

A Conceptual Framework for Manufacturing Organization to Implement Green Manufacturing

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Abstract

As the manufacturing sector to play a bigger role in the country's economy, there should be a growth while mitigating the environmental concerns for which the manufacturing sector must use energy and resources efficiently and minimize the generation of waste. Green Producing (GM) Industrial Activity is currently the necessity of the time associate degree less an empty catchword.. In this research paper, a conceptual framework has been presented for the manufacturing organization to implement green manufacturing which assists the operation manager to create their process and product more sustainable. Thus, a resultant framework is based on an inclusive and methodical analysis of the literature to describe the dynamic process of green energy, green products, and green processes in manufacturing organizations. As the research raises theoretical and managerial questions as well as scope for future research on this important topic, the assessment and the conceptual framework might be useful for both academicians and managerial level.

Keywords: Green Manufacturing; Green Economy; Manufacturing Industry; Literature Review; Conceptual Framework.

INTRODUCTION

What "Green" means and importance of it

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 (refer to figure 1). Aim of the Green initiatives is to minimize the impact of human beings activities on the environment. According to [1], Green manufacturing (GM) is an approach, that all inventive techniques towards efficient environmental solutions that result in cost saving from reduced work handling, effluent control, and process automation or other environmental and operational benefits [1]. Proposed amalgam a multi-

criteria decision-making tool to evaluate GM practices namely, environmental emission control and impact remediation, reducing, reusing and recycling (3R), green supply chain practices, and optimal use of natural resources [2]. Identified critical success factors for GSCM practices which necessitated an increase in awareness level among society and customers of green products/processes [3]. Authors have verified the positive impacts of GM on the environmental and social performances of the organization and also inferred that it can contribute to reducing the cost of raw materials and expenses towards environmental and occupational safety, to improve operational performance, and corporate image. Implementation of green manufacturing

practices in SMEs has contributed positively through improved operational performance and competitive advantage [4], [5, 6] improved environmental performance via waste minimization,

with qualitative and quantitative benefits as reported by [7]. The society's rising concern for Green can be grouped into three broad categories:

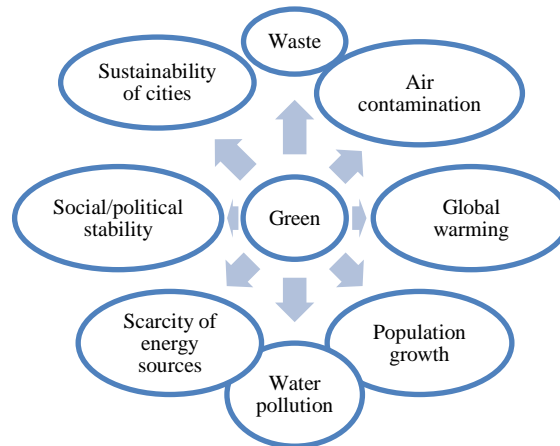


Figure 1: Green encompasses many different concerns.

Rising Emissions and Associated Climate Change

Greenhouse Gas (GHG) emissions have increased rapidly in the recent past and their growth is further accelerating. 0.74 °C global temperature has increased over the last century which was historical warming observed in the history of Earth.

As shown in fig. 2, emissions rate will get double by 2050. This could result in a consequent temperature rise of 4 - 6 °C over preindustrial levels by the end of this century (as per Stern Review). This exceptional change is expected to have a vital impact on the global ecosystem and related activities

