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Green Manufacturing: Need Of The Hour

Vishal Garg[1], Khushbu Gaur[2]
[1]Research Scholar (Thapar University, Patiala),Assistant Professor (GITM, Bilaspur)
[2]Assistant Professor (Ganpati Business School, Bilaspur)
[1] contactvishalgarg@gmail.com, [2]khushbu.gaur23@gmail.com

Abstract: Green Manufacturing" refers to multidisciplinary approaches aimed at reducing the energy- and material-intensiveness of manufacturing processes. One of the most challenging goals ahead is the use of only renewable energy sources to meet energy demands. The Green demonstrates that, by applying a combination of different environmental technologies, energy requirements could be reduced by between 60-70 percent. Apart from the innovative handling of energy demands, the Green manufacturing applies many other environmental technologies. In the not-too-distant future, environmentally benign manufacturing will become one of industry's greatest strategic challenges, not only from an engineering perspective, but from a business and marketing perspective as well. The purpose of this study is to gather information on research and development in India aimed at developing alternative methods for materials processing with the purpose of minimizing toxic material generation and optimizing products and byproducts for sustainability and reuse characteristics.

Keywords:- Green Marketing**,** Green Manufacturing , Reuse, Recycle, Green Practices, Green Products and Green Energy

1. INTRODUCTION

The Government of India would like the manufacturing sector to play a bigger role in the country's economy. The Ministry of Commerce and Industry, has set a target to increase the sector's contribution to the GDP to 25 percent, from the current level of about 16 percent. While this growth is necessary, the country's environmental concerns need to be studied with great concerns — the manufacturing sector must use energy and resources efficiently, and minimize generation of waste to maximum level so as to save the environment from coming dangers. It is estimated that even if every factory, power plant, car and airplane is shut down, the average global temperature would still increase by 0.6˚C in this century which is above normal. It is a myth that there is an inescapable trade-off between environmental sustainability and economic progress. Green manufacturing provides significant opportunities for investment, growth and jobs.

'Green Manufacturing' or sustainable industrial activity is now the need of the hour and it is not a slogan no more. Green manufacturing involves transformation of industrial operations in three ways: (1) using Green Energy E.g. Solar or Wind energy , (2) developing and selling Green products E.g. using Green Marketing Options and (3) employing Green processes in business operations (by reducing the waste to maximum level and recycling the waste products). A recent global survey by BCG reveals that as many as 92 percent of the companies surveyed are engaged in Green initiatives in India. Manufacturing companies that adopt Green practices benefit not only through long–term cost savings, but equally importantly, from brand enhancement with customers, better regulatory traction, greater ability to attract talent and higher investor interest and also some rebates in the form of subsidies from the central or state government. However, these benefits require a long term commitment.

The motivation for adopting Green has varied across sectors. Some take it up owing to regulatory compulsions (example: power), while others see it as an opportunity to build a stronger brand with consumers and society (example: retail sector and telecom sector). Steel manufacturers have adopted Green initiatives to stabilize rising energy costs, while automobile companies have seen it as an opportunity to launch electric and hybrid cars to meet increasingly stringent emission regulations (example: Reva electric cars and hero electric bikes). The impact of Green initiatives also varies by the industry sector. For example, Green initiatives in the power sector have the maximum impact on reducing CO2 emissions followed by transportation and then the industrial sector.

Consumers are increasingly adopting Green products. In a recent BCG survey of consumers in both, developed and developing countries, more than half the respondents indicated their preference for Green products, especially in food and electric consumer durables. Many consumers also indicated their growing willingness to pay a premium for Green Products. However, the survey also revealed that there is still a huge gap in consumer awareness that Green companies must bridge up the gap as soon as possible. Successful implementation of Green manufacturing requires going beyond small initiatives, and adopting an integrated three–step framework:

(a) Planning for Green as a core part of business strategy,
(b) Executing Green initiatives across the value chain by shifting towards Green energy, Green products and Green processes.
(c) Communicating and promoting Green initiatives and their benefits to all stakeholders specially consumers.

