations and, hence, strive to become energy efficient to improve their image among customers and society at large. These firms feel that advocating a "green" image is a way to advertise and gain competitive advantage. The firms in this group which feel that they do not have adequate expertise to assess opportunities for energy usage reduction and to select technologies that would increase their energy efficiency usually hire the services of consultants. This group of firms has implemented energy efficiency projects on their own impetus and can therefore collectively be categorized as ***habitual adopters.*** An important motivation among habitual adopters is improving their "image" among customers and other stakeholders. The results of the study reveal that there are only 6 percent firms (16 percent of the adopting firms) that can be classified as habitual adopters with an internal motivation.

The second group of adopters comprises firms that are driven by some external impetus to improve their energy usage performance. External reasons include:

- Inconsistent energy supply or supply failure that forces the firms to search for alternate technologies
- Rising prices of traditional sources of energy that have a negative impact on the cost structure of these firms *(Box B)*

- Pressure from local stakeholders and regulatory bodies (such as pollution control boards) concerning the polluting effects of traditional sources of energy
- A desire to increase the rate of production
- Concerns about wastage with regard to traditional sources of energy *(Box E)*.

Facing such external impetus, these firms have implemented projects to overcome these constraints and in the process have become energy efficient. The goal of becoming energy efficient is achieved indirectly. Such firms can be categorized as ***circumstantial adopters.***

Given the above, we can summarize the drivers that led to the adoption of environmentally friendly projects as follows:

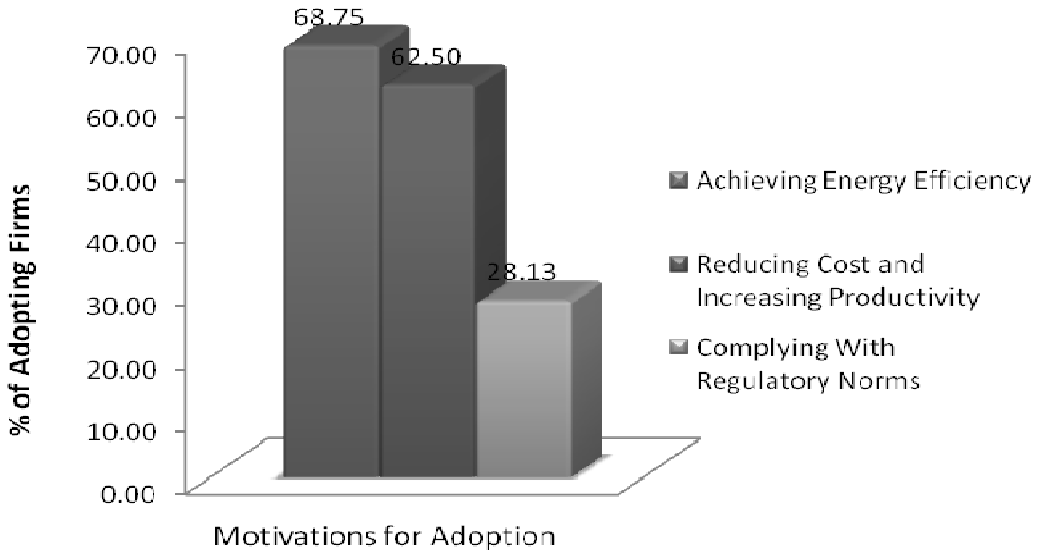
(a) Achieving energy efficiency

(b) Reducing costs and increasing productivity

(c) Complying with regulatory norms.

These motivations are not mutually exclusive.

Figure 8 Motivations for adopting energy efficiency projects



Do SMEs feel that it is their moral and social responsibility to implement projects that will help them reduce energy usage or prevent wastage of energy? Unfortunately, we only found one firm

that values corporate social responsibility. This firm which has a "technology-oriented management" deems that it is the moral responsibility of existing firms to reduce their energy consumption because as new firms emerge, energy capacity is increased and natural resources are being depleted. The remaining firms that reportedly have implemented (or are planning to implement) projects to achieve energy efficiency are motivated not by moral compulsion, but by economic and/or legal reasons.