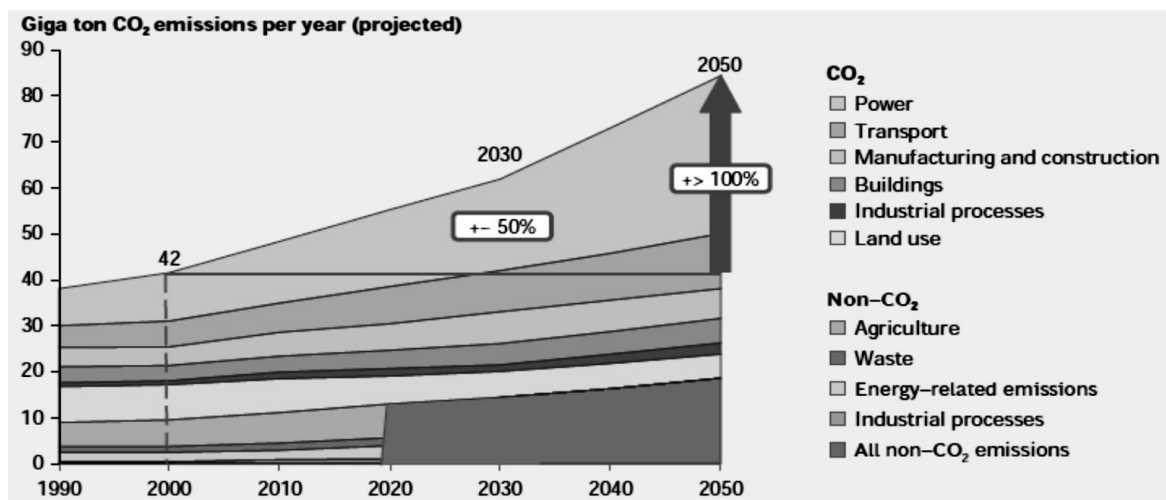


Figure 2: Greenhouse gas emissions will be double by 2050 if we do not act (Source: Stern Review).

The Fast Depletion of Scarce Natural Resources

Due to increasing inhabitants and

industrialization, the consumption of natural resources is rapidly increasing, while their availability is decreasing. This

has led to cyclic mismatches in demand - supply and highly variable prices impacting both corporate margins and consumer spending. Hence there is an urgent need to manage the use of these resources, find and develop alternatives which are less scarce.

Growing waste generation and pollution

Increased industrialization and urbanization impact on waste generation and environmental pollution. Industrial waste with chemical composition can be potentially dangerous to health and its disposal without treatment it is leading to land and water pollution. Due to the demand of the electronic products e-waste is also becoming a major.

GREEN PRODUCTS

Green product development is the second step in the transformation of green manufacturing. Recycled, Low carbon footprint, Organic and Natural's are becoming popular buzzwords which are associated with Green products. Developing Green products can often mean higher costs. However, by developing Green products and effectively marketing them, firms can derive additional volumes and price premiums which can compensate for their cost of development.

GREEN PROCESSES IN BUSINESS OPERATIONS

Implementing Green processes in business operations are the third step in transformation. This entails the efficient use of key resources, reducing waste generation through lean operations, bringing down the carbon footprint and conserving water. Employing Green processes improves operational efficiency and lowers costs.

FACTORS DRIVING GREEN MANUFACTURING

Many companies have started adopting

Green initiatives in their operations which are driven by five factors:

- Rising energy and raw material costs
- Growing consumer awareness for Green products
- Increasing regulatory pressure
- Technological advancement which open up new attractive business opportunities
- The need to enhance competitive differentiation

Firms undertaking Green initiatives plunk to be advantaged on brand enrichment, political grip and regulatory conformity, greater ability to exert a pull on and retain talent, better customer retention and cost savings.

INDUSTRY PERSPECTIVE

Green as an Integral Part of Business

In a recently conducted BCG survey [9], 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 the future. The survey revealed that 92% of the companies are already engaging in Green initiatives in some way. By adopting Green the firm can improve image followed by cost savings; maintaining competitive advantage and increasing employee morale (refer fig. 3). Problems of environmental problem.

Transformation to Green Manufacturing

Manufacturing companies can address these concerns by focusing on three areas:

Green Energy

Green energy involves production and use of cleaner energy. Green energy includes both deploying renewable energy sources like CNG, wind, solar and biomass, and achieving higher energy efficiency in operations.

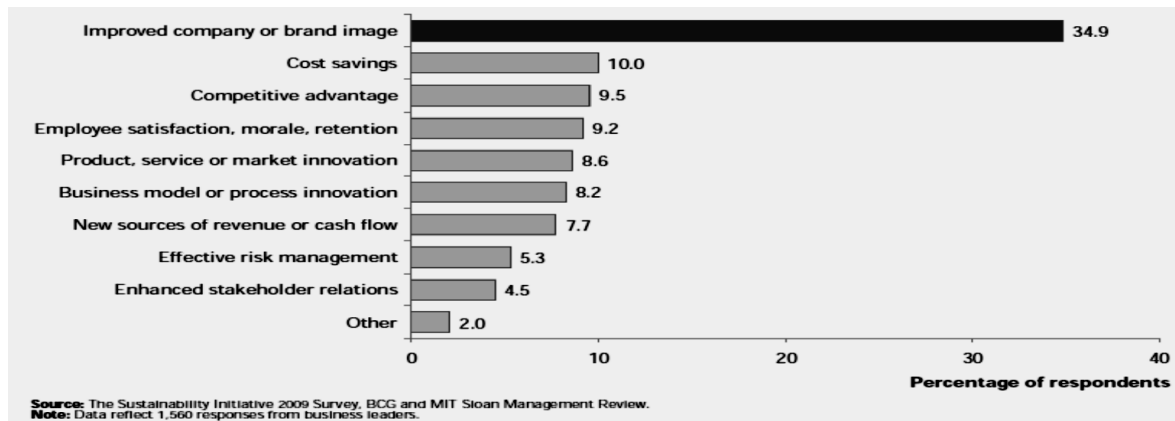


Figure 3: Improved company image, top concerns driving green (Source: The sustainability initiative 2016 survey).

