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Confederation of Indian Industry
Since 1895

Green Manufacturing

Energy, Products and Processes

March 2011

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With 64 offices and 7 Centres of Excellence in India and 7 overseas in Australia, China, France, Singapore, South Africa, UK and USA, and institutional partnerships with 223 counterpart organizations in 90 countries, CII serves as a reference point for Indian industry and the international business community.



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Green Manufacturing

Energy, Products and Processes

1. Executive Summary

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, in its discussion paper on the growth strategy for manufacturing, 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 mitigated — the manufacturing sector must use energy and resources efficiently, and minimize generation of waste. It is estimated that even if every factory, power plant, car and aeroplane is shut down, the average global temperature would still increase by 0.6°C in this century. 'Green Manufacturing' or sustainable industrial activity is now the need of the hour and no more an empty slogan.

Green manufacturing involves transformation of industrial operations in three ways: (1) using Green energy, (2) developing and selling Green products and (3) employing Green processes in business operations. A recent global survey by BCG reveals that as many as 92 percent of the companies surveyed are engaged in Green initiatives. 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. However, these benefits require a long term commitment and making tradeoffs against short term objectives, as the economics of Green manufacturing is still evolving and not well understood as yet.

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 (example: retail). Steel manufacturers have adopted Green initiatives to stabilise rising energy costs, while automobile companies have seen it as an opportunity to launch electric and hybrid cars to meet increasingly stringent emission regulations. 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 and habits. 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 consumer durables. Many consumers also indicated their growing willingness to pay a premium for Green. However, the survey also revealed that there is still a huge gap in consumer awareness that Green companies must strive to bridge.

Successful implementation of Green manufacturing requires going beyond small standalone 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 and (c) communicating and promoting Green initiatives and their benefits to all stakeholders.

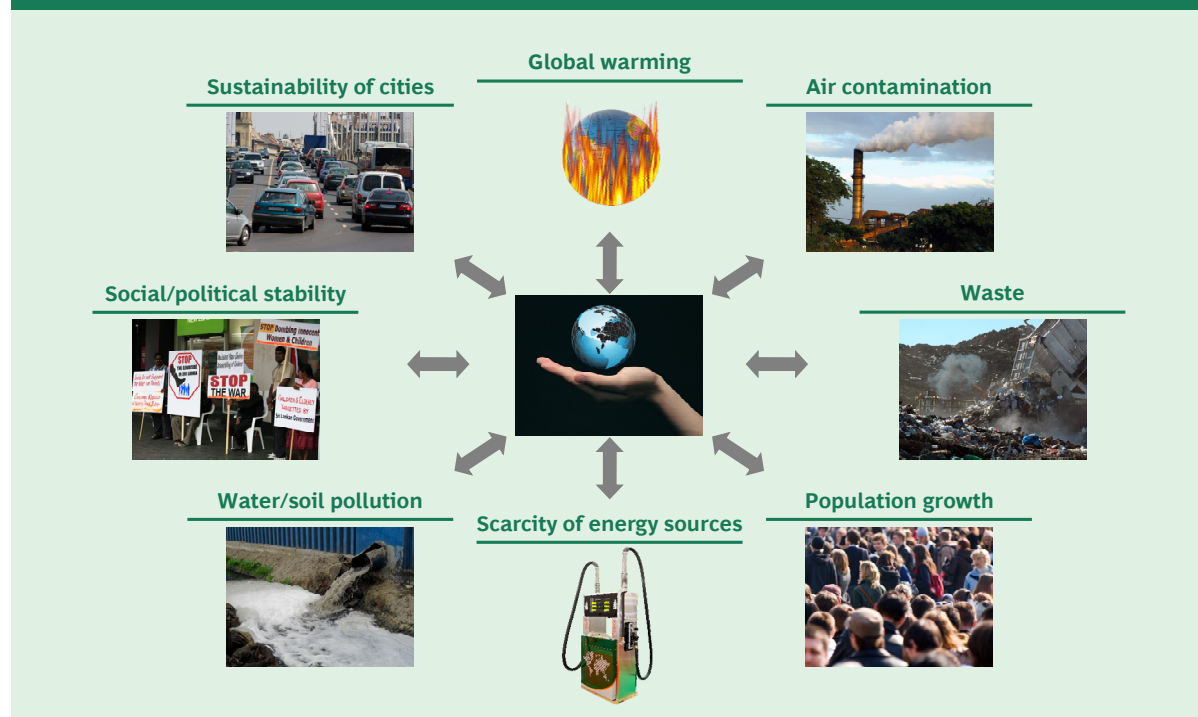
Green manufacturing in India is at the take-off stage. While there has been significant policy development and adoption by the manufacturing industry in the area of Green energy, there is substantial scope on both the policy front and its adoption in the areas of Green products and Green processes. Successful transformation into Green manufacturing will bring tremendous benefits, both tangible and intangible, for the nation and the business community.

2. Introduction

A. 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 (refer Exhibit 1). Green initiatives aim to minimize the impact of human activities on the environment.

Exhibit 1: Green encompasses many different concerns



The society's rising concern for Green can be grouped into three broad categories:

1) 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 century¹—the fastest warming observed in the history of Earth. At the current rate, emissions will double by 2050, compared to the 2000 levels (refer Exhibit 2). This could mean a corresponding temperature rise of $4\text{--}6^{\circ}\text{C}$ over pre-industrial levels by the end of this century². This unprecedented change is expected to have a grave impact on the global ecosystem, hydrological system, sea level and crop production and related activities.

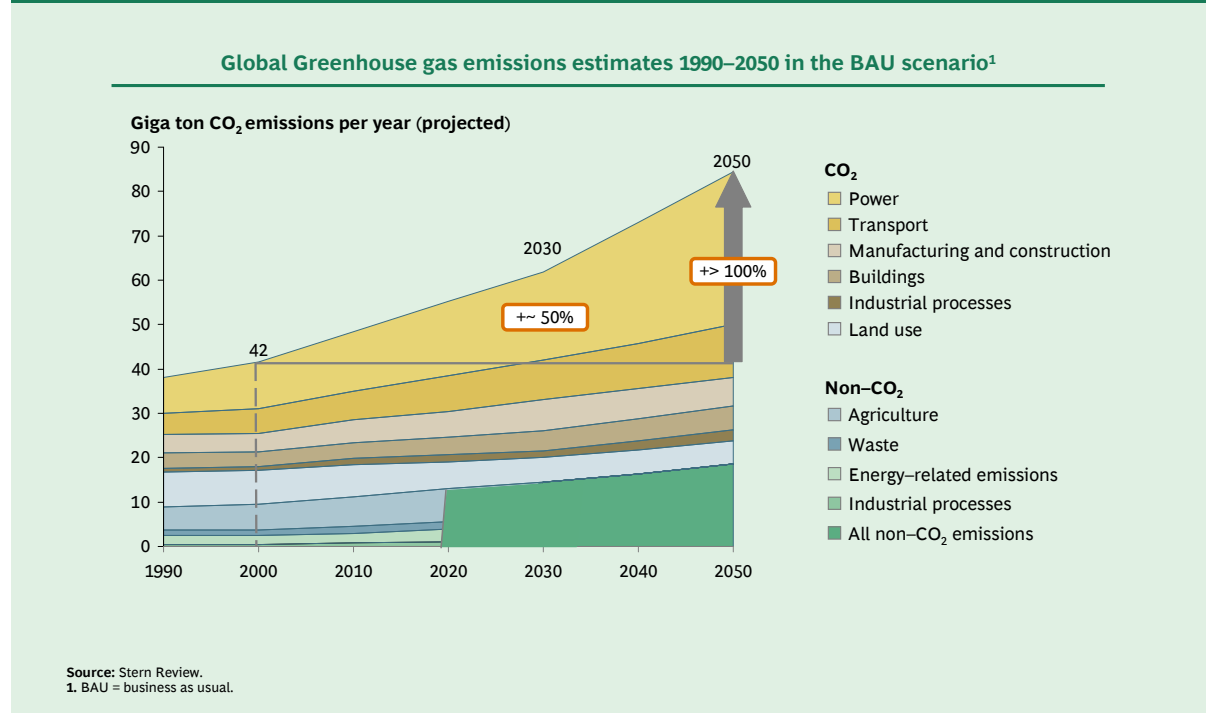
2) Fast depletion of scarce natural resources