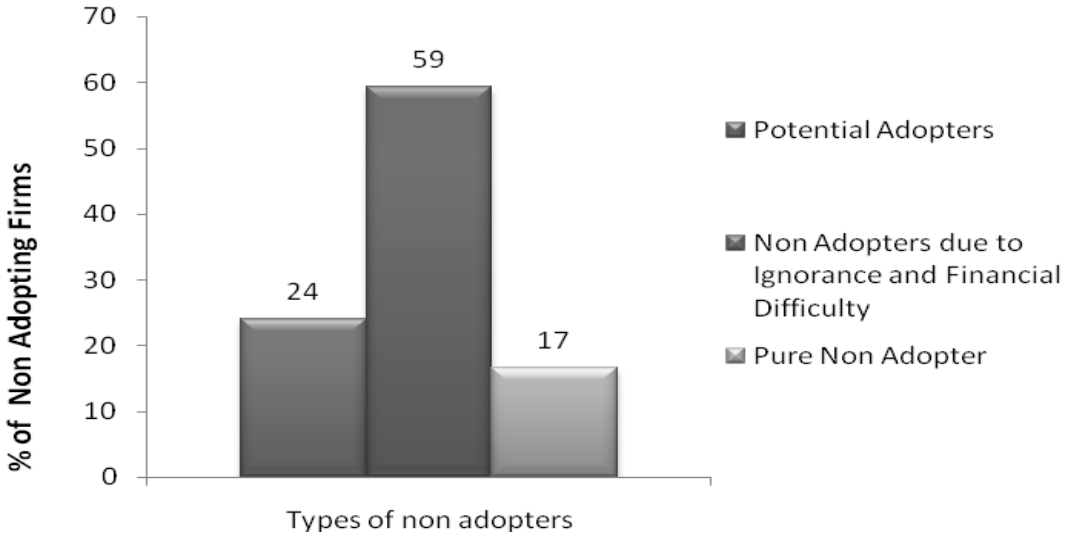
Most firms have implemented projects which aim to reduce costs or to comply with restrictions imposed by regulatory authorities like pollution control boards. The study identified at least 22 percent adopting firms which undertook the necessary investments to reduce energy costs solely because of a rise in energy prices. The study also found that 41 percent of adopters implemented projects to achieve energy efficiency with the dual aim of reducing costs and increasing productivity. That is, about 63 percent of the firms in our study chose to become adopters not because energy efficiency was a key objective, but because of some other pressure, e.g., cost reduction and productivity increase. The goal of achieving energy efficiency is simply a collateral aim in these cases.

Regulation also plays a major role in making SMEs environmentally friendly (Tilley, 1999). Not surprisingly, in the present study regulatory norms, particularly those advocated by the pollution control boards, have influenced the decision of many firms to implement energy efficiency projects. In the present study, 28 percent of adopters cite regulatory norms as a factor which induced the firms to carry out projects to achieve energy efficiency. Many of the firms in the food processing sector have implemented fuel substitution projects to avoid emissions penalties from pollution control authorities.

We also found that adopters have a positive attitude towards information sharing and also expressed willingness to share their experiences with their peers.

Just as the adopters can be classified in different categories, there are also different types of non-adopters. Analysing the qualitative data collected during the study, the non-adopters can be classified into three distinct groups based on their attitude towards energy efficiency projects.

Figure 9 Types of non-adopters



One group of non-adopters is characterized by a remarkably positive attitude towards energy efficiency projects. These firms understand the importance of energy management and have therefore already put in place energy monitoring practices. These firms to a large extent share energy usage information with other members of the organization in an effort to sensitize the organization about rising energy usage. Their present status as non-adopter is attributable to their lack of knowledge about specific technologies or practices that could increase energy efficiency within the organization. These firms also expressed their desire to shift to such technologies, provided the technology is cost effective. This group of firms can be considered ***potential adopters.***