Green manufacturing in India is at the take–off stage. While there has been significant policy development and adoption by the manufacturing industry in the area of Green energy, there is still scope on both the policy front and its adoption in the cases of Green products and Green processes. Successful transformation into Green manufacturing will bring tremendous benefits, both tangible and intangible, for the nation and the business community and to the society also.
Manufacturing plays a very strategic role in an organization, especially to build competitive advantage and improve performance. With rapid changes in technology, customer needs and globalization, manufacturing itself is constantly transforming and evolving. The beginning of the century saw the automobile industry introduce the mass production techniques which revolutionized manufacturing processes. Over the years the need for meeting individualistic customer demands without compromising productivity or quality, brought about the introduction of flexible and mass customization techniques.

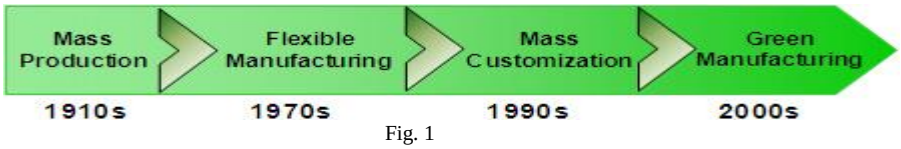

Fig. 1

2. WHAT 'GREEN' MEANS AND WHY IT IS IMPORTANT

Green stands for ecological sustainability and encompasses many different concerns including, but not limited to, air, water and land pollution, energy usage and efficiency, and waste generation and recycling. Green initiatives aim to minimize the impact of human activities on the environment.

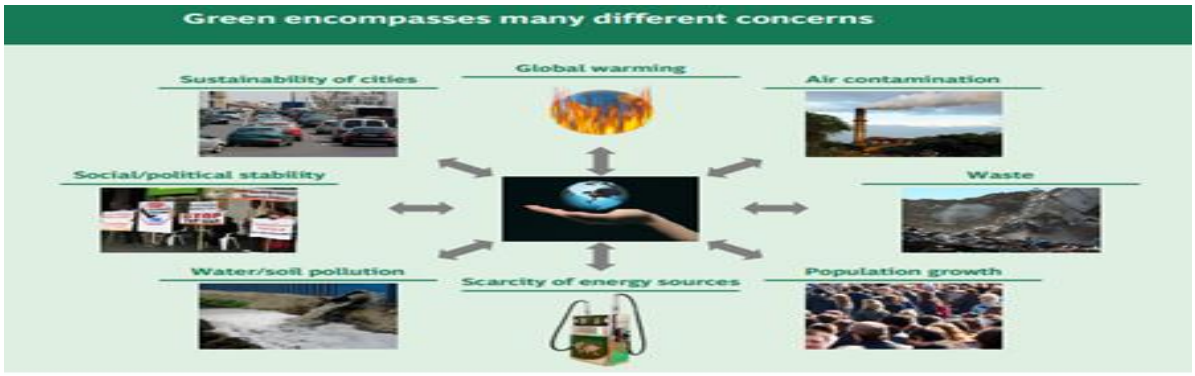

Fig. 2

A) Rising emissions and associated climate change

Greenhouse gas (GHG) emissions have increased rapidly in the recent past and their growth is further accelerating. Global temperatures have increased by 0.74°C over the last century —the fastest warming observed in the history of Earth. At the current rate, emissions will double by 2050, compared to the 2000 levels. This could mean a corresponding temperature rise of 4–6°C over pre–industrial levels by the end of this century. This unprecedented change is expected to have a grave impact on the global ecosystem, hydrological system, sea level and crop production and related activities.

B) Fast depletion of scarce natural resources

With ever increasing population and industrialization, the consumption of natural resources (example: wood, coal, oil, food, water, etc.) Is rapidly on the rise, while their availability is shrinking. This has led to periodic mismatches in demand–supply and highly fluctuating prices, impacting both corporate margins and consumer spend. There is an urgent need to (a)

adequately manage the use of these resources and (b) find and develop alternatives which are less scarce (example: wind, sun).

C) Growing waste generation and pollution

Increased industrialization and urbanization have led to significant growth in waste generation and environmental pollution. Industrial waste with chemical composition can be potentially dangerous to health, and its disposal without treatment is leading to land and water pollution. The release of industrial effluents in rivers and other water bodies is destroying local habitats. As the demand and use of electronic products rise, e–waste is also becoming a major source of environmental pollution.