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).

¹ Intergovernmental Panel on Climate Change (IPCC) estimates.

² Stern review.

Exhibit 2: Greenhouse gas emissions will double by 2050 if we do not act



3) 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.

B. Transformation to Green Manufacturing

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

1) 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.

2) 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.

3) Green processes in business operations

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.

C. 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:

- ◇ Rising energy and input costs
- ◇ Growing consumer pull for Green products
- ◇ Increasing regulatory pressures as policy makers introduce new and stricter environmental and waste management laws
- ◇ Technological advances which open up new attractive business opportunities
- ◇ 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)

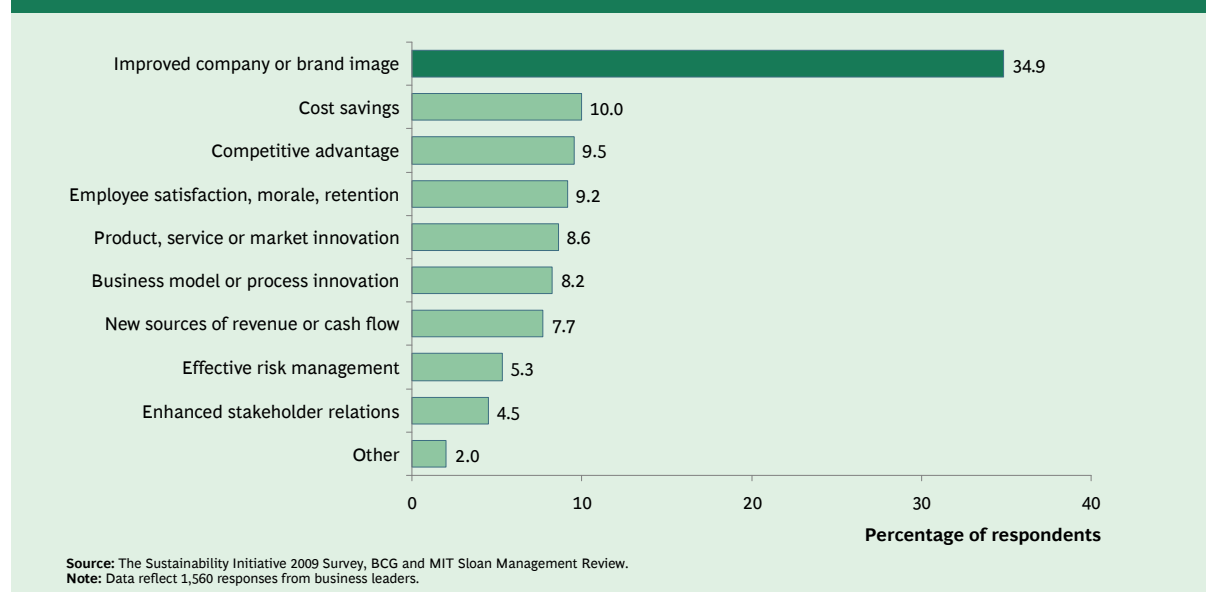
Green has moved from being perceived as a 'necessary evil' to being seen as 'good business'. Companies that undertake Green initiatives stand to be advantaged on brand enhancement, political traction and regulatory compliance, greater ability to attract and retain talent, enhanced customer retention 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.

3. Industry Perspective

A. 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 survey³, executives of nearly all the

Exhibit 3: Improved company or brand image, top concerns driving Green



³ BCG survey of 1560 executives, as part of BCG & MIT Sloan Management Review report on Sustainability Initiative, published in BCG report: 'The Business of Sustainability'.

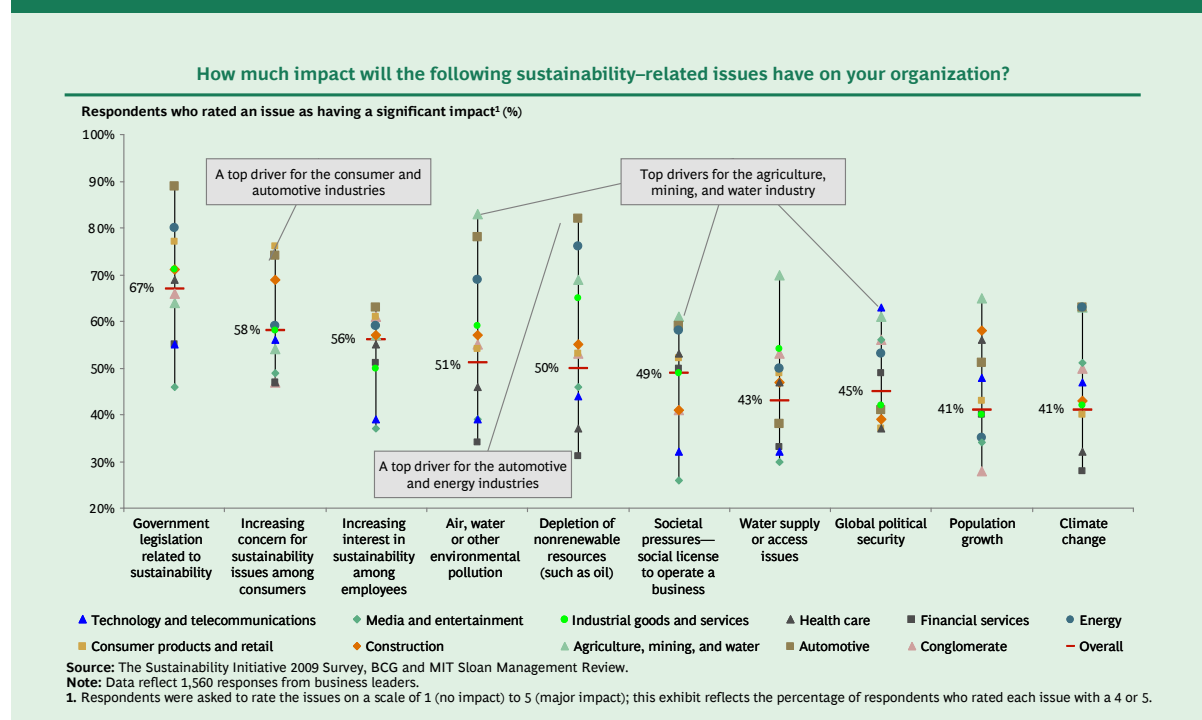
companies interviewed said that sustainability-related issues have or will soon have a material impact on their businesses. Many executives also felt such issues will shape the strategic direction of their businesses in future.