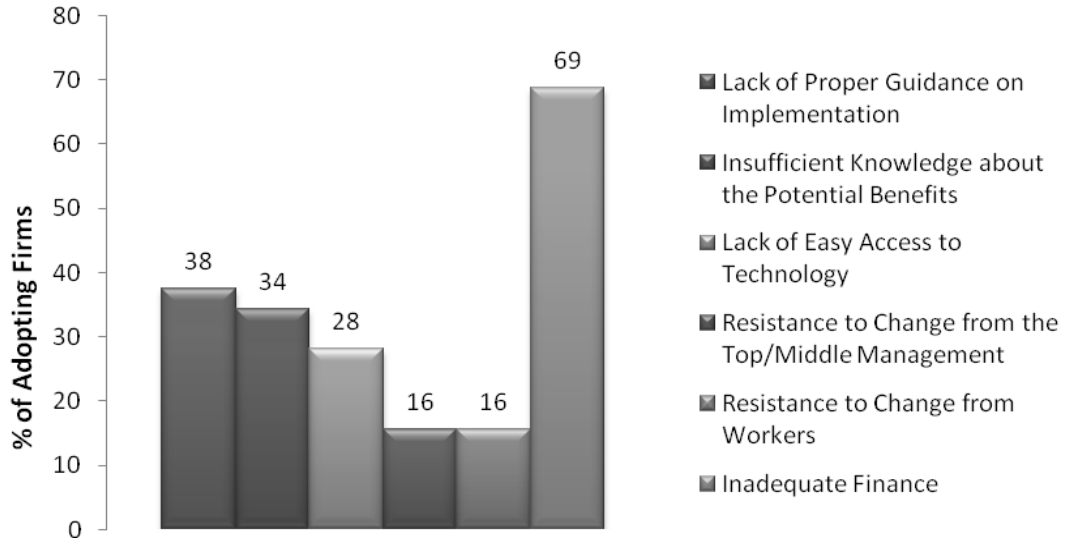
The second group comprises 59 percent non-adopters who are either not aware of any energy efficient technology or are aware of such technologies and/or processes and their long-term benefits, but are hesitant to adopt them due to the investment costs of such projects. These firms do not believe that any such projects or practices can fit their budget.

The third group of firms – ***pure non-adopters*** – is fully content with their existing technology and their top management is not interested in implementing any project that would help them become energy efficient. Many firms in this group feel that energy efficiency projects are unprofitable. In this group, there are a few firms, specifically in the food processing sector, which are tradition bound and feel that the taste and texture of their products are the result of traditional methods that have been followed for years. Any change in their production process

would alter the very basic nature of their products and affect their competitiveness. Hence, they will not, under any circumstances, switch to alternate energy efficient processes.

8.3 Difficulties implementing energy efficiency projects

Figure 10 Barriers to implementing energy efficiency projects



This study attempted to understand the main difficulties firms, which have implemented projects related to energy efficiency, have experienced. Lack of adequate funds stands out as the most important obstacle in this respect. 69 percent of adopters cited the lack of adequate funds as the major obstacle[14]. All these firms have deployed their own funds (equity) to finance projects to enhance energy efficiency. Further, all firms which are currently non-adopters but are classified as potential adopters, have plans to implement energy efficiency projects using their own funds. Receiving debt financing from commercial banks for such projects is not considered a viable option by these firms for the following reasons:

- Firms are not sure whether the banks and financial institutions are inclined to finance such projects
- Firms perceive that they will not be able to comply with the numerous formalities required to procure bank loans

[14] In this context it is important to note that about 34 percent of firms which are non-adopters also emphasize the lack of adequate funding as an important factor for the non-implementation of energy efficiency projects.

- Firms feel that they do not have the required expertise to furnish financial projections that banks require for the financing of projects, and hiring consultants for preparing project plans is costly
- Many firms expressed their inability to provide collateral securities to secure such loans
- Some firms expressed their concern about the interference of banks in their business should they take a bank loan.

Most firms included in our study asserted that investment in projects to increase energy efficiency are by nature “non-traditional” investments and that the major barrier to undertaking such investments is the perceived high cost of implementation. In this regard, 50 percent of adopting firms consider that such investments are indeed costly compared to other investments. Further, the firms are also unsure about the payback period of such investments. 34 percent of adopters expressed lack of knowledge about the potential benefits (including the payback period) of implementing such project(s). Incidentally, it has been found that those firms which have implemented process reengineering without incurring additional investments do not monitor the savings achieved thereby. However, when considering those adopting firms which have undertaken technology reengineering, the majority expect a payback period of 1–3 years with only 17 percent of such firms anticipating a payback of more than 3 years.