3. Forces Driving Green Manufacturing

A number of companies have started adopting Green initiatives as an integral part of their operations. These initiatives are driven by five factors:

1. Rising energy and input costs
2. Growing consumer pull for Green products
3. Increasing regulatory pressures as policy makers introduce new and stricter environmental and waste management laws
4. Technological advances which open up new attractive business opportunities
5. The need to enhance competitive differentiation, particularly for first movers or those who are able to break the compromise between short–term higher costs and numerous benefits (example: brand premium, new customer segments)

Green has moved from being perceived as a 'necessary evil' to being seen as 'good business'. Companies that undertake Green initiatives stand to be advantaged on brand enhancement, political traction and regulatory compliance, greater ability to attract and retain talent, enhanced customer retention and potential cost savings. However, these benefits require a long term commitment and making tradeoffs against short term objectives, as the economics of Green manufacturing are not well understood yet.

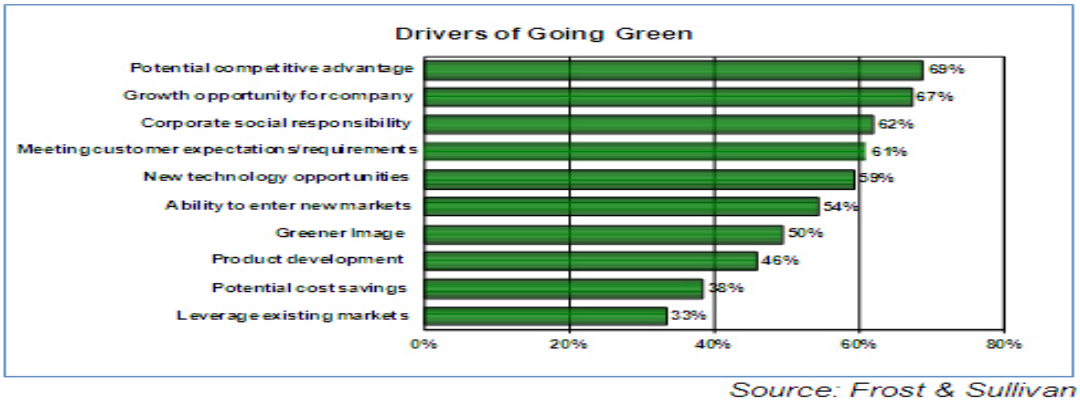

Fig. 3

There are many drivers which are expanding the boundaries for green manufacturing. Frost & Sullivan recently conducted a survey among senior industry leaders to find some of the drivers for going green. A growing number of executives today feel that going green will help them to compete more effectively in the marketplace in the long term. Also organizations tend to conform to implicit expectations of their communities, which is another driver of change. In summary the major drivers can be grouped into three key areas:

1. **Competitiveness**: The natural desire of manufacturing firms to improve its processes and capabilities for competitive advantage. This can manifest in terms of technology, new product and process development as well as opportunities for business
2. **Corporate Social Responsibility**: The growing pressure on manufacturing firms to become more responsible to the social and environmental impact it creates. Companies would like to brand themselves with a "green" image.

3. **Legislation**: Manufacturing firms have to constantly strive to meet current and upcoming stricter environmental regulations.

4. GREEN AS AN INTEGRAL PART OF BUSINESS

Over the past decade, climate change from GHG has moved from being a topic of general discussion to becoming an important factor contributing to the financial performance for manufacturing companies. In a recently conducted BCG survey, executives of nearly all the companies interviewed said that sustainability–related issues have or will soon have a material impact on their businesses.

Many executives also felt such issues will shape the strategic direction of their businesses in future. The survey revealed that 92 percent of the companies are already engaging in Green initiatives in some way. Improved company image was the most important reason for adopting Green, followed by cost savings, maintaining competitive advantage and increasing employee morale.

Fewer than 25 percent of the respondents said that their companies had pulled back on their commitment to Green during the recent economic downturn – a fact that clearly indicates that sustainability measures are here to stay. In fact, many sectors like automotives and media even increased their commitment during the downturn, to cope with fluctuating and increasing energy and commodity prices.

