GREEN BUILDING BUSINESS

Target Country: India

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ABSTRACT

Can “Green Buildings” save India from transforming to cement valleys? What kind of technology solutions the Finnish companies could sell to India in order to have a win-win situation? India is second largest growing economy in the world with growing population at a rate of 1.3 % and energy consumption at 4.3 % and vanishing water resources. The construction sector in India is one of the major consumers of energy.

Due to these increasing consumption patterns, there is scarcity of sources like water and energy which is an emerging threat to the Indian population. In order to tackle these problems, the Government of India is trying to find out different solutions to combat those problems at a national and international level.

This paper summarizes a study carried out by visiting India to explore the wider context of Green buildings from the viewpoint of need versus opportunity. In addition to summarizing mechanisms of change (barriers and drivers) the study reviews a set of policies that could help in promoting Green building awareness and help building a modern India consisting of Green constructions. In this modern India, setting up new thermal plants is not considered the only option to meet energy requirements. Instead alternative energy sources of energy and efficiency in the utilization of energy is thought as smart solution.

Green constructions from residential estates to Malls and airports should be considered in the long term strategy plan as a long term solution to combat climate change and reduce utilization of fossil fuels and reduce wastage of water. The energy and water saved could be distributed for rural consumption which suffers from lack of those facilities.

By 2025 the combination of Green buildings and smart growth in India could deliver improved efficiency in utilization of resources that are needed to mitigate climate change and solve scarcity of energy and water.

Key words: Energy efficient buildings, Green buildings, Sustainable buildings, Green Constructions, Fly Ash Management, Energy Gap in India, Water Crisis in India, Constructions in India

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1 INTRODUCTION

1.1 Background

This study attempts to present a snapshot of developments and important features in the general area of Green buildings development in North India (Punjab and Haryana specially). The study explores business opportunities and feasibility in the field of Green Building business in India. It also provides a package of necessary facts and analysis for entering Green building business in India.

Currently, Indian government is encouraging foreign companies to invest in India through their policy frameworks and financial incentives. The results of the research will be fruitful for Nordic firms who want to develop green building solutions business to an international level in India, which is an emerging market with rapidly expanding middle class society needing electricity. The main reasons to invest in Green business are high demand, cash rebates and positive environmental impact. It is interesting to understand the term “Sustainability” and role played by sustainable developments in order to measure and report construction sectors performance against economic, social and environmental factors in India. The study helps in understanding the role played by the construction industry of India. Is the industry benchmarking worldwide in terms of adapting to modern green principles? Is India taking into account environmental and social performance in addition to financial performance?

Construction activity is one of the largest activities boosting the Indian economy and has a significant impact on the environment in terms of leaving the footprints. Constructions in India have been pursued without giving much attention on the environmental issues which has resulted in pressure on its finite natural resources. Unplanned and unsustainable constructions in India have lead to severe environ-

mental issues. There are four important factors to consider with respect to the effects of the construction industry in India. For example,

1) Water: The green envelop and ground water resources have been severely depleted to give way to the new construction developments in India. Water is an important component for mankind survival and acts as a backbone for agriculture, industry, tourism, and healthy living. Water scarcity has negative effect on the income and wellbeing of society.

2) Cities: The migration of rural population to the urban areas in search for jobs and better living is increasing pressure on the cities and results in social unrest.

3) Air: Air pollution has harmful impact on the health of the population and consequently limits the productivity of the people. The health and well being of the society is impacted by the built environment and it influences the human senses, emotions, sense of community, and general wellbeing.

4) Limited understanding: Unfortunately limited amount of people understand the environmental problems in India.

There have been several recent initiatives by central and state governments in India to push the construction industry to promote sustainable buildings to integrate the principles of sustainable development into country policies and programmes. In India, environmental measures are addressed under a five-year plan in linkage with the Millennium Development Goals (MDGs) adopted by the United Nations. These measures are not intended to serve only a single purpose but concurrently pursue many other purposes such as prevention of pollution, global warming and mitigation of poverty.

The international co-operation in fighting climate change can be increasingly seen through several clean energy projects in India. The Kyoto Protocol which came into action in February 2005 is a set of rules to the international Framework Con-

vention on Climate Change with the objective of reducing Greenhouse gases (GHGs). In India several Clean Development Mechanism (CDM) projects are operating under the Kyoto's protocol. However it is unclear that these movements are actually having the desired effect.

How can Indian economy maintain the growth curve while addressing environmental issues? This research explores all possible factors which lay down the need for sustainable buildings as economically viable solution for India to meet the growing energy needs and reduce GHGs emissions.