Lack of proper guidance for implementation is another important obstacle. Many firms complain about the lack of implementation partners and technology experts who understand the specific needs of small firms and who can guide them through the implementation process. Another obstacle firms face is the lack of access to technology. In most cases, the firms reported that they had to conduct their own research among their circle of contacts or other sources of information to identify suitable technology. These firms asserted that the process of implementing energy efficiency projects could have been easier and less time consuming, if such information was more readily available.

9 Conclusion

In a developing country like India, micro, small and medium enterprises facilitate sustainable development by generating employment and other opportunities at the grassroots level. But when it comes to protecting the environment and its resources, most SMEs become inhibitors to the goals of sustainable development. This scenario is amply corroborated by the present survey which tried to gauge the approach of SMEs in India to energy efficiency. Although the frequency of energy efficiency project implementation is not very encouraging, much of the blame can be ascribed to various external obstacles MSMEs face. For one, the existing policies have failed to generate much MSME awareness regarding environmental protection. Further, MSMEs face certain resource and knowledge constraints that inhibit project implementation. Again, most MSMEs have a myopic vision regarding profitability which limits them in their consideration of the long-term benefits and in the adoption of energy efficient technologies that would generate a long-term sustainable competitive advantage as envisaged by corporate environment strategists.

Box A Traditional process requirements restrict embracing clean technology

A "micro" enterprise, Taramoyee Mistanna Bhandar (TMB) is located in a busy area of the Kolkata city. This 30-year old firm enjoys a reputation among its customers for quality food products – milk products and fried snacks. The firm believes that the source of its competitive advantage over its rivals lies in the unique taste of the products it manufactures. Although TMB is aware of the government regulation against the use of traditional fossil fuels like coal within the city premises, it still uses coal as one of its primary sources of energy. TMB "respects" the customers' choice of taste which, according to the firm, is possible because of the slow (and time consuming) heating process, specifically with regard to its milk products, which is possible only with the use of coal in the ovens.

TMB deals with interruptions in the availability of coal and the wastage of coal, particularly during the rainy season, when coal stored in the open air gets wet. At the same time, the firm is aware that coal fired ovens slow the production and limit rapid increase in volume. Driven by these limitations of coal fired ovens, TMB partially switched to diesel-fired ovens a few years ago. Now it only uses these ovens for processing fried snacks. It continues to use coal ovens for preparing the milk products – the major component of their product line. TMB is altogether reluctant about the use of LPG (in place of diesel), because of the problem of storing LPG cylinders (lack of space) and irregularities in the supply of LPG cylinders. TMB is also concerned about the additional safety precautions involved when using LPG and do not intend to invest in safety devices.

Box B Rising price of fuel: A driver for exploring alternatives

Star Chanachur (SC) specializes in the manufacturing and marketing of fried food products which are popular among its customers as snacks. SC is very much aware of the inefficiency of coal as a source of energy. After establishing its business, the firm used coal for 15 years as its principal source of energy. Then it switched to diesel ovens. Switching to the more energy efficient diesel ovens was motivated by – among other factors – problems with the availability of good quality coal, wastage of coal in the form of ash, problems with the storage of coal, etc. After having used diesel as a source of energy for the next 8 years, the firm's profitability decreased as the price of diesel started increasing in leaps and bounds. The rapidly rising cost of energy compelled the firm to switch to the old system of coal stoves.

At present, SC uses coal stoves for its production process – notwithstanding its dissatisfaction with the inefficiency of coal as a source of energy and the pollution the coal stoves cause. The firm is not contemplating switching to LPG stoves as the partial elimination of subsidies on LPG has meant that the price of LPG is also rapidly increasing and the firm feels that using LPG stoves will reduce its profitability.

In future, the firm would be interested in exploring bio gas and bio diesel as a source of fuel - only because of the lower costs of these fuels. The firm is least concerned about the positive impacts such bio-fuels will have on the environment. However, it is not sure about the regular availability of bio diesel. As a first step to implement its future plan, the firm has registered as a Small Scale Industry (SSI) with the District Industrial Centre (DIC) to be granted technical and financial assistance from the DIC to set up a bio gas plant. But unfortunately, the firm is facing a crucial hurdle – it does not have sufficient space to set up the plant. Although the constraint has resulted in a temporary setback, the firm is exploring options to tide over the crisis.