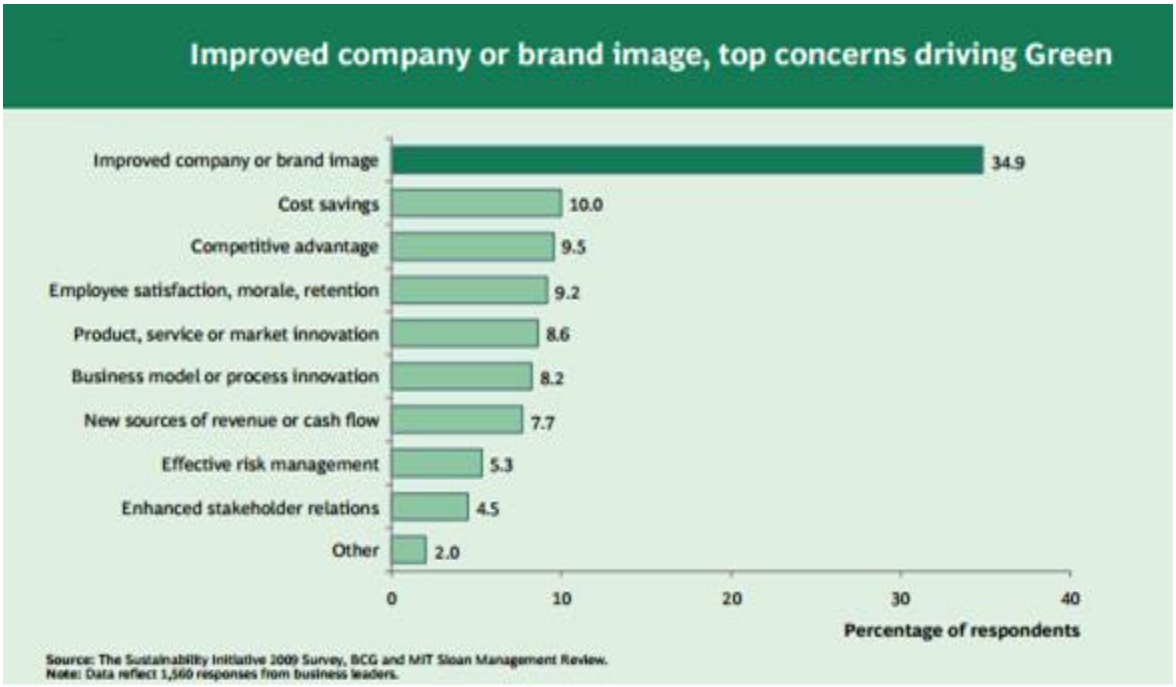

Fig. 4

5. TECHNOLOGIES FOR GREEN MANUFACTURING

Today, there is a plethora of new and emerging technologies that aid in both, making the traditional businesses Greener, as well as creating completely new ones. For example, technologies for reducing GHG can be classified into five broad categories:

1) Carbon sinks

This category consists of emergent technologies related to Carbon Capture and Storage (CCS) being developed for use in power plants that are fired by fossil fuels such as coal. These technologies enable capturing and storing CO2 in ways such that it does not enter the atmosphere. For example, CO2 from fossil fuels is trapped and stored in underground wells under intense pressure which keeps it in liquefied form.

2) Efficient fuels

This category encompasses a class of technologies that use cleaner fuels for generating power. Examples include biomass, hydro power, Integrated Gas Combined Cycle (IGCC), etc.

3) Consumer Green

This involves using clean and efficient fuels at the user end and solutions covering demand side management. For example, off–grid solar power applications like solar water heating and building insulation are included in this category.

4) Green transportation

Electric vehicles, fuel cells, and bio–diesel are some examples of this category.

5) Industry efficiency

This category refers to the use of Green production methods and technologies in traditional Industries such as iron and steel, cement, refining, chemicals, etc. Multiple such technologies are emerging in each of these industries**.**