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 (refer Exhibit 3).

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.

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 (refer exhibit 4). For example, increasing consumer concerns for sustainability and the depletion of natural resources such as oil, are the top issues for the automotive industry. In comparison, water shortage, population growth and environment pollution are the top concerns for the agriculture and water related industries. This means that manufacturing companies have to first understand the key drivers of concerns in their respective industries, and then develop specific Green strategies to address them. The more innovative companies have seized this as an opportunity to differentiate themselves from their peers and enhance their competitive advantage.

Exhibit 4: Companies are influenced by a varying range of Green issues



An important element of a firm's Green strategy is to build a Green brand that customers trust. Developing such a brand is not an easy task and requires an integrated promotion campaign which consistently communicates the company's Green positioning and policies. Standard setting and labelling (refer exhibit 5) are powerful tools used by companies across different industries to build this credibility around the company overall, as well as its products and processes, to help consumers make informed decisions.

Exhibit 5: Standard setting by companies

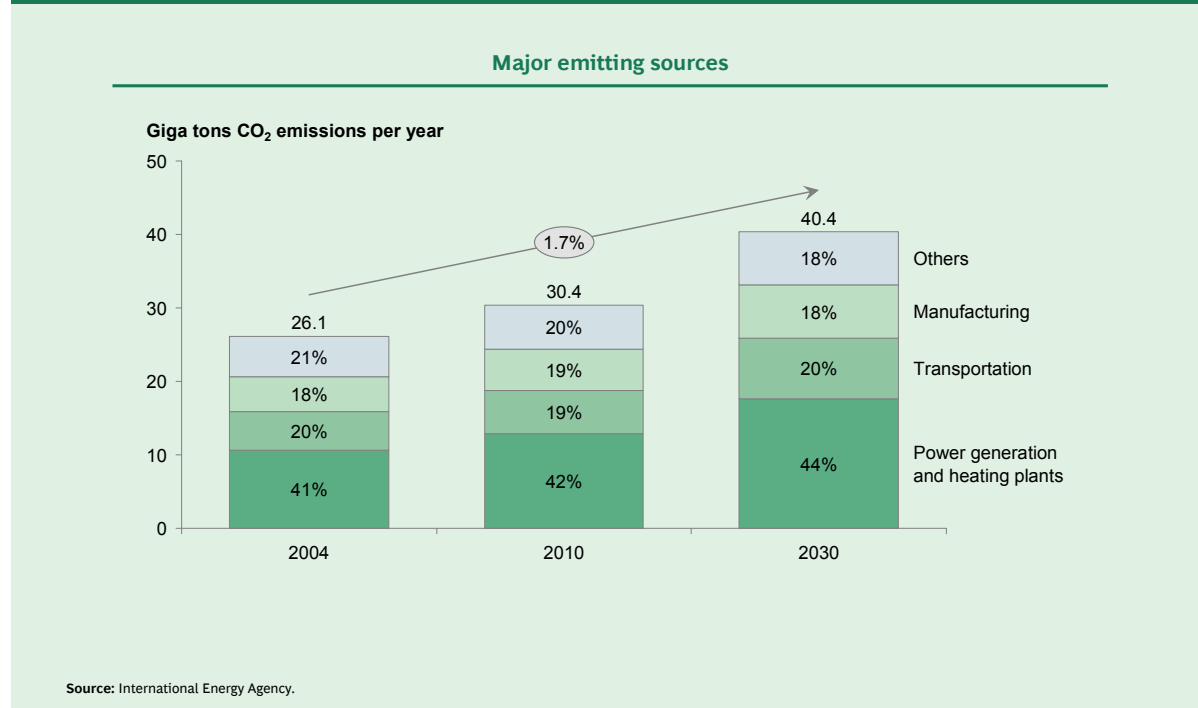
Name	Description
 Designed for the Environment	Introduced by the US Environmental Protection Agency (EPA) to indicate that products contain environmentally preferable ingredients. This label can be used on Green cleaning products and detergents.
 Energy Star	An EPA certification whose goal is to reduce Greenhouse gas emissions through energy efficiency. This is the certification to look for when buying a Green appliance.
 Forest Stewardship Council	Products that bear the FSC logo are guaranteed to contain wood or wood products harvested from a certified, well-managed forest. This logo is most often found on Green building products.
 Green Seal	Aims to reduce the environmental impacts tied to the use, manufacture, and disposal of products and services.
 Greenscapes	This EPA logo appears on Green landscaping products and signifies that the product is designed to be environmentally friendly by preserving natural resources, and by reducing waste and pollution.
 LEED	Promotes sustainable site development, water savings, energy efficiency, sustainable materials selection, and indoor environmental quality. This certification is applied to buildings, and not on individual products.
 Quality Assurance International Certified Organic	The QAI Certification Program is designed to certify every step of the organic chain: From the land on which the product is grown; to the processing and handling facilities transforming the product to prepare it for store shelves. This certification can appear on anything from clothing manufactured from organic fibers to organic foods.
 USDA organic certification	All the ingredients are grown in a manner that models natural systems through promoting biological diversity, recycling of nutrients, and replenishing soil fertility without the use of toxic and persistent chemical pesticides and fertilizers. This label is applied to organic foods and fibers.
 Water Sense	An EPA logo which certifies that the product is water efficient. The product bearing a water sense label is at least 20% more efficient than an average product in it's category and meets these other guidelines.

Source: BCG analysis.

B. Green in Traditional Industries

As observed earlier, different industries have varying degrees of exposure to different sustainability concerns. Green energy is an issue which 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 exhibit 6 indicates, power generation is the highest emitter of GHG,

Exhibit 6: Power generation, transportation and manufacturing are the three largest sources of CO₂ emissions



followed by transportation and manufacturing. It is, therefore, not surprising that these three sectors have the most to gain from Green initiatives.