Box C Education – The driver for embracing CSR

Starting in 2006, Sumis Enterprise (SE), a manufacturer of canned and packaged sweets, has been exporting its products to the Middle East and other Asian countries. The firm also supplies confectionery products to many reputed hotels in the country.

The firm is now planning exports to the US and is in the process of obtaining the necessary clearance from US authorities. Since its establishment, this firm has maintained a forward-looking approach and has primarily focused on issues such as quality and hygiene.

One of the owners received his education in food technology from a reputed institute in India and it is the attitude of the owners that has played an instrumental role in the firms' embrace of green technology as one of its corporate philosophies. While setting up the production unit, the firm has accorded a lot of importance to achieving near 100 percent mechanization – to ensure quality and hygiene, as well as energy efficiency.

The firm has imported machines (conforming to the parameters of energy efficiency) from Germany and other countries. It keeps close watch on energy consumption and sensitizes its staff about the need to conserve energy. The firm uses electricity and LPG as its source of energy and proudly declares itself as a unit with close to zero pollution. The firm accords much importance to environmentally friendly disposal of waste. There is an overall awareness and respect for environmental protection.

The owners are proud that it is their education that has played a pivotal role in adopting a technology which is not only energy efficient but also helps them gain competitive advantage in the international market by reducing costs and maintaining quality.

The owners also feel that being sensitive to environmental protection is a responsibility that everyone in society must assume and fulfil.

The owners stress the importance of research and development of products and processes and regularly participate in the R&D programmes sponsored by the Khadi and Village Industries Commission, Government of India, for exploring innovative products and processes. The vision of the owners is to expand their business while upholding the goals of a sound corporate social responsibility.

Box D "We know what is best for us"

A 35-year old proprietorship firm, Pioneer Steel (PS), a rolling mill, has an annual revenue of approximately Rs. 3.00 million. The firm is "confident" that it is aware of the best practices and there is "no need to depart from its traditional business practices and philosophy."

Achieving energy efficiency is not a priority for the firm. Pioneer Steel does not wish to consult any consultant or expert to monitor or reduce energy usage as, according to the firm, this is a non-productive exercise and such practices would result in an unnecessary increase in the cost of production. PS is reluctant to switch to any more energy efficient technology and states that "do not say we are not aware of any other technology, rather say, 'no other technology is required'". PS believes that any government regulation(s)/policies will not be able to induce them to adopt energy saving technologies as there is no adequate incentive for doing so.

Although electricity is the main source of energy, in the past, the firm has switched from coal to furnace oil as a source of heat. This was induced by the rising price of coal, wastage of coal and disruptions in the supply of coal. In the immediate future, the firm has no intention of adopting any new technology or process as it is not convinced that such processes will be beneficial in terms of profit.

Another firm, Associated Hosiery Textiles (AHT), is a 35-year old firm with an annual revenue of approximately Rs. 8.00 million. It is engaged in spinning and weaving activities. Electricity is the main source of energy. The firm operates mostly with old machines, as it thinks that "better machineries are not available".

However, with the rising price of electricity, the firm has switched from multiple lever operated machines to single lever operated machines in an effort to reduce its energy bill. Consequently, there has been a 12 percent increase in costs associated with every 20 percent increase in production. AHT, however, is planning to replace some of its machines in the short run.

The major motivation of this plan is not to achieve energy efficiency, but to reduce labour costs. The firm will introduce a more "mechanized" system of production and dismiss part of its staff. The firm feels that newer machines will not be able to contribute much to the reduction of energy usage or energy cost, but will help reduce labour costs and achieve better economies of scale.

Box E Reducing the cost of production at the cost of the environment

A 33-year old firm, Exclusive Printing (EP), is engaged in textile printing. The process requires a lot of heat and, traditionally, the firm has used coal fired ovens *("sigris"*) in their production process. These "sigris" produce adequate heat but are extremely polluting. Sometimes, in addition to coal, the firm uses rubber tyres in these "sigris", which helps reduce the cost of manufacturing. Although the "sigris" are installed in the open air, during the monsoon season, EP relocates the "sigris" to closed rooms and also uses the trapped heat in the rooms to dry the printed textile.