1.2 Scope and Methodology

The main objectives of the research are:

- To produce the thesis – an academic document for the purpose of furthering the knowledge in the 'green building business' in India.
- To analyze the latest business potential scenario in the field of Green building business in North India regions namely Punjab and Haryana.
- To determine the current transition stage in Green building business.
- To present possible ways and strategies for entering into Green building business.
- To verify the policy frameworks in the state from the PEDA (Punjab Energy Development Agency) and small and medium enterprises (SMEs).
- To verify if there are any gaps between policies implemented and the real situation.

The research is indented to address questions like:

- Why Green buildings for India?
- What is the business potential in India?
- What benefit would Nordic industries and India reap in green building business?

2 THE PROBLEM AREA

The problem is how India can meet the booming construction industry needs while taking sustainability into consideration at same time. The construction sector in India is a significant contributor to the National gross domestic income (GDI). As per the Confederation of Indian Industries, the construction sector contributes to about 8-10 % of India's GDP. The real estate comprising of housing, commercial and retail is growing at a rapid rate and is poised to emerge as one of the most preferred investment destination for the local Indians and well as the foreign investors.

Before digging into the problem deeper it is important to understand sustainable environment and its relationship with economical progress.

2.1 Sustainable development

Sustainability can be defined as the capacity to maintain a certain process or state indefinitely. According to Brundtland Commission convened by the United Nations in 1983 the "Sustainable Development" is defined as balancing the fulfillment of human needs with the protection of the natural environment. The human needs should be met not only in the present, but in the indefinite future as well. Infinite economic growth is impossible on a finite planet, and that Earth's limits also define the limits of all material-based activities. An "unsustainable situation" occurs when natural capital (the sum total of nature's resources) is used up faster than it can be replenished.

Promoting sustainable development is an on-going process, whose desirable characteristics change with time, across space and location and within different social, political, cultural and historical contexts. By understanding sustainable development we are able to recognize the alternative futures which lie before a society. Promoting sustainable development requires recognition of the common good and

requires engagement across all levels of social organizations. (Allen, T. & Thomas, A. 2000, 158)

The rise of environmental problems, such as climate change, biodiversity loss and deforestation has led to growing demand for international interventions to deal with both Tran boundary and global environmental matters. The globalization of environmental governance has been accompanied by pressure to try new and innovative procedures. (Baker, S. 2006. 1-4)

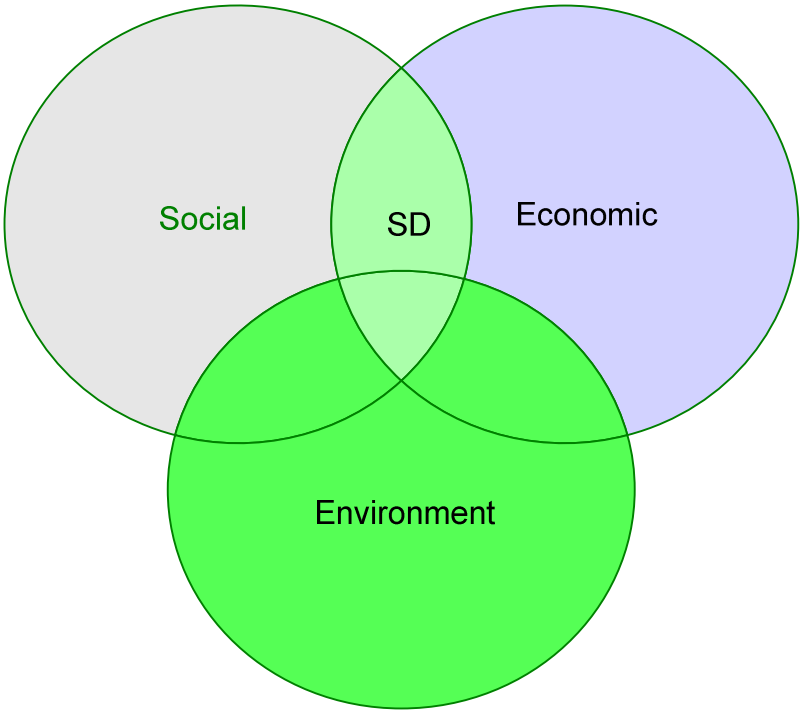

Figure 1: Triple Bottom Line: Framework for Sustainable Developments. Source: Sustainability Reporting [Retrieved 15.10.08]. Available at http://www.sustainabilityworks.biz/whatisit.html

The term Triple Bottom Line was invented by John Elkington in 1980s. It provides an approach to report and assess organizational performance in relation to sustainability.