The survey also revealed that different industries have significant differences in the way they are impacted by Green issues, although some issues are common to all, which means that manufacturing companies have to first understand the key drivers of concerns in their respective industries, and then develop a specific Green initiative to tackle them. The more

innovative companies have seized this as an opportunity to differentiate themselves from their peers and enhance their competitive advantage.

Green in Traditional Industries

Different industries have varying degrees of exposure to different sustainability concerns.

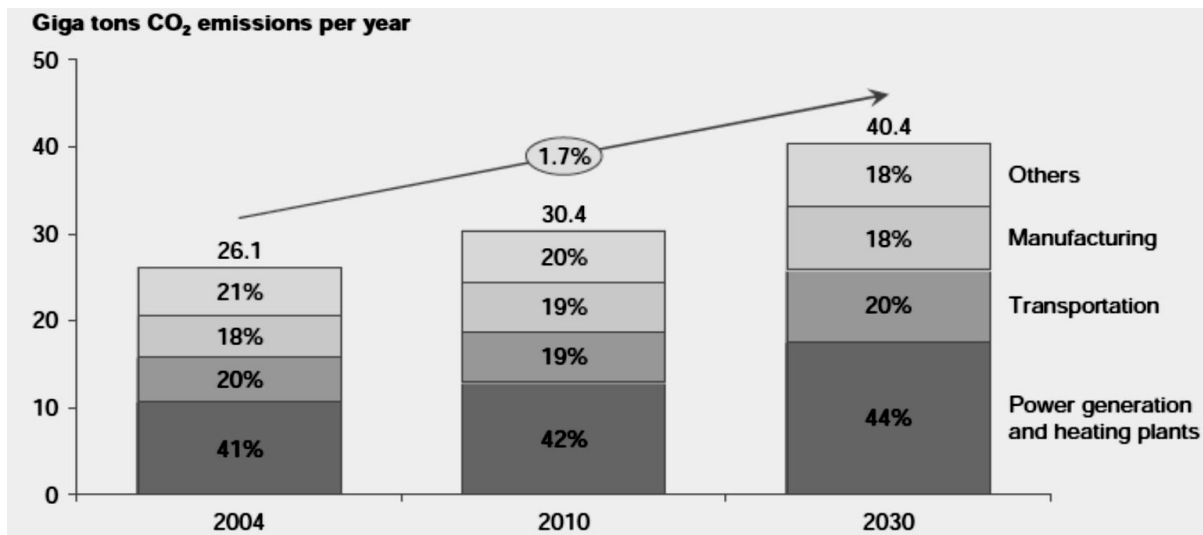


Figure 4: Major CO₂ emitting sources (Source: International Energy Agency).

Green energy is an issue that is common to all but the relative impact and performance vary significantly, depending on the energy intensity and carbon footprint of the industry segment. As fig. 4 indicates, power generation is the highest emitter of GHG, followed by transportation and manufacturing. It is, therefore, not

surprising that these three sectors have the most to gain from Green initiatives.

Manufacturing - Steel

Steel is an energy and emissions exhaustive industry which depends on fossil fuels. According to the International Energy Agency, 20% of all energy

consumed by industries worldwide and about 30% of the world's direct industrial CO₂ emissions account by iron and steel industries (refer fig. 5). For many steelmakers adopting Green is important.

Regulators are tightening controls and raising fines on GHG emissions and waste disposal. Hence, investors prefer companies that are managed for ecological sustainability.