Availability of good quality coal, variable heat generated by coal, wastage of coal and the disposal of ash are the prime concerns of this firm. In an effort to deal with these difficulties the firm has invested in a few diesel-fired stoves. These stoves run simultaneously with the "sigris". However, in the diesel-fired stoves, the firm mixes burnt engine oils (available from local garages and vehicle-servicing units) with diesel in an effort to reduce the cost of production. This mixed fuel is not as efficient as diesel and also results in heavy pollution and a lot of smoke. The smoke causes a lot of discomfort to the workers.

The firm is aware that LPG-fired stoves are comparatively more energy efficient and less polluting. But the cost involved in the initial setup of such stoves is the main hurdle and the firm is reluctant to invest in such stoves in the short run. EP also rejects the idea of financing such investments through loans from the bank, as it "feels" that it does not have adequate collateral security to offer for receiving such a loan.

Box F "Knowledge" – A crucial issue for achieving energy efficiency

JMD Enterprise is a proprietorship firm manufacturing "sarees" – a traditional dress for women in India. The approximate annual revenue of the firm is Rs. 25.00 million. The energy cost constitutes a substantial share (nearly 30–35 percent) of JMDE's costs of production and, as a result, the rising price of energy has become a major concern for the firm. In an effort to keep a tight check on energy usage (and resultant cost), the firm has started monitoring daily energy usage and has begun sensitizing its staff about the requirement to reduce energy usage.

The firm has also started streamlining housekeeping processes by adopting various energy saving practices like installing "Khus Khus" – a traditional curtain made of coir which can be soaked in water (and thereby cuts down on air conditioning costs), replacing wooden windows with glass windows (so that natural light can be used), installing CFL bulbs, etc.

However, to reduce its energy bill, the firm is not planning on implementing any project(s) to replace the old machinery with more energy efficient machines. The firm is not aware that the Bureau of Energy Efficiency (BEE) in India certifies a host of machines as being energy efficient and that financial institutions like the Small Industries Development Bank of India (SIDBI) offers debt finance (at a concessional rate) for purchasing such machinery. The firm admits that it is unaware of the availability of any better technology or practice which would be more energy efficient.

On the contrary, Kothary Hosiery Factory Private Limited (KHPL) is relatively young firm (2 years), with an annual revenue of Rs. 180 million, and adopted energy efficient technology right from its inception. The owners of the firm had prior knowledge about the measures to achieve energy efficiency. The owners feel that energy efficiency is an important strategy – particularly in the light of rising energy prices. The firm planned for an alternative fuel source based on husk. Husk which is cheap and easily available is being used to generate electricity. The firm has used a power factor and steam condensate recovery system to achieve energy efficiency. It has also undergone an energy audit. This firm seeks to adopt other green technology solutions in order to become more environmentally friendly and reduce the input cost of inputs.

Box G Orientation towards technology – Driver for implementing energy efficiency projects

Castle Industries Private Ltd. (CIPL) is a company which has been involved in the casting and forging of steel for the last 20 years. It has an annual turnover of approximately Rs. 50 million. The firm prides itself on its "technical" culture and asserts that it has always shown an interest towards adopting environmentally friendly means of production.

Previously, the firm was using furnaces fired by furnace oil for smelting. Now it has switched to induction furnaces in an effort to adopt an environmentally friendly and cost efficient technology. The move has helped the firm protect itself against the rising price of furnace oil. This change has helped CIPL achieve, on average, cost savings of approximately Rs 3.00 – 4.00 /MT. In an industry marked with severe competition, such savings have helped CIPL immensely.

However, the firm financed this switch from its own funds – as it could not get a loan from the banks and other financial institutions. This has resulted in some delay in installing the induction furnace.

The company is on the lookout for better ways to make its production process more energy efficient and is coordinating with the Small Industries Development Bank of India - Japan International cooperation Agency (SIDBI-JICA) technology improvement initiative. In an effort to minimize energy costs, the company has now institutionalized detailed energy cost calculation as a mandatory part of product costing and is taking all possible steps to sensitize the staff to achieve energy efficiency.