The triple bottom line (TBL) provides a framework that guides operations for environmentally and socially responsible outcomes. It can be described by Social, Environment and Economic factors (Refer to Figure 1). Social is related to fair and beneficial business practices toward labor, the community and region in which

a firm conducts its business. Environment refers to our surrounding which includes living and non-living things around us. The non-living components of environments are land, water and air. The living components are germs, plants, animals and people. The Economy defines how societies use scarce resources to produce valuable commodities and distribute them among different people. In order to achieve sustainability all these three interwoven factors need to have a balance with each other creating Triple Bottom Line. (Darrell, B. & Dillard J. & Marshall Scott R., 5)

2.2 Current challenges

Today, climate change is one of the serious threats to our planet. Buildings have major environmental impact contributing to this climate change. To give way to buildings resources such as forests, water, and energy are depleted. Energy used in creating and operating buildings is twice as much as cars and trucks. Buildings consume 30 % of the world's energy and 16 % of water. According to the experts by 2050 the energy consumption of buildings would increase to 40 % emitting 3,800 mega tones of carbon which is main cause of global warming.

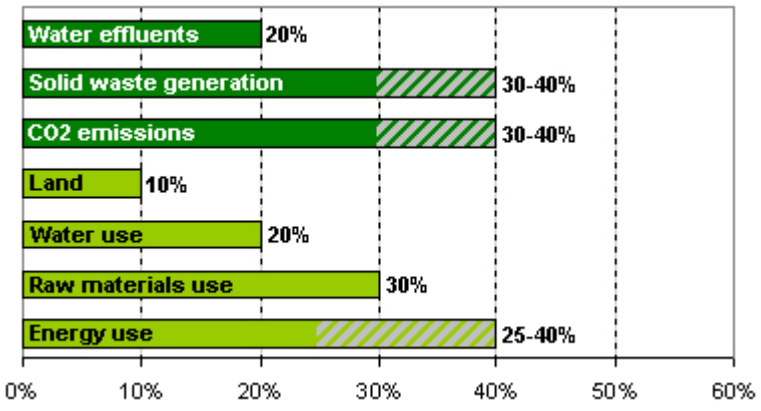

Figure 2: Share of the Built Environment in Pollution Emissions and Resource use. Source: Earth Trends, 2007 using data from UNEP SBCI, 2006 [Retrieved 28.10.08]. Available at http://earthtrends.wri.org/updates/node/232

The built environment (man made surroundings) provides social and economic benefits. Simultaneously it contributes to 30 % in consumption of global raw materials and approximately 40 % of energy usage. Solid waste generation and greenhouse gas emissions are other by-products of the man made surrounding with contributions of about 40 % in the pollution emissions. (Refer to Figure 2) There are many factors which highlight the need for sustainable buildings in order to safeguard the future of India. These factors are explained in the following discussion.

2.2.1 Energy gap

In India, one quarter of the energy goes for making and operating buildings. Eco-friendly principles should be taken into consideration at the time of constructing a new building. The building sector has emerged as a major factor which impacts the environment in both terms of enormous utilization of energy during construction of the building and also in the long run with respect to the costs of using the building.

According to the Indian Ministry of Power about 20 to 25 % of the total electricity consumed in government buildings in India is wasted because of the inefficient design parameters of buildings. This results in an annual energy related financial loss of about 1.5 billion Rupees (US $33 million). (Palit, D. 2004)

According to Dr. Ashok Khosla the electricity consumption in the Indian commercial sector accounts for about 8% of the total electricity supplied by the utilities and has been growing annually at about 11-12 %. (Khosla, A.2008) This is mainly attributed to the increasing energy intensiveness of newly constructed commercial buildings. The buildings being designed and used today are consuming excessive energy for heating, cooling, lighting and even for the material being used for construction. This may cause serious environmental problems.

Many parts of India suffer from electricity breakdowns several times a day. There is a huge gap between the demand and supply of electricity in India. According to the Ministry of Power survey there was a gap of 41,630 Million KWh in Jan 2006. (Refer to Figure 3). Can sustainable buildings play some role in reducing the consumption of electricity?