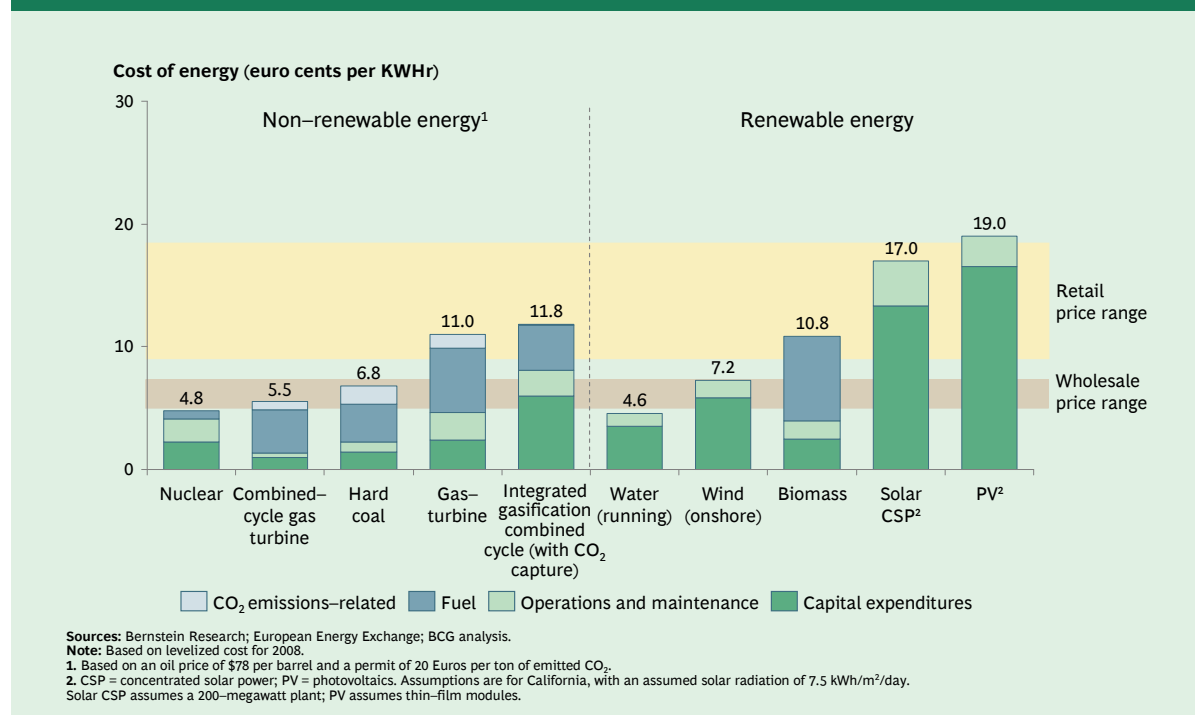
1) Power generation

The world used roughly 20,000 terawatt-hours of electricity in 2008; that amount is expected to increase by about 2.8 percent per year and reach 28,000 terawatt-hours by 2020⁴. Three-quarters of the current electricity generation are based on fossil sources such as coal, oil and gas. This poses several challenges. The first challenge is that of increasing global warming with GHG emission levels already exceeding 380 parts per million (ppm) and projected to reach 400–430 ppm by 2020⁵. Second, with scarcity of fossil sources ever-increasing, energy prices are expected to rise, especially as economies around the world emerge from the economic crisis. Finally, the political uncertainty in resource-rich countries has the industrialized nations worried about energy security.

The power generation industry will have to reinvent itself over the next few decades to address these challenges and shed the tag of the largest emitter of GHG. Many Green energy technologies are now available to them. Some of them are becoming competitive with fossil fuels while others are still expensive (refer exhibit 7)⁶. As the economies of scale take effect in the future, the cost of these technologies is expected to fall and the share of clean alternatives in power generation is expected to rapidly increase across regions⁷.

To succeed, incumbents in the power sector need to develop a detailed understanding of the cost and development trajectories for renewables, and include them in their fuel portfolios.

Exhibit 7: Green Energy can be cost competitive with conventional sources



⁴ International Energy Agency, World Energy Outlook 2008.

⁵ Intergovernmental Panel on Climate Change (IPCC).

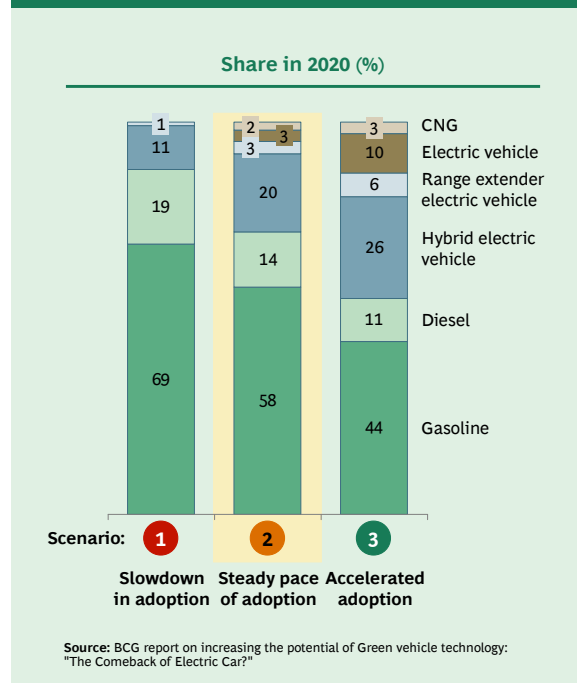
⁶ BCG report on potential of solar power generation: "Solar Storm".

⁷ BCG report on alternate energy: "What's Next for Alternate Energy?".

2) Transportation

The second most 'non-Green' industry is transportation. Governments around the world are tightening the regulations on emission and particulate matter. Driven by increasingly stringent Government regulations, concerns of energy security and higher oil prices, and equally aided by the enhanced public approval of Green brands, virtually all leading automobile manufacturers are exploring ways to reduce the CO₂ emissions of their vehicles and increase fuel efficiency.

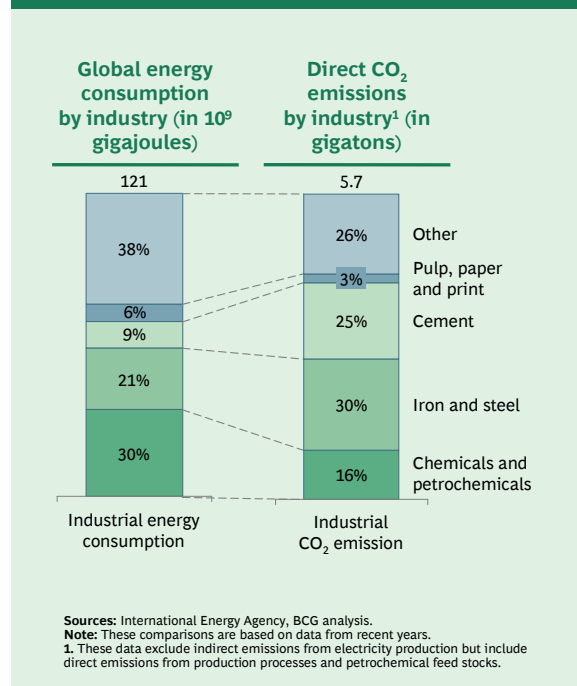
Exhibit 8: Alternate propulsion to achieve over 12% share by 2020



For example, the automotive industry is investing heavily in the development of new clean propulsion technologies. These include hybrid vehicles and power trains, fuel cells, and electric cars. However, within the industry, there are contradictory opinions on the extent of inroads that new technologies shall be able to make. As manufacturers debate whether to invest in traditional cars or in emerging technologies, estimates suggest that alternatives will definitely be a more attractive opportunity in the future.