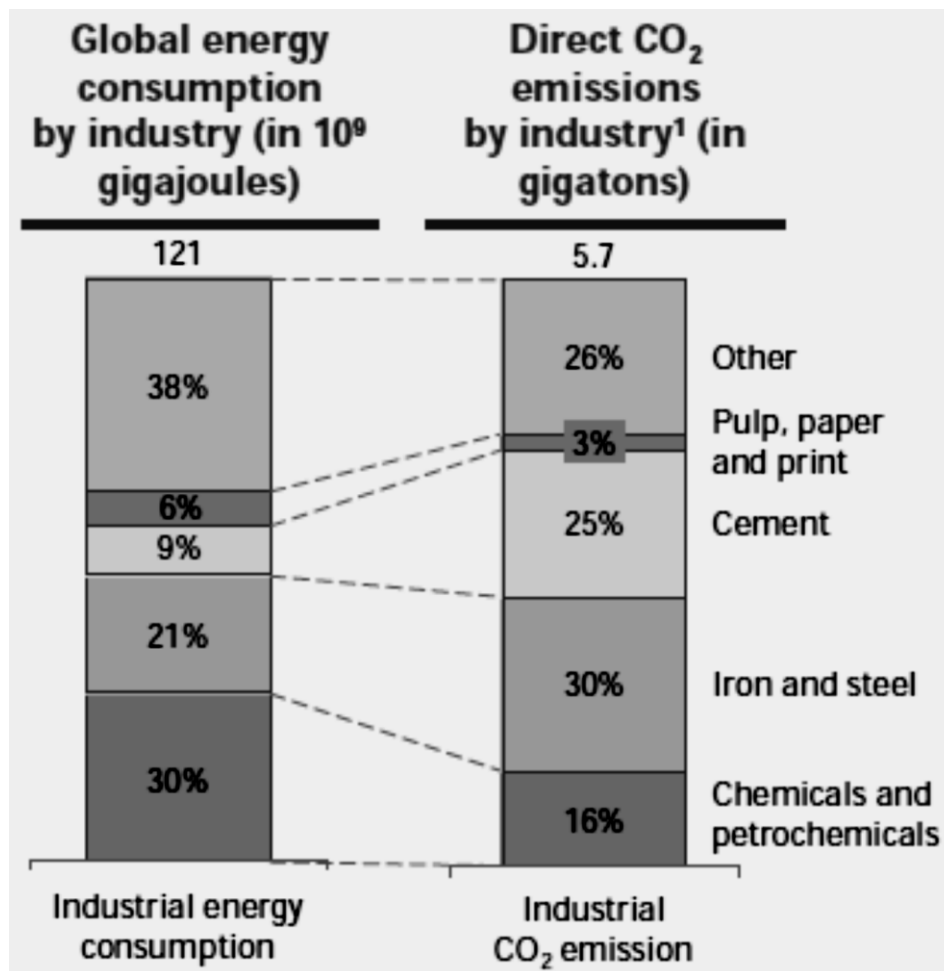


Figure 5: Iron and steel industry accounts for 30% of CO₂ emissions (Source: International Energy Agency, BCG analysis).

TECHNOLOGIES FOR GREEN MANUFACTURING

Today, there is a new and emerging technology 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:

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.

Efficient fuels

This category encompasses a class of technologies that use cleaner fuels for

generating power. Examples include biomass, hydropower, Integrated Gas Combined Cycle (IGCC) etc.

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.

Green transportation

Electric vehicles, fuel cells, and biodiesel are some examples of this category.

Industry efficiency

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

CONSUMER PERSPECTIVE

Green Awareness

In an recently concluded BCG survey consumers across developed and developing nations about 2/3rd of the participants expressed the belief that the environment is in a poor form and that environmental problems are a primary threat to the society. Consumers are becoming increasingly aware and conversant with Green, they are also adopting Green lifestyle and buying Green products. The ongoing growth of Green awareness around the world presents a huge prospect for companies. According to the BCG survey findings while consumers believe that as an individual they can and should contribute to sustainability by adopting Green products, they also hold companies to a higher standard when it comes to being Green.

Another finding of the survey was that about 50% of these consumers purchased Green products and willing paid higher

prices that have better quality perception.

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 products 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.

Obviously, awareness is a critical lever for increasing sales of Green products. It is predictable that companies lose on an average nearly 20% of potential purchasers when consumers are not adequately informed about the sustainability facet of their offerings. Companies need to carefully plan and invest in their customer awareness programs and work with their retailers to provide adequate shelf space and visibility to ensure their Green efforts are fully leveraged [9].

FAMEWOK FOR ADOPTING GREEN MANUFACTURING

Challenges in Adopting Green

Companies face challenges on various fronts, most critically in providing leadership for such an effort. Companies have to transition from:

1. Approaching Green as limited often isolated initiatives with a narrow focus to a more holistic approach.
2. Meeting regulatory compliance to developing eco advantage.
3. Viewing initiatives as cost centers to assessing them as business opportunities how Green is the product during the lifecycle of its use.
4. How Green is the manufacturing process.