Energy Source	Demand	Supply	Gap/Shortage
Electricity (Jan 2006) (In Million KWh)	5,21,872	4,80,242	(41,630)

Figure 3: Supply and Demand Gap in the electricity sector in India. Document available at: Competition in India's Energy Sector –TERI. Source: Ministry of Power Economic Survey 2005-06, Planning Commission, Ministry of Petroleum and Natural Gas, Gail Infraline, Annual Report 2004-05, Ministry of Coal [Retrieved 13.10.08]. Available at: http://www.competition-commission-india.nic.in/work_Shop/AJOY_ACHARYA_17.3.06.pdf

Many rural parts of India suffer from occasional blackouts and the electricity provided has limitations to some hours. The rising population, increasing standards of living and rapid urbanization in India result in an increase in building construction activities. This demands a larger share of the energy available in already strained energy supply scenario. In India the most part of the energy requirements are met by burning fossil fuels.

Air conditioning is widely used in India throughout the year and it places a considerable demand on the electricity grid. In a typical Indian house, air conditioners consume major part of the total power used. The air conditioning industry in India has been growing at a rate of 25 – 30 % in 2007/08 and is expected to continue its growth in the near future. It is challenging to meet the growing electricity demand for the feeding the air conditioners when there is already lack of electricity.

2.2.2 Air pollution

The bricks used in most of the conventional buildings in India are made in old fashioned chimneyless kilns. These kilns burn fossil fuels like coal or wood, which account to massive %age of air pollution and thus damage the health of the people living nearby.

Cooling systems like air conditioners and fridges produce large amounts of chlorofluorocarbons (CFCs), which are part of greenhouse gas emissions. Air conditioners work day and night to combat hot climate in India but simultaneously they inject additional carbon into the air and contribute to global warming.

Very large part of environmental problems are caused because of the materials that are digged out of the ground go into the construction of buildings, roads and other construction projects. There is enormous consumption of fossil fuels at the construction sites as well as during the stone mining process. Burning of these fossil fuels from the diesel generators generate carbon emissions which has additional impact to global warming.

2.2.3 Water Scarcity

India fears scarcity of water in coming years in spite of abundant rains, rivers and lakes. Many people die in India because of drinking polluted water from resources like rivers or ground water. The conventional buildings lack water treatment and water management systems. Entire grey water from bath, wash basin and kitchen (residential waste water) is not recycled and it is pumped down to the sewers. The sewerage water is rarely treated and recycled depending on the residential location and affordability of technology. The untreated water finds its way to the rivers or ground causing water pollution which influences the health of many people. India is lacking proper water management system and as an outcome of it the groundwater is disappearing and river bodies are turning into makeshift sewers.

According to the Government of India, currently the water consumption in India is about 750 billion m3/year for all the applications like agricultural, industrial, domestic and commercial. Assuming a conservative figure of per capita water consumption of 1000 m3/year, the water availability in India is likely to get fully stretched by the year 2010. This leads to the importance of water conservation by way of increasing user efficiency, decreasing the demand on these sources and recycling and reusing wastewater as well as rainwater. (D.A.E. 2006, 1)

2.2.4 Improper waste management

Apart from the energy and water crisis in India, improper waste management adds to the environmental problems. Construction waste management is another challenge faced in India. The debris from building demolitions and remodeling is not recycled at a sufficient level and is often left untreated on the roadsides or dumpsites. The toxic parts from the construction debris leak to ecosystems causing water and soil pollution which raises concern over health problems to the society (Figure 4).

Figure 4: Improper waste handling from Conventional buildings. Source: The Hindu Newspaper [Retrieved 13.10.08]. Available at: http://www.hindu.com/pp/2006/11/19/stories/2006111900130600.htm

In India most of the electricity is generated from thermal plants which generates fly ash. The fly ash is dumped into landfills or left untreated on the river banks. Fly ash is a superfine residue left behind when coal is burnt to generate electricity. It is estimated that up to 80–100 million tons of fly ash is produced each year by the low-quality coal used in India and close to 90 % of this ends up in landfills covering an area of 40,000 acres (160 km²) which causes serious environmental threats like contaminated groundwater and soil.(Bandza A. 2007)

2.2.5 Housing needs for emerging population

The population density in urban India has increased drastically due to increasing population and migration of people from rural to urban areas, or immigration from neighboring countries. According to the Ministry of Urban Development, contribution of urban population to GDP will reach to 70% from the current of 60% by 2011. (Urban housing shortage Report. 2008)

The construction industry is growing at a fast rate to meet the demand of increasing population. As per the Confederation of Indian Industries (CII), the construction sector in India is one of the rapidly growing sectors with growth rate of 9.2% against the world average of 5.5%. It has significant contribution to the India's GDP with the contribution of 10% and projected to grow more in coming years. (Lakshmi, D. 2008, 2)

Figure 5: Population growth trends in India. Source: Kundu, A.2007. [Retrieved 13.10.08]Available at: http://www.urban-age.net/10_cities/07_mumbai/_reflections/india_Kundu.html

According to world population indicators report, Indian population almost tripled during the period of 1951–2001 (Refer to Figure 5). This phenomenal increase in the population during the last fifty years has led to rapid industrialization and high rate of urbanization creates pressure on natural resources like land, air and water. It is estimated that Indian population would cross 1,500 Million by 2030 encapsulating urban population of 700 Million. While addressing all of the above mentioned problems how can energy hungry India meet its growing population needs in coming future without destroying the environment? Is the scarcity of the resources changing the present way of building new constructions?