According to BCG estimates⁸ for the automotive industry, emerging Green alternatives will have a substantial share in new car sales by 2020 (refer Exhibit 8). Cars equipped with alternative propulsion technologies—including hybrids, range extenders, and electric vehicles—will together achieve market penetration of over 28 percent at the current pace of development. If the industry is able to break the cost-benefit trade-offs in creating and owning a Green car and offering consumers an attractive value proposition, the share of these products could well reach close to 50 percent by 2020.

Exhibit 9: Iron and Steel industry accounts for 30% of CO₂ emissions



3) Manufacturing – Steel

Steel is an energy-and-emissions-intensive industry, relying heavily on fossil fuels. According to the International Energy Agency, the iron and steel industries account for close to 20 percent of all energy consumed by industries worldwide and about 30 percent of the world's direct industrial CO₂ emissions (refer Exhibit 9). For many steelmakers, adopting Green is no longer merely an option, but an imperative. Regulators are tightening controls and raising fines on GHG emissions and waste disposal. Meanwhile, investors prefer companies that are managed for environmental sustainability.

Energy cost accounts for a large share of the cost of production of steel — more than one-third for an integrated steel plant. Energy intensity, measured in gigajoule per tonne of steel, can vary widely for different plants — the most energy

⁸ BCG report on increasing the potential of Green vehicle technology: "The Comeback of Electric Car?"

efficient plants can have less than 50 percent energy intensity compared to their inefficient counterparts. Rising energy prices have changed the competitive positioning of many industry players⁹. For example, Russian and Chinese steel producers who are less energy efficient, or who lack access to low cost energy, have been severely impacted by the increase in fuel prices. By contrast, in the same period, Indian players have gained from their coal linkages and Government-controlled prices of natural gas.

The challenge of maintaining competitiveness in face of rising fuel prices coupled with tightening environmental regulations makes it imperative that steelmakers improve their operations by both decreasing their energy intensity, and reducing environmental pollution.

C. 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.

Each technology within these five categories can be further characterized on two dimensions – maturity (nascent versus established) and availability (local versus global). A mapping of Green energy technologies is shown in Exhibit 10. While some technologies such as biomass, hydro and off-grid solar score higher in terms of their relative technological and commercial maturity, there are others like tidal waves, wind offshore and concentrated solar power which are relatively nascent. Similarly, while technologies such as IGCC and CCS are globally available for use, others such as geo-thermal and waste to energy are available only in select geographies.

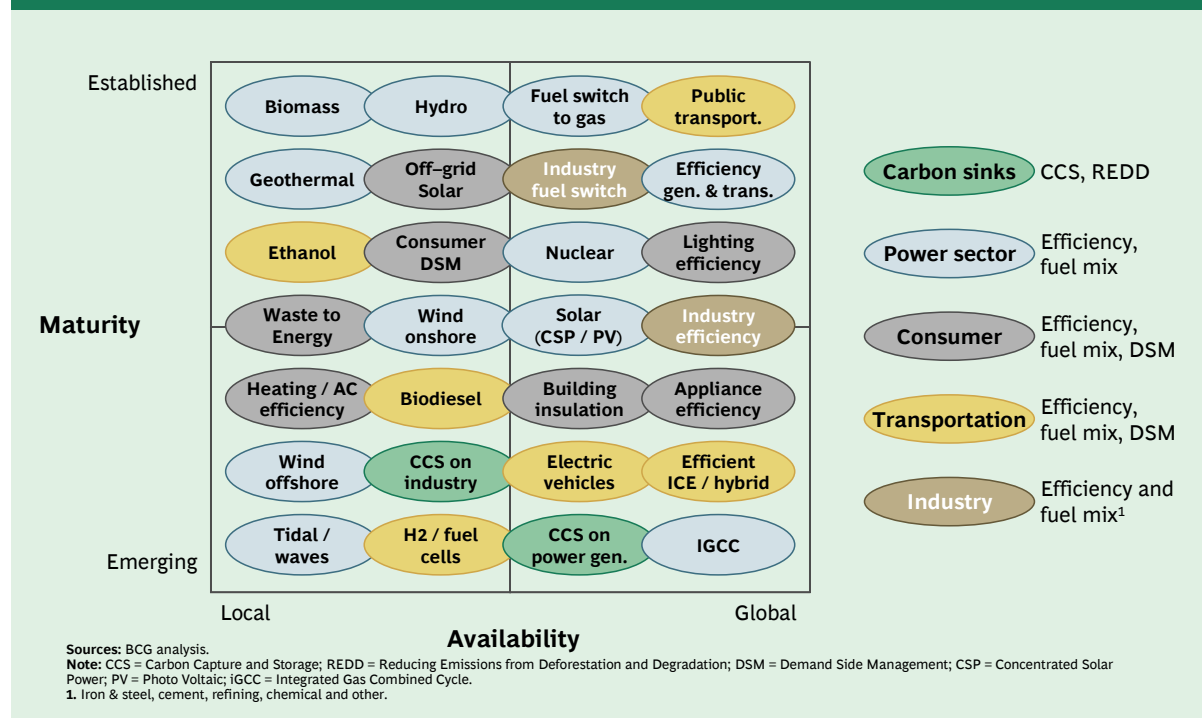
Categorising technologies on these two dimensions provides guidance in making business model choices. It also helps strike a balance between opportunistically harnessing the revenue pools of today and proactively positioning for capturing future revenue pools. Depending on their appetite for resource commitment, companies can make fundamentally different choices.

⁹ BCG report on sustainable steel manufacturing: "Sustainable Steelmaking".

Players committed to long term adoption of Green can select a portfolio of technologies to implement – ranging from mature and readily available ones (example: concentrated solar power) to making selective bets in new ones (example: anodized mirrors technology to make mirrors and reflectors).

Similarly, many mature as well as emerging Green technologies are available in the areas of water and waste management.

Exhibit 10: Canvas of sustainability space with varying degrees of maturity and technology availability



4. Consumer Perspective

A. Green Awareness

Green manufacturing is imperative, not just due to tightening regulations or cost benefits, but also because consumers are demanding it. In a recently concluded BCG survey¹⁰ of consumers across developed and developing nations, about two-thirds of the participants expressed the belief that the environment is in a poor shape and that environmental problems are a primary threat to the society.

Not only are consumers becoming increasingly aware and conversant with Green, 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. According to the BCG survey findings, while consumers believe that as individuals, 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.

¹⁰ BCG Lightspeed Research Global Survey of 9000 adult consumers, published in the report "Capturing Green Advantage for Consumer Companies".