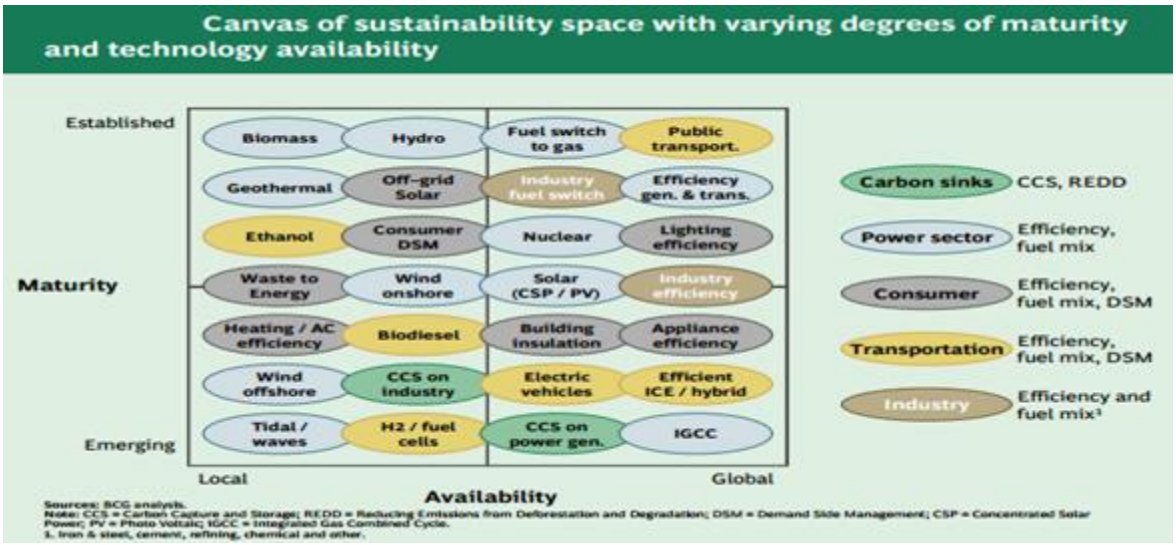

Fig. 5

6. CONSUMER PERSPECTIVE REGARDING GREEN AWARENESS

Green manufacturing is of vital importance, not just due to tightening regulations by the government or cost benefits, but also because consumers are demanding it. In a recently concluded BCG survey of consumers across developed and developing nations, about two–thirds of the participants expressed that the environment is in a poor shape and that environmental problems are a primary threat to the society and some solid action needs to be taken as soon as possible.

Not only are consumers becoming increasingly aware they are also adopting Green habits and buying Green products. The continuing expansion of Green consciousness around the world presents a huge opportunity for smart companies to bake the opportunity before their competitors grasp it. According to the BCG survey findings, while consumers believe that as individuals, they can and should contribute to sustainability by adopting Green products.

Another finding of the survey stated that about 50 percent of these consumers purchased Green products. The survey also indicated that consumers greatly value the direct benefits that Green products offers to them, such as – superior freshness and taste, the promise of safety and health, and savings on energy costs, absence of chemical treatments. They are willing to pay higher prices for Green products that have better quality perception. While shopping for Green is becoming common in many countries, shopping habits vary considerably by product category and nation to nation. Certain Green product categories like paper, food products, disposable home products, consumer durables and beauty products are more popular than others and are purchased more often.

7. GREEN MANUFACTURING PROCESS

There are many interpretations of green manufacturing and all convey similar meaning. According to Manly and Smith, it is a system that integrates product and process design issues with issues of manufacturing, planning and control in such a manner as to identify, quantify, assess, and manage the flow of environmental waste with the goal of reducing and ultimately minimizing environmental impact while also trying to maximize resource efficiency. Green Manufacturing is also known by plethora of different names: Clean manufacturing, environmentally conscious manufacturing, environmentally benign manufacturing, environmentally responsible manufacturing and

Sustainable manufacturing. Irrespective of the various acronyms, the primary goal remains the same - designing and delivering products that minimize negative effects on the environment through their production, use, and disposal.

Fig. 6

The fundamentals of green manufacturing are very simple and relate to minimizing the use of resources and the environmental impact of a product. This philosophy is extended to all the elements of its life cycle - from its design to its end of life.There are tremendous opportunities which will arise with Green manufacturing. Each element of this cycle has the potential to be an industry by itself, given the rapid growth rate and demand it is expected to generate in the mid to long term. Although it is very difficult to estimate the market size for green manufacturing, industry experts feel this would be very significant in the coming decade. As government, companies and consumers realize the importance of going green the barriers for investment in these technologies is expected to fall rapidly.