3 ANALYSIS

In this phase environmental impacts are assessed qualitatively with the normal exceptions of energy, water consumption and waste production. Environmental problems are complex and interrelated; therefore optimizing performance of a building material, product, or system by themselves cannot produce remarkable environmental benefits. It is necessary to measure the environmental impacts and calculate the total environmental performance in order to determine which alternative technology is preferable.

During the research visits to India in July and August several face to face interviews were held in the North Indian states of Punjab and Haryana. The main stakeholders were Punjab Energy Development Association (PEDA) representatives, a construction architect in Chandigarh and five other Small and Medium Enterprises (SME's) located in Mohali and Chandigarh, who are involved in manufacturing of renewable energy solutions for residential and commercial sectors. The information collected from the various stakeholders is collected and analyzed using the STEEP and SWOT analysis tools.

The research is organized in a flexible structured way to strengthen the thinking and get better understanding on the problem space in a logical way. The methodology used to analyze the problem area for the thesis can be divided into following phases:

- Preparation phase
- Hypothesis phase
- Analytical phase
- Result phase and
- Results evaluation phase.

These phases are explained in detail below and the techniques used in those phases to get the outcomes. (Figure 6)

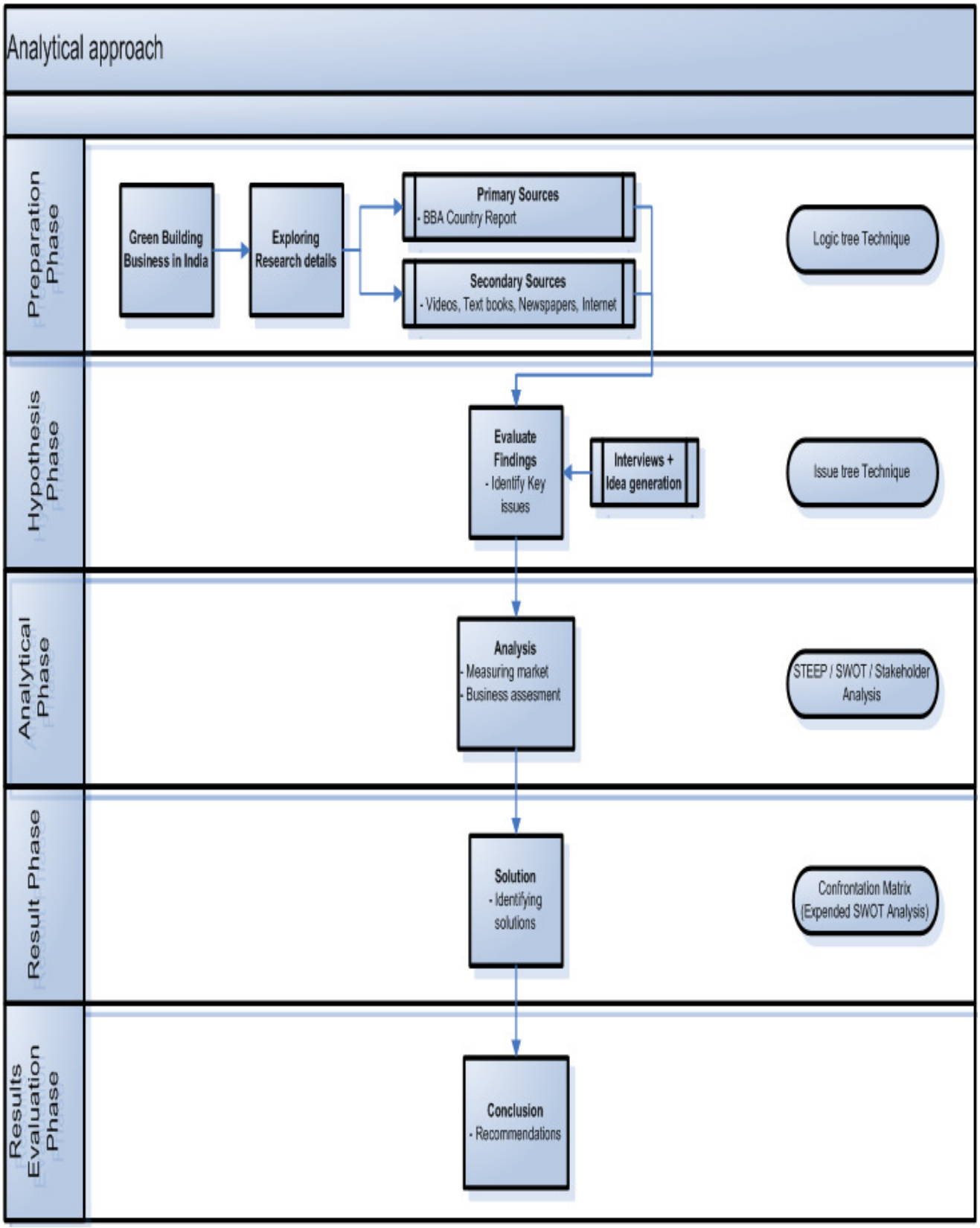

Figure 6: Techniques/ Analysis used at different stages

Preparation Phase: At this phase the research topic is known and task is to collect basic information about the research and understand the problems associated to the research. The problem is broken into smaller components to understand different aspects about it.

Logic tree technique was used in this phase. This is a hierarchical grouping of elements and is used in order to make the research more productive. Information was gathered from the primary sources like India environmental analysis report. Secondary sources provide understanding and analysis of primary sources.

Hypothesis Phase: After breaking the problem into its essential components the next phase is to evaluate the findings from the exploratory process of the preparation phase.

Issue tree technique was used in this phase. The issue tree is a series of questions or issues that must be addressed to prove or disprove a hypothesis and splits the research problem into its smaller component parts. This technique is used in my study to generate ideas to construct the semi structural interviews. Using issue tree technique the possible questions will be discovered in order to form hypothesis and will act as road map for analytical phase.