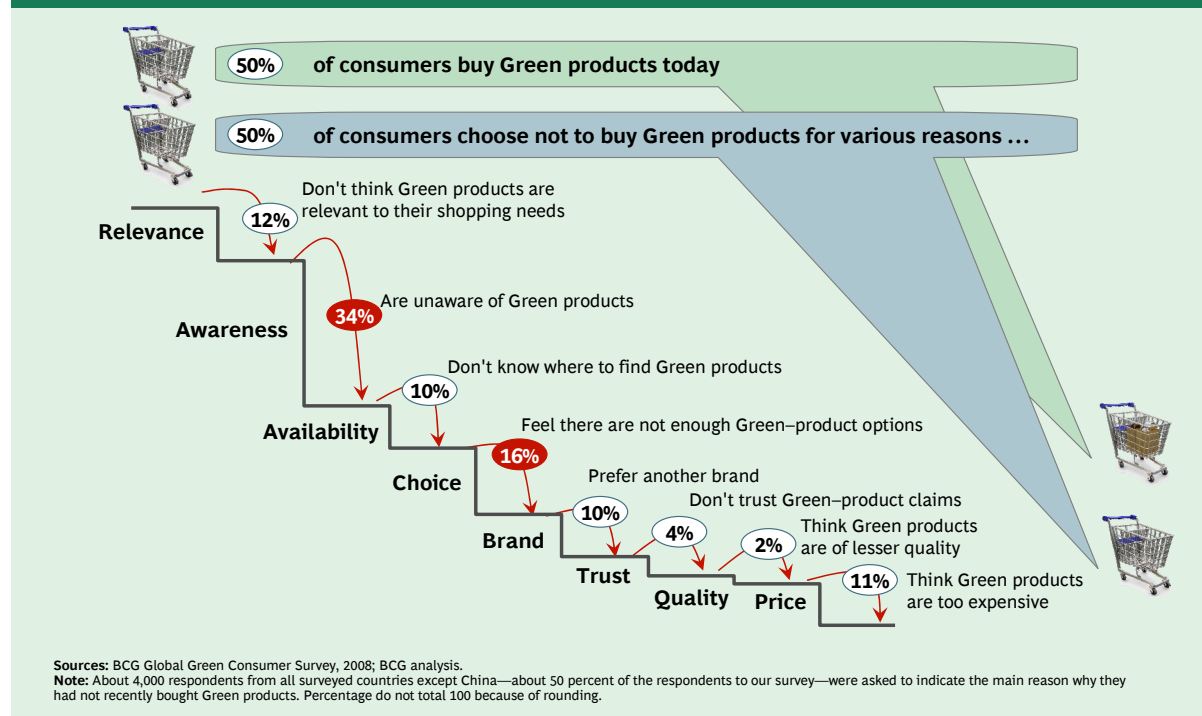
The term Green is recognized the world over as shorthand for environmental consciousness. However, when asked to define Green and their expectation from Green products, consumers had a range of responses depending on where they lived and the type of products they bought. It is, therefore, critical for companies to discover how their target consumer segments feel about Green, what they expect from Green products and what prices they are willing to pay for them.

Another finding of the survey was that about 50 percent of these consumers purchased Green products. The survey also indicated that consumers greatly value the direct benefits that Green products offer, such as – superior freshness and taste, the promise of safety and health, and savings on energy costs. 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. 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.

B. 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 (refer Exhibit 11).

Exhibit 11: Raising awareness amongst consumers most critical lever for increasing purchases for Green products



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.

5. Framework for Adopting Green Manufacturing

A. Challenges in Adopting Green

Even in tough market conditions, the business case for Green remains compelling. There is greater recognition of the imperatives of becoming Green and understanding that Green has to address all three areas – Green energy, Green products and Green processes. However, companies face challenges on various fronts, most critically in providing leadership for such an effort. Companies have to transition from

- a) Approaching Green as limited, often isolated initiatives with narrow focus to a more holistic approach,
- b) Meeting regulatory compliance to developing eco–advantage, and
- c) Viewing initiatives as cost centres to assessing them as business opportunities.

This calls for a major transformation which to succeed, requires a systematic approach and a framework addressing the three principal 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 modelling the business case – or even finding a compelling 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 realising the full benefits.

B. Economic Assessment and Making Strategic Choices

Like any major transformational exercise, 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.

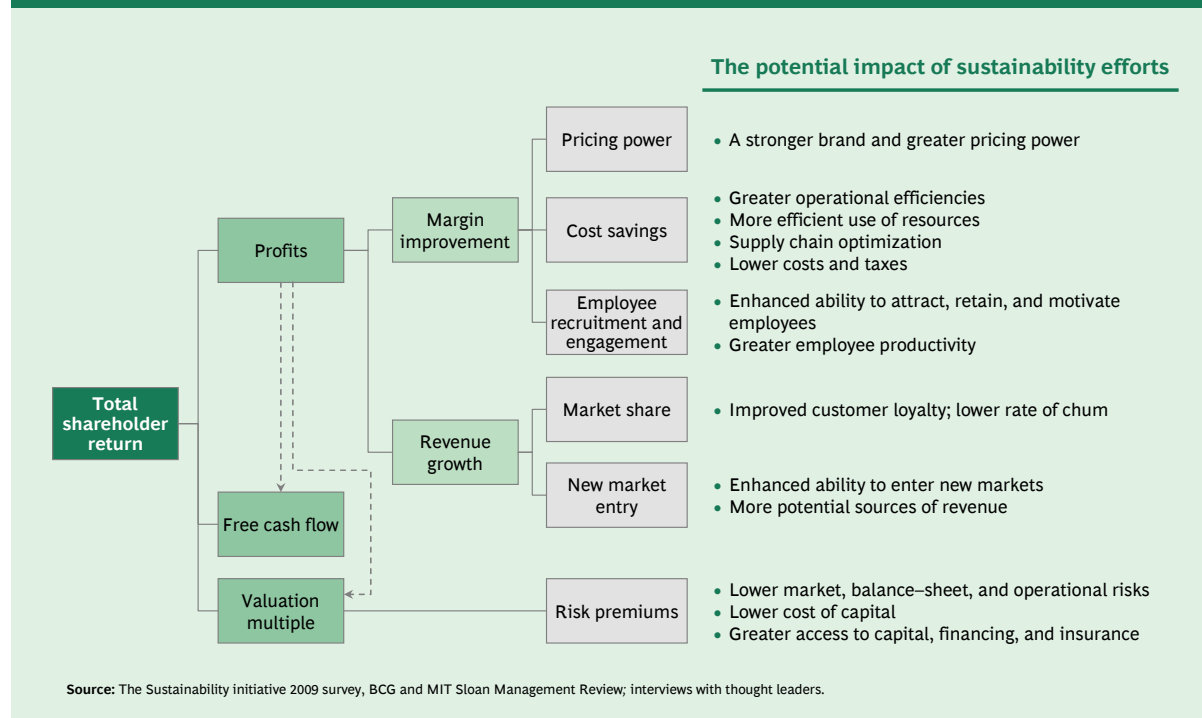
An economic assessment requires estimating the 'value' generated over the long term through these initiatives. It should cover all drivers of value creation – from quantitative metrics like pricing power and cost savings, to qualitative ones like employee recruitment and engagement – otherwise, some of the long term benefits of Green will not get captured as part of the business case (refer Exhibit 12).