8. GREEN INVESTMENT

In its Vision 2050 report, the World Business Council for Sustainable Development describes a world in which the manufacturing industries follow life-cycle approaches that enable dematerialization and expanded service systems. In a sustainable world of about 9 billion people by 2050, a complete range of new products and services is offered, based on high longevity, low embodied water, as well as low-energy and material content. This transition will not happen overnight, and it will require substantial investment. A major challenge is one of transition in industrial production, to become less carbon and material intensive while at the same time preserving jobs or reinvesting in completely new employment opportunities. This is particularly relevant for developing and emerging economies that currently invest heavily in conventional production infrastructure.

Both at the country and industry sector level, improved resource-efficiency and decoupling offers the opportunity of competitive advantage and a sustainable future. However, making the investment decision to pursue green manufacturing opportunities requires careful consideration of real net benefits and longer term consequences of decisions made today. This includes consideration of research, development and design options that enable users and consumers to move away from the throwaway consumption paradigm. Some technology innovations hold potential for drastic gains in resource efficiency, while others may bring more costs than benefits. The cases of energy and water resources display the importance of having appropriate regulations and pricing in place. The area of human resources and employment highlights the importance of carefully considering direct and indirect impacts.

9. BARRIERS TO HIGHER GREEN CONSUMPTION

As mentioned earlier, many consumers, particularly in developed countries, are willing to pay a premium for Green. Their willingness to pay more depends on a product's category and perceived benefits, and is highest for food and consumer durables. The findings of the survey establish clearly that price is not a significant obstacle for many buyers. In fact, price ranks much lower as a barrier to Green purchasing than lack of awareness of Green alternatives or a perceived lack of choice.

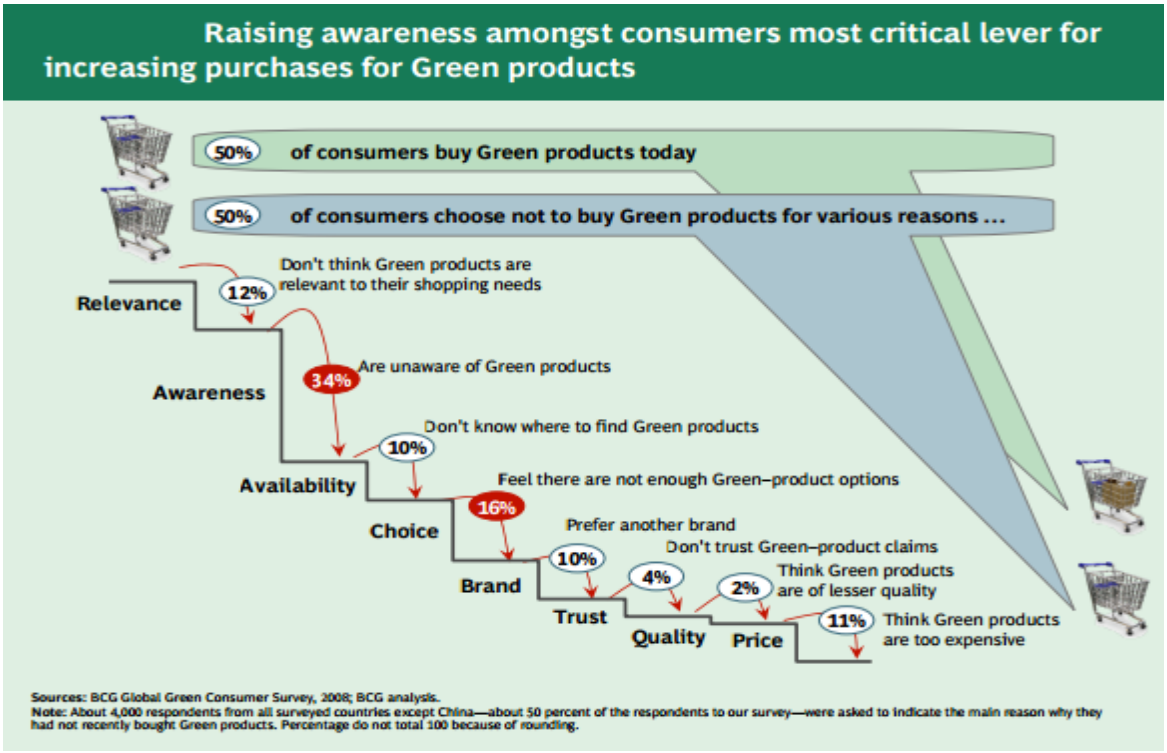

Fig. 7

Quite clearly, awareness is a critical lever for increasing sales of Green products. It is estimated that companies lose, on an average, nearly 20 percent of potential purchasers when consumers are not adequately informed about the sustainability aspect of their offerings. Companies need to carefully plan and invest in their customer awareness programmes and work with their retailers to provide adequate shelf space and visibility to ensure their Green efforts are fully leveraged.