Qualitative approach for the research was chosen to gather a more holistic view of the organizations involved in green building business in India. Interviews were organized with the Green building architect, representatives from the governmental agency and SMEs in Punjab, North India. A series of guiding interview questions were prepared which formed a framework for the research. The questions allowed the interviews to be conducted in a fairly organized and systematic way. The objectives of the research were explained before organizing face-to-face interviews.

Analytical Phase: In this phase the STEEP analysis is used to analyze the Green building business in India. This gives an eagle's view on business opportunity in sustainable constructions in India. Results of STEEP will be utilized in the SWOT

analysis to get an insight on key issues to be addressed for entering into Green Building business in India. Stakeholder's analysis will be used also in order to understand the key players in the field of Green buildings in India.

Result Phase: After analyzing important points of the problem, confrontation matrix or expended SWOT analysis will be used in understanding the different strategies which could be used for doing environmental business in India.

The confrontation matrix will give my research an insight on how the Nordic green construction industries should position themselves in the Indian market with their products. This matrix is used to analyze the outcomes of the research and recommend best possible strategy from four strategies namely attack strategy, the defense strategy, the strengthening strategy and the withdrawal strategy.

Solutions for the key problems addressed in the hypothesis phase will be provided here.

Result evaluation Phase: In this section recommendations on strategies and possible business solutions will be discussed. Recommendations on creating win-win situation for both countries based on the analysis and solutions will be explained. This phase provides solutions to the questions linked to the research problem.

3.1 Approaches to understanding the Macro environment

In order to have an overall look at the problem, there are different analyzing tools which could be used such as PEST, porter five forces, market segmentation and stakeholders analysis.

For having a better understanding on the business development assessment and decision-making I initially thought to use a PEST analysis tool. It is an acronym for Political, Economic, Social and Technological factors. My problem area had to deal with environmental factors as well along with other PEST factors. Since the

environmental factors could not be covered with the standard PEST tool therefore extended variation of PEST namely STEEP will be used.

STEEP analysis is used to understand the Indian market trend (growth or decline) and business potential in Green building business. It helps in understanding the "big picture" of the green constructions business environment, the opportunities and threats that lie within it.