Performing an economic assessment is only one part of the story. Having made a viable case, companies need to make a strategic choice on how Green they want to be, and why. The choice of initiatives could vary depending not only on the underlying economics of the options, but also on the market context and opportunities for strategic differentiation. Potentially, companies can choose to be:

- ◇ **Planet indifferent:** where the measures adopted are minimal,
- ◇ **Good citizens:** where they carry out a few isolated initiatives which are the bare minimum that customers demand or regulators stipulate, or
- ◇ **Green innovators:** where they try to stay ahead of the curve on sustainability and transform the issue from one of risk management to that of top line growth and a key business opportunity.

While the first two choices do not allow the company to fully leverage the potential of Green and are only relevant with a short term lens, the third commits the company to a comprehensive Green strategy and to getting the most from the initiatives.

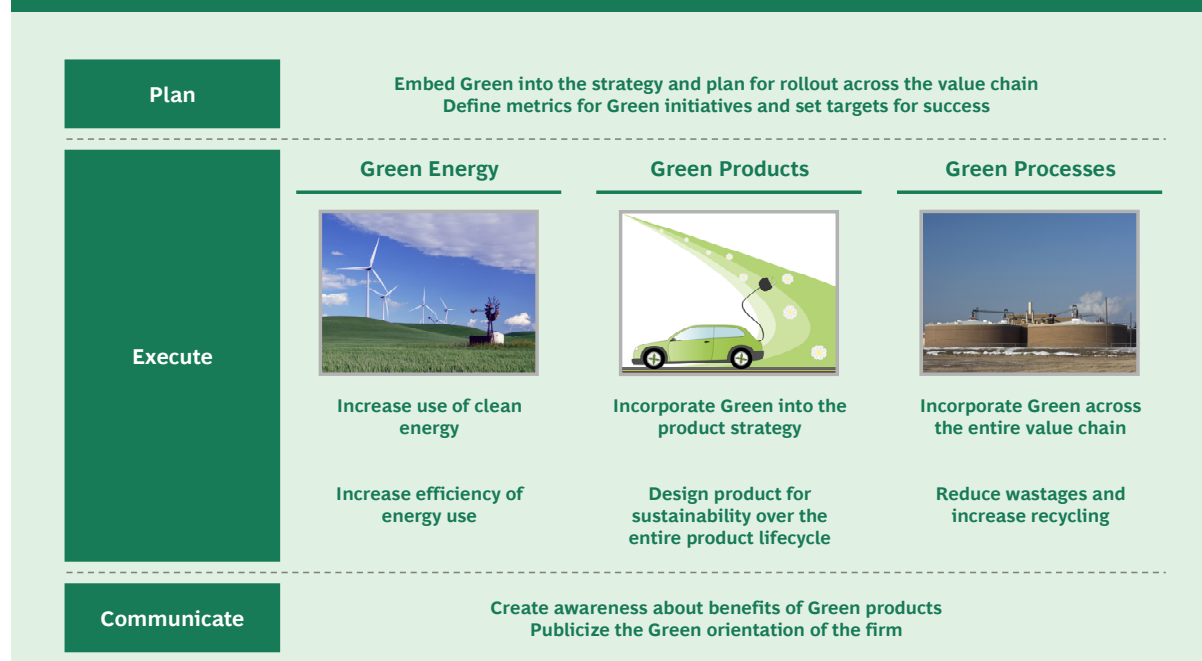
Exhibit 12: Framework for economic assessment of Green initiatives



C. Implementation Framework

Becoming Green is a long journey of transformation. To succeed, adequate attention is required on planning and execution of the initiatives. Early wins and successes are important to build

Exhibit 13: Framework for companies to successfully implement Green



momentum. It calls for a fully committed top management, tight periodic reviews and constant internal and external communication.

A simple three-step implementation framework can be followed covering all three areas of action – Green energy, Green products and Green processes (refer Exhibit 13).

1) Plan

Green initiatives must be factored into the business strategy, future resource planning and budgeting exercises. For example, companies need to plan comprehensively to increase the use of Green energy, shift the product portfolio to Green products and overhaul business operations towards Green processes. 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 or scorecards quantifying the impact of the Green initiatives they have undertaken, set specific targets on those indices and track progress against those targets.

2) Execute

With a robust plan in place and targets clearly defined 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 or better use of daylight in building design, can go a long way towards reducing 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 are 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 incentivising all suppliers, channels, customers and employees to adopt similar measures.

3) Communicate

Along with well thought-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 increasing revenues.

6. Green Manufacturing Agenda for India

A. India's Green Challenge

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 centres. Today, India is the fourth-largest economy and the fifth-largest GHG emitter in the world¹¹. During the 18 year period between 1990 and 2008, India's CO₂ emissions increased more than 150 percent, placing it just behind China.

Rapid urbanization and industrialization generate massive amounts of waste. For example, India generates close to 4 million tonnes 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 percent of e-waste makes it to authorized recycling facilities, with the rest either going into landfills or being processed at informal recycling yards¹². The Indian e-waste market is expected to nearly double from 450 KT per annum currently to about 800 KT per annum by 2020.

B. Setting the Agenda for Green Manufacturing

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.

1) Green energy

Over the past few years, both the Government and the industry 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.

According to a report by the UN Environment Program (UNEP) – 'Global Trends in Sustainable Energy Investment 2010' released in July 2010 – India was ranked seventh in the world in terms of investment in sustainable energy. Under the National Solar Mission, the Government plans to generate 20,000 MW of solar power by 2022 in three phases, with 2000 MW capacity equivalent off-grid solar applications¹³. India is the fifth largest wind energy producer in the world with an installed capacity of around 11,500MW and has three times this wind potential it can still tap. Similar aggressive targets have been set for hydro and nuclear power generation.

The 11th Five Year Plan has set a target of increasing energy efficiency by 20 percent and the Government is also offering tax holidays, soft loans, subsidies and other incentives for renewable energy projects. The Government has set up the Indian Renewable Energy Development Agency (IREDA) as a public sector unit for market development and financing. The Bureau of Energy Efficiency (BEE) was set up to support awareness and demand creation for energy efficient products, goods and services. BEE has set up the Energy Efficiency Financing Platform (EEFP) for supporting the cost effective financing of energy efficiency project implementation and its expansion. In the Union Budget 2010–11, the Government announced setting up of National Clean Energy Fund (NCEF) for funding research and innovative projects in clean technologies. The Central Electricity Regulatory Commission (CERC) has announced Renewable Energy Certificate (REC) norms in a bid to promote power generation from clean sources in the country.

¹¹ Ministry of Environment and Forest, Government of India: India Greenhouse Emissions – 2007.

¹² Research on India: Waste Management – India (August 2009).