Another company, Titan Engineering Private Limited (TEPL), has been involved in steel fabrication for 39 years. The company believes that good technology can be a source of competitive advantage. TEPL, with an approximate annual turnover of Rs. 90.00 million, is constantly seeking means to reduce energy consumption, as energy cost is an important element of their cost structure. The firm switched from transformer-type fabrication equipment to rectifier-type equipment and thus reduced annual energy consumption by almost 50 percent. This has resulted in increased profitability.

At the same time, the firm tried to streamline its energy usage through housekeeping activities and adopted measures like switching rom incandescent lamps to CFL. The lighting of the workshop area has also been changed from "tube lights" to sodium vapour lamps. All these measures have helped the firm reduce its energy costs substantially.

References

Ang, J (1991): "Small Business Uniqueness and the Theory of Financial Management", *The Journal of Small Business Finance*, 1(1), pp: 1-13

Bhattacharya, S.C. (1992): "The Energy-cum-Environment Audit: Concept, Approach and Advantages", *The Environmentalist*, 12(3), pp. 187-189

Biggs, T and M. Shah (1998): "The Determinants of Enterprise Growth in Sub-Saharan Africa: Evidence from the Regional program on Enterprise Development", *RPED Discussion Paper*, The World Bank.

Birch, D.L. (1979): *The Job Creation Process: Final Report to The Economic Development Administration*, MIT Program on Neighborhood and regional Change, Cambridge, MA

Birch, D.L. (1987): *Job Creation in America: How Our Smallest Companies Put the Most People to Work*, New York, Free Press

Brown, C, J. Hamilton & J. Medoff (1990): *Employers: Large and Small*, Harvard University Press, Cambridge, MA

Dixit, A.K. and R.S. Pindyck (1994): *Investment under Uncertainty*, Princeton University Press, Princeton

Government of India (2002): *Employment Generating Growth*, Planning Commission, Government of India, New Delhi

Government of India (2004) *Final Results: Third All India Census of Small Scale Industries 2001-2002*. New Delhi: Development Commissioner (SSI), Ministry Of Small Scale Industries (http://www.laghu-udyog.com/publications/books/fcensus.htm)

Government of India (2009): *Annual Report, 2008-09*, Ministry of Micro, Small and Medium Enterprises, Government of India, New Delhi

Graafland, J and H. Smid (2004): "Reputation, Corporate Social Responsibility and Market Regulation", *Tijdch-rift voor Economie en Management*, 49(2), pp. 271-308

Green, P.E., D.S. Tull and G. Albaum (1998): *Research for Marketing Decisions*, Prentice Hall, New Delhi

IEA (International Energy Agency) (2004): *Key Energy Statistics*, IEA, Paris, (http://www.iea.org/dbtw-wpd/Textbase/nppdf/free/2004/keyworld2004.pdfS)

Lovins, L.H (2008): *Rethinking Production*, 2008, State of the World: Innovations for a Sustainable Economy, Worldwatch Institute, New York

Nooteboom, B (1993): "Firm Size Effects on Transaction Costs", *Small Business Economics*, Vol: 5, No.: 4

Norberg-Bohm, V (1999): Stimulating 'green' technological innovations: An Analysis of Alternative Policy Mechanisms, *Policy Sciences*, 32, pp: 13-38

Ritchie, J (1993): "Strategies for Human Resource Management: Challenges in Smaller Entrepreneurial Organizations", in R. Harrison (Ed.), *Human Resource Management*, Workingham, Addison-Wiley

Solow, R (1991): *Sustainability: An economist's perspective*, The Eighteenth J. Steward Johnson Lecture, Woods Hole Oceanographic Institute, Woods Hole, MA

The World Bank (1995): "Workers in an Integrating World", *The World Development Report*, The World Bank, Washington DC

Tilley, F. (1999): "The Gap Between the Environmental Attitudes and the Environmental Behaviour of Small Firms", *Business Strategy and Environment*, 8, pp. 238-248

Williamson, D, G. Lynch-Wood, J. Ramsay (2006): "Drivers of Environmental Behaviour in Manufacturing SMEs and the Implication for CSR", *Journal of Business Ethics, 67*, pp. 317-330

Printed in Austria
V.11-87164—December 2011—300

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Telephone: (+43-1) 26026-0, Fax: (+43-1) 26926-69
E-mail: unido@unido.org, Internet: www.unido.org