The macroeconomic factors encapsulated in the STEEP model are:

- Social
- Technological
- Economical
- Environmental
- Political

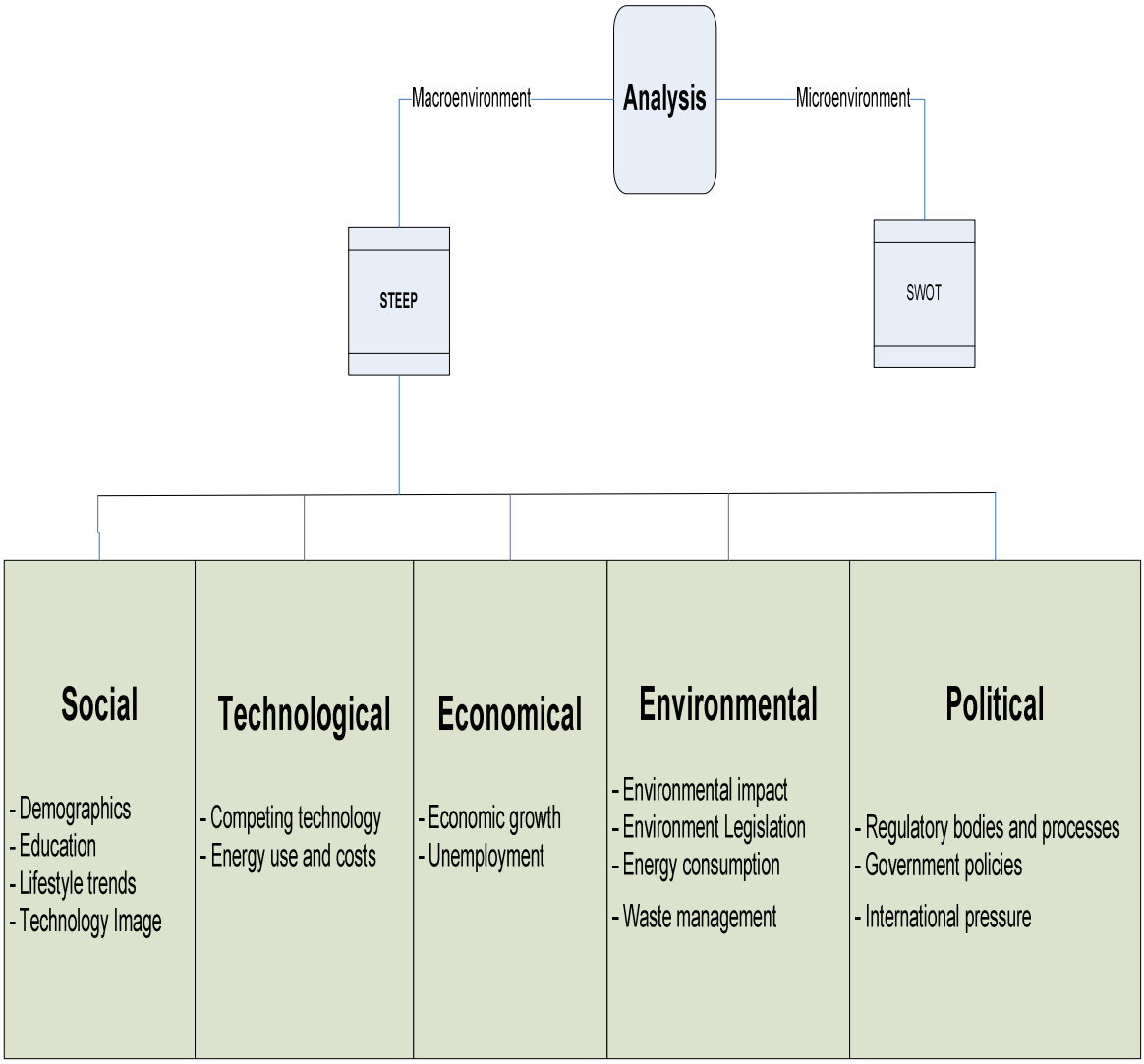

Figure 7: WBS for Macro environment analysis

It is important to note that STEEP analysis is done from the viewpoint of Nordic companies interested to get into green building business in India. (Figure 7)

Social Factors: These factors often look at the cultural and demographic aspects and have effect on the customer needs and size of potential markets.

Technological Factors: Technology is a major driver of globalization and its factors look at elements such as Research and development activity, automation, technology incentives and the rate of technological change.

Economic Factors: This includes factors such as economic growth, interest rates, exchange rates and inflation rate which affect the purchasing power of potential customers and the firm's cost of capital.

Environmental Factors: These include sections such as environmental impact, environmental legislation, energy consumption and waste disposal.

Political Factors: They include government regulations and legal issues which have a huge influence upon the regulation of businesses, spending power of consumers and other businesses.