¹³ New article: National Solar Mission cleared; to generate 20,000 MW by 2022 – Economic Times (November 19, 2009).

The number of carbon credits issued for emission reduction projects in India is set to triple over the next three years to 246 million by December 2012 from 72 million in November 2009 as per estimates¹⁴. This will cement India's second position in the global carbon credits market, technically called Certified Emission Reduction units or CERs. The growth in CER issuance will be driven by capacity additions in the renewable energy sector and by the eligibility of more renewable energy projects to issue CERs. Consequently, the share of renewable energy projects in Indian CERs will increase to 31 percent.

While considerable progress has been made as shown above, India has still some way to go. Close to 75 percent of India's energy generation comes from coal and natural gas. In efforts to provide electricity to 40 percent 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 (e.g. Solar Mission) and strengthening the regulatory framework (BEE) for improving the energy efficiency.

2) Green products

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 behaviour. Consumer consciousness about Green products is expected to grow further and companies are quickly identifying this avenue as a route to achieving competitive advantage.

Indian companies are also implementing the RoHS (Restriction of Hazardous Substances) compliance for many of their products. For example, the Godrej Group's furniture division has systematically created a range of products that provide for a Greener customer experience in terms of emitting lower Volatile Organic Compounds (VOCs), thereby making long hours of working on an office floor much better. In the automotive sector, the Society of Manufacturers of Electric Vehicles (SMEV) expects sales of electric two-wheelers to double in the coming months, spurred by an incentive scheme announced by the Ministry of New and Renewable Energy (MNRE). Compressed natural gas-powered vehicles in India also increased 30 percent over 2009, to reach 1 million in 2010¹⁵. Green buildings are catching up fast in the country. It is estimated that about 2–3 percent of all construction in India is Green, which is similar to a developed country like the US. This figure is expected to go up to about 10 percent for new constructions over the next few years¹⁶.

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. Here the 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.

3) 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 processes to minimise waste and enhance energy efficiency. For example, the shortage of reasonably priced domestic high-grade coal is forcing cement

¹⁴ CRISIL Research Study (May 12, 2010).

¹⁵ Natural Gas Vehicles – India.

¹⁶ News Article: Green construction gaining traction in India – livemint.com (December 30, 2010).

companies to be more innovative in their manufacturing operations. Power consumption in an engineering plant can be reduced by using more power-efficient motors and moving to Compact Fluorescent Lamp (CFL) and natural lighting in the buildings. By adopting these measures, an engineering plant was able to reduce power consumption by nearly 35 percent in a short span of time.

But there is still a long way to go in many sectors. For example, even the more advanced amongst the Indian steel producers consume more than 20 percent higher gigajoules per ton of hot metal in the iron making stage as compared to their advanced Chinese counterparts, and over 70 percent more gigajoules per ton compared to advanced western European producer. Some efforts to bridge this gap have now started to come to the fore. For example, the Essar Group has claimed that it has reduced its energy consumption very significantly and has planned three Clean Development Mechanism (CDM) projects in its upcoming blast furnace project in Hazira aimed at reducing CO₂ emissions.

In a bid to promote energy efficiency and reduce industrial carbon emission levels, the 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, BEE would set energy efficiency targets for industrial units and issue them energy saving certificates or ESCerts against those targets. Units that exceed targets for energy efficiency can sell the ESCerts to units that fall short of targets. Energy audits play a critical role in improving energy efficiency and the Government has mandated the appointment of an energy auditor for industries with high energy intensity.

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 percent of water consumption in just a few years. Manufacturing plants can minimise waste generation by redesigning their press tools and machines to reduce the scrap they produce, and by improving scrap collection and recycling. For example, Godrej Locks improved scrap recycling for all brass made products such as locks, by collecting the scrap and providing it to local smelters for recasting it into brass sheets and rods. Another example of a Green process is ITC's paper plant at Bhadrachalam which has been re-designed to consume less water than the industry average and at the same time convert pulpwood into crisp white paper much faster.

C. Role of Technology in Enabling Green

Green technology is the common denominator across all the three areas of Green energy, Green products and Green processes. Companies can think about the role of these technologies in their business strategy in two different ways – building a new Green Business, and using technology to 'Green' an existing one.

For example, companies can set up Green energy businesses using technologies such as concentrated solar power or storage technologies like molten salts and ultra capacitors. Another example is building Green waste management businesses using new technologies such as aerobic composting and pyrolysis which can make products like bio-organic fertilizers, organic manure, Refuse Derived Fuel (RDF) economically viable. On the other hand, existing process intensive manufacturing industries like cement can be made Green by replacement of existing cyclones with low pressure drop cyclones or conversion of open circuit cement mills to closed circuit which significantly enhances the energy efficiency in the old plants.

Indian companies can also consider investments in emerging Green technologies as part of a broader portfolio comprising both, short term and long term plays. For example, the Tata Group, as part of their Green portfolio is investing in Sun Catalytix Corporation, an energy storage and renewable fuels company founded by Daniel Nocera, a professor from MIT, as a longer term bet.

D. 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 (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 on-going business operations.

For example, an equivalent of ISI certification can be implemented as part of a holistic policy framework to govern Green products by giving 'Green' ratings based on criteria like product recyclability and biodegradability. These ratings have to be actively promoted and will provide a critical lever to companies to differentiate themselves, and also enable the consumers to make more informed choices.

In the area of Green processes, the current focus on one hand has been on improving energy efficiency through energy audits which are basically voluntary and on the other, the recent strictness in the implementation of laws to check industrial pollution. The scope of these efforts can be widened and integrated into a 'Green Audit' which focuses on all three – energy, water and waste. This could be done through incentivising, through voluntary participation, or by mandating via an independent regulatory body.

Finally, the Government can speed up the adoption of many Green technologies by using levers like PPP models (e.g. such a model is proposed for development electric and hybrid transportation), 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.

7. Concluding Remarks

In his address to his shareholders at the annual general meeting in 2009, the Chairman of ITC — the conglomerate with businesses across paper, cigarettes, consumer goods, hotels and agribusiness — spoke about implementing a totally new paradigm of competitiveness based upon creation of 'Green businesses' and also the generation of 'Green livelihoods'. He went on to say that in the future, "...competitiveness and profitability will be increasingly linked to the ability of business to make carbon reduction and the creation of sustainable livelihoods an integral part of their value proposition to consumers...". Similarly, the Godrej Group has set up a Mission on Sustainable Growth task force led by a very senior leader of the firm and constituting of senior executives representing each operating division. The mandate of the task force is to make its processes and products more sustainable, namely Godrej Green!

The manufacturing companies are Green pioneers. Green manufacturing is core to their competitive strategies. The transformation journey to Green manufacturing has just started. While there are a few early adopters, the industry at large needs 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 this transformation with both stronger incentives on one hand and regulatory mechanisms on the other. The industry associations can bring the different stakeholders together and support the roll-out of a communication strategy.

The prize for success is enormous for both individual manufacturing companies and the country as a whole. Failure is no more a choice.

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