Three prime impediments to decisive action:

- 1) Companies don't fully understand drivers and issues relevant to them and their industries and what sustainability means to them.
- 2) Companies face difficulties in modeling the business case for sustainability. The initiatives are not a priority for most and often the economics are not well understood as technologies and costs are still evolving.
- 3) Even the companies that adopt Green initiatives perform these activities as peripheral to their core business and not integrated into their corporate strategy. Hence the execution is flawed and they fail in realizing the full benefits.

ECONOMIC ASSESSMENT AND MAKING STRATEGIC CHOICES

Like any major transformational exercises success in adopting Green requires companies to understand the full set of facts on costs and benefits and the entire range of Green measures available to

them. Once this fact base is developed companies have to select their Green initiatives based on both, economic and strategic assessments of the choices they identify.

An economic assessment requires estimating the 'value' generated over the long term through these initiatives. It should cover all drivers of value creation – from quantitative metrics like pricing power and cost savings to qualitative ones like employee recruitment and engagement – otherwise, some of the long term benefits of Green will not get captured as part of the business case.

IMPLEMENTATION FRAMEWORK

Becoming Green is a long journey of transformation which requires adequate attention on planning and execution of the initiatives. A simple three-step implementation framework can be followed covering all three areas of action – Green energy, Green products, and Green processes (refer fig. 6).

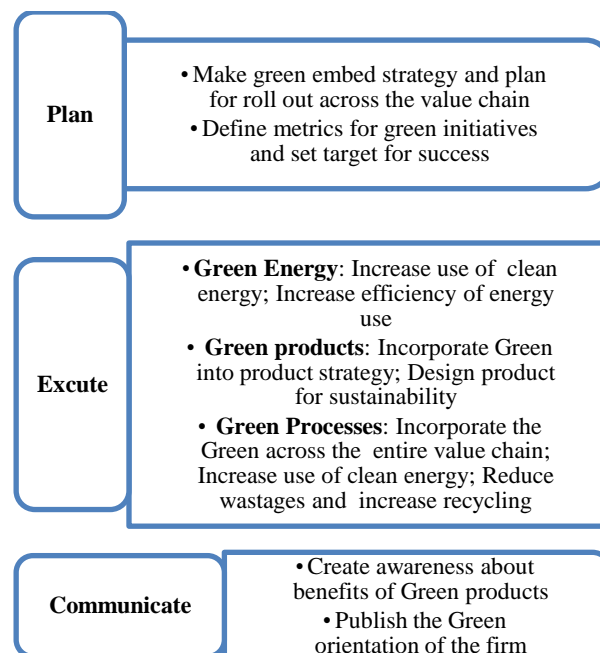


Figure 6: Conceptual framework for companies to successfully implement Green.

Plan
Green initiatives must be factored into the

business strategy, future resource planning and budgeting exercises. A sustainability

charter based on short term and long term goals must be laid out with Green targets and metrics. Companies should develop Green indices quantifying the impact of the Green initiatives, set and track specific targets on those indices.

Execute

With a robust plan and clearly defined targets and monitored, Green needs to be integrated across the value chain and made a part of the core business.

Green energy: Manufacturing companies with high energy consumption need to shift towards using cleaner energy and plan for increasing the efficiency of its use. Setting up captive wind or solar power generation units and using energy-efficient practices such as installing LED lighting can help to reduce the energy intensity of operations.

Green products

To move towards a Green product portfolio companies should conduct an evaluation of their products based on (a) how Green is the resources and energy being used (b) how Green is the product during the lifecycle of its use and (c) how Green is the manufacturing process. By quantifying these parameters, companies can assess the Green value of their product offering. In the planning stage itself companies should set out targets for this metric, and then periodically assess progress against those targets.

Green processes in business operations

Companies need to gradually redesign business processes used in different parts of the value chain. This could include shifting to more sustainable manufacturing options, making changes towards reducing waste, increasing recycling, reusing resources and incentivizing all suppliers, channels, customers, and employees to adopt similar measures.

Communicate

Along with well-through implementation a well formulated promotion campaign for Green initiatives is equally important to fully leverage their potential benefits. Customer education campaigns about Green product offerings and the Green orientation of the firm in terms of energy and processes can translate into increased revenues.