10. INDIAN GREEN AGENDA

India's rapid economic and industrial growth, coupled with urbanization, has come at the high cost of increasing GHG emissions, rising demand for scarce resources like water and increasing waste generation, particularly from urban centers. Today, India is the fourth largest economy in PPP terms and the fifth largest GHG emitter in the world. During the 18 year period between 1990 and 2008, India's CO2 emissions increased more than 150%, placing it just behind China. According to CII-BCG report, India generates close to 4 million tons of hazardous waste from industrial and biomedical sources. Apart from hazardous industrial waste and effluents which cause water and land pollution, e-waste is also becoming a major area of concern for India. Estimates suggest that only 3% of e-waste makes it to authorized recycling facilities, with the rest either going into landfills or being processed at informal recycling yards.

11. SOLUTIONS TO PROMOTE GREEN MANUFACTURING IN INDIA

The CII-BCG report suggests that to overcome these challenges, or at the very least to minimize their impact, the Indian manufacturing sector will need to take concerted action on all three areas,

(i) Green energy
(ii) Green products and

(iii) Green processes in business operations.

A) Green Energy

Green energy involves production and use of cleaner energy. This is the first and most obvious step given the dependence of industry on energy. Green energy includes both deploying renewable energy sources like CNG, wind, solar and biomass, and achieving higher energy efficiency in operations. Over the past few years, both Government and industry have recognized the challenges posed to the country's environment by industrial growth and rapid urbanization. While considerable progress has been made, India has still some way to go. Close to 75% of India's energy generation comes from coal and natural gas. In efforts to provide electricity to 40% of households that do not yet have it, and to sustain its industrial growth, India can expect a six to eight-fold growth in energy production over the next 25 years. Projections suggest that the share of coal in the energy mix is unlikely to go down substantially in the next 20 years. This calls for ensuring the implementation of the aggressive targets set for Green fuels and strengthening the regulatory framework for improving the energy efficiency.

B) Green Products

Developing greener products is the second step in this transformation. 'Recycled', 'Low carbon footprint', 'Organic' and 'Natural' are becoming popular buzz–words which are associated with Green products. Developing Green products can often mean higher costs. However, by developing Green products that are sought by consumers, and effectively marketing them, companies can derive additional volumes and price premiums, which can offset their cost of development. Indian companies and consumers have begun accepting Green products. Companies are offering their customers a growing range of Green products, ranging from organic food products, to electric cars and solar heaters. Lighting and air-conditioning companies are introducing new-age products with energy efficiency as the key differentiating lever. Explicit energy ratings for electric appliances are a new reality and consumers are not only accepting these, but also incorporating them in their buying behavior. Consumer consciousness about Green products is expected to grow further and companies are quickly identifying this avenue as a route to achieving competitive advantage. While some companies have made efforts to introduce Green products into the market, the efforts are still at an early stage and have to be systematically expanded to cover more of the manufacturing sector. Manufacturing companies should evaluate their product portfolio in terms of the energy intensity of their manufacture and in-life use, recyclability and waste generation. The CII-BCG report says various industry associations can play an active role on educating both their member companies and consumers, and bringing together the different stakeholders to set standards which conform to international Green norms and are customized for Indian environment.

C) Green Processes

The third area is implementing Green processes in operations. This entails efficient use of key resources, reducing waste generation through lean operations, bringing down the carbon foot–print and conserving water. Employing Green processes improves operational efficiency and lowers costs. The CII-BCG report says that Indian manufacturing is catching up with the long term benefits of Green processes to improve corporate brands, reduce costs and achieve compliance at the same time. Energy intensive companies are implementing lean processes to minimize waste and enhance energy efficiency. However, there is still a long way to go in many sectors. In a bid to promote energy efficiency and reduce industrial carbon emission levels, Government is evolving a PAT (Perform, Achieve and Trade) regime designed by the National Mission for Energy Efficiency under the Prime Minister's National Action Plan for Climate Change.