GREEN MANUFACTURING AGENDA FOR INDIA

India's Green Challenge

Today India is the 4th largest economy and the 5th largest GHG the emitter in the world (Govt. of India: India Greenhouse emission - 2015). India's CO₂ emissions have increased more than 150% placing it just behind China. 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. The Indian e-waste market is expected to nearly double from 450 KT per annum currently to about 800 KT per annum by 2020.

Setting the Agenda for Green Manufacturing

To overcome these challenges or to minimize their impact the Indian manufacturing sector will need to take concerted action on all three areas.

Green energy

In the past few years both the Government and the Industries have recognized the challenges posed to the country's environment by industrial growth and rapid urbanization. While India has had strict environmental protection laws for many years the implementation has been weak at times. This scenario is changing if one goes by some of the recent high profile cases, where companies were either

denied permissions or given conditional approvals and had to commit to certain sustainability conditions. To supplement the impact of these laws, the Government has launched eight major initiatives as national 'missions' to promote Green, the most prominent of them being the Solar Mission to promote Green energy.

The 11th Five Year Plan has set a target of increasing energy efficiency by 20% and the Government is also offering tax holidays, soft loans, subsidies and other incentives for renewable energy projects.

Green products

Indian companies have begun to offer their customers a growing range of Green products and also customers demand is increasing for purchasing green label products. Consumer consciousness about Green products is expected to grow further and companies are quickly identifying this avenue as a route to achieving competitive advantage.

Manufacturing companies should evaluate their product portfolio in terms of the energy intensity of their manufacture and in-life use, recyclability and waste generation. Here the various industry associations can play an active role in 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.

Green processes in business operations

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 six sigma processes to minimize waste and enhance energy efficiency.

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.

ROLE OF TECHNOLOGY IN ENABLING GREEN

Green technology is the common denominator across all three areas of Green energy, Green products, and Green processes. Companies can think about the role of these technologies in their business strategies in two different ways of building a new Green Business and using technology to Green an existing one. Indian companies can also consider investments in emerging Green technologies as part of a broader portfolio comprising both, short term and long term plays.

AGENDA FOR THE GOVERNMENT OF INDIA

The Government of India has to play a key role in the transformation into 'Green Manufacturing. To promote Green energy, both the Central and State Governments have launched many initiatives with significant budgetary support (for example: Solar Mission). The promotion of Green technologies has been included in the draft strategy for the manufacturing sector prepared by the Department of Industrial Policy & Promotion (DIPP), Ministry of Commerce and Industry. However, there has not been adequate attention given to financial, regulatory and policy support to promote Green products and Green processes in ongoing business operations.

Finally, the Government can speed up the adoption of many Green technologies, creating a dedicated Green Fund to invest in emerging technologies, setting up Green science parks which promote collaboration between businesses, research institutions

and universities and providing fiscal incentives for the early adopters.

DISCUSSION

The Government of India would like the manufacturing sector to play a bigger role in the country's economy. So they started the 'Make in India', 'start-up India' initiative for the growth strategy. It has set a target to increase the sector's contribution to the GDP to 25%. While this growth is necessary without affecting on environmental concerns and using resources and cleaning energy efficiently in their processes. Green manufacturing involves the transformation of industrial operations by using Green energy, developing Green products and employing Green processes in business operations.

A recent global survey by BCG reveals that 92% of the companies surveyed are engaged in Green initiatives. Adopting Green practices benefits like long-term cost savings, brand enhancement with customers, better regulatory traction, greater ability to attract talent and higher investor interest will take place. However, these benefits require a long-term commitment and making tradeoffs against short term objectives as the economics of Green manufacturing is still evolving.

The inspiration for adopting Green initiatives has varied across sectors to sectors depending on the tangible and intangible benefits for the particular sector. Also, customers are adopting practice to buy green products in their lifestyle.

Successful implementation of Green manufacturing requires an integrated three-step framework rather than individual initiative:

- (a) Planning for Green
- (b) Execution of Green initiatives
- (c) Communication and promotion.

Successful conversion into Green manufacturing will bring remarkable

benefits, both tangible and intangible for the nation and the business community.

CONCLUSIONS

Implementing green model into the manufacturing business, competitiveness, and profitability will be increasingly linked to the ability of a business to make carbon reduction and the creation of sustainable livelihoods as an integral part of their value proposition to customers.

For manufacturing organizations green manufacturing is a core competitive strategy and it has just started so there is a need to develop comprehensive plans to address all three areas Green energy, Green products and Green processes.

The government has to play an effective facilitator role in transformation with both incentives on one hand and regulatory mechanisms on the other.

The industry associations can bring the differently stakeholders together and support the roll-out of a communication strategy.

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