Under the scheme, The Bureau of Energy Efficiency (BEE) would set energy efficiency targets for industrial units and issue them energy saving certificates. It is also important to address water consumption and waste generation as big levers of Green. It is possible to reduce water consumption by better control of processes, recycling water and embracing new water-saving technologies. For example, in the metal businesses which use plating as a process, water consumption is a direct function of the number of tanks used. Therefore, a shift to plating technologies / processes with fewer tanks can save as much as 40-50% of water consumption in just a few years. Manufacturing plants can minimize waste generation by redesigning their press tools and machines to reduce the scrap they produce, and by improving scrap collection and recycling.

12. CONCLUSIONS

Moving towards a green manufacturing has the potential to achieve sustainable development and eradicate poverty on an unprecedented scale, with speed and effectiveness in India. A green manufacturing economy substitute's clean energy and low carbon technologies for fossil fuels, which addresses climate change, creates jobs, and reduces import dependencies. New technologies promoting energy and resource efficiency provide growth opportunities in new directions, offsetting brown economy job losses. However, there are many risks and challenges along the way. Moving towards a green economy will require leaders, civil society and leading businesses to collaboratively engage in this transition. It will require a sustained effort on the part of policy makers and their constituents to rethink and redefine traditional measures of wealth, prosperity and wellbeing. However, the biggest risk of all may be maintaining the status quo, and the biggest cost will be the opportunity lost of not engaging in a transition towards a green manufacturing economy.

REFERENCES

[1] Barton, Allan F.M. (1979). Resource Recovery andRecycling. A Wiley – Interscience Publication, John Wiley & Sons, Inc., Canada.
[2] D.C. Esty and A.S. Winston. (2009). Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, And Build Competitive Advantage. Hoboken, New Jersey : John Wiley & Sons, Inc.
[3] Olson, Eric G., (2010) Better Green Business-Handbook for Environmentally Responsible and Profitable Business Practices, Pearson Education Inc., USA
[4] Hart, Stuart L.,Beyond Greening: Strategies for a Sustainable World fromThe Harvard Business Review on Green Business Strategy, (2007).
[5] Uday Pal. Identifying the path to successful green manufacturing. The Journal of the Minerals, Metals & Materials Society (JOM), 2002.54(5), p25
[6] Prof Kevin Gallagher, Boston University, at http://www.voxeu.org/index.php?q=node/3156
[7] Edward B. Barbier, "A Global Green New Deal", UNEP-DTIE, February 2009
[8] International Labor Organization (ILO). 2009. Global Employment Trends January 2009. ILO, Geneva.International Institute of Labour Studies, ILO. 2009.
[9] World Bank. 2008. Global Financial Crisis and Implications for Developing Countries. Paper for G-20 Finance Ministers' Meeting. São Paulo, Brazil. November 8, 2008.
[10] Source: IPCC 2007: Fourth Assessment Report. Working Group II Report "Impacts, Adaptation and Vulnerability" p.319 available
[11] USA Today. July 11, 2008. Oil sets new trading record above $147 a barrel. Available at: .
[12] http://www.usatoday.com/money/economy/2008-07-11-3815204975_x.htm
[13] Businessgreen.com. November 7, 2008. IEA warns oil will hit $200 a barrel by 2030.
[14] Technical Summary in : "Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change" Barker
[15] UN News Centre. February 4, 2009. Only sustainable farming will help meet growing food demand, says UN expert.
[16] Barbier, Edward. 2009. "A Global Green New Deal". Report prepared for the Economics and Trade Branch, Division of Technology, Industry and Environment, United Nations Environment Programme. February, 2009.
[17] For a more detailed discussion see: ILO (2009) The financial and economic crisis: A Decent Work response' ILO Governing Body 304th Session, Geneva, March 2009 (GB.304/ESP/2)
[18] Green Jobs: Towards decent work in a sustainable, low-carbon world", report commissioned by UNEP, ILO, IOE and ITUC, September 2008.
[19] Sukhdev, Pavan, et al, "The Economics of Ecosystems and Biodiversity – Interim Report", European Communities 2008.
[20] Barbier, Edward B., "A Global Green New Deal", prepared for UNEP-DTIE, February 2009