Any form of pollution caused is a reflection of inefficiency which can be addressed in two different ways – One, treatment and compliance, which only adds to cost but does not add any value. The other aspect is to address the root cause of inefficiency and use it as an opportunity for resource conservation and reap economic benefits. Currently the transmission loss of electricity is about 35 % in India due to electricity thefts and lack of efficient technology. There are many sectors like construction, energy and water which lack efficiency and Indian Government should find and fix the root causes of inefficiency on handling the resources efficiently than wasting thousands of dollars in building new thermal power plants.

STEEP OF INDIA

STEEP - Social Factors

The social factors influencing the sustainable constructions in India are demographics, education, lifestyle trends and technology image.

Demographics: India is the second most populous country in the world after China. According to the Population Reference Bureau (PRB) India's population is growing at a rate of 1.6 % having a population of approximately 1.13 billion people (estimate for March 10, 2008) and will overcome China by 2050. (Population Reference Bureau, 2008) At the current rate the Indian urban population will increase to a total of 575 million persons by 2030. This transition to an urban society is faced with unbalanced growth causing high pollution levels. The Study conducted by the National Institute of Bank Management (NIBM) states that estimate of 68 million Indians (assuming average size of households consists of 3 people) will require independent housing in 2015. (Study of Residential housing demand in India- NIBM.2008) The increasing urban population would create a vast demand for constructions in India from residential to commercial sector. These constructions are part of the living environment and have affect on living conditions, social well-being and health of the local society. It is therefore important to explore environmentally and economically sound design and development techniques in order to design buildings and infrastructure that are sustainable, healthy and affordable. The need for the new constructions within environmental friendly framework generates the demand for green constructions in India.

Education: Education plays another key role in sustainability of environment and economical development. With the increasing awareness on the climate change the Indian societies are becoming more aware of environmental friendliness. Emerging middle class society is getting a better understanding that by adapting to the green building principles the negative impact on environment is reduced and helps them in saving operational costs. Furthermost, there is a healthy competition growing within cities to promote educational awareness of the environment. Peo-

ple are able to understand that by using eco-friendly constructions, the environment in which they live will be pollution free and will not stretch the natural resources to their peak. Several Governmental and Non-governmental organizations like LEED-INDIA, Teri-Griha and PEDA are involved in promotion of green constructions awareness from young to old population.

Gurcharan Singh from PEDA stated during an interview on 4th July 2008 that currently Punjab has not yet established a sound foundation in Green building business due to lack of awareness about such energy efficient buildings. The state would see a dramatic change in terms of sustainability development if Central Government would make the Energy Conservation Building Code compulsory. He also mentioned that Punjab and Haryana are well endowed with the abundant renewable energy supplies from biomass, water and sun but these supplies are not used efficiently. With the future vision of reducing dependency on the electric power grids the PEDA complex was set up at Chandigarh in 1991. The PEDA complex has solar passive design and reduces the demand for artificial lighting, cooling and heating. By reducing the electricity demand in the Northern regions of Punjab and Haryana the electricity could be distributed to the near by states like Rajasthan, Delhi, Jammu and Kashmir. PEDA's current role is also to promote awareness on energy efficiency through seminars, university and college visits. (Singh, Gurcharan.2008). The key questions asked during the interview can be seen in the Appendix 4.

Lifestyle trends: The increasing trend of the Indian inflation rate to 11 % in July 2008 results in the increased cost of living. Due to higher costs, people are looking for alternate sources for saving costs. The emerging middle class society which is widening their knowledge of eco-friendly principles will opt for green construction when they realize the potential long term savings from reducing operational costs. Indirectly, members of society are the stakeholders of sustainable development.

In India, poverty and environmental degradation are closely inter-related especially in the rural areas where natural resource base is the main source of liveli-

hood for the people. The survival needs of the poor force them to continue to degrade an already degraded environment. Elimination of poverty is therefore a prerequisite for environmental protection. Increased demand of green products in the construction market could also open new job opportunities in the rural areas. This would reduce the migration pressure on the urban cities and will provide employment opportunities in the rural areas of India.

There is also an increasing trend in the change of family lifestyle from joint families to nuclear families which means an increase in the need for more housing. This need for housing will create business opportunity for new residential constructions. Families adapting to green principles are also seen as proactive environmental friendly people and they gain more prestige in the educated Indian society. If the new residential constructions are built using the green principles in mind and cost effectiveness it would be easier to sell those constructions to the Indian society which is in the need for new homes.

Technology Image: This factor is observed from an international level in terms of image represented by the Indian companies to the foreign world. Most of the Indian companies irrespective of their line of business from IT (Information technology) to automobile industry are increasingly interested to promote a green brand image. Corporate India is steadily waking up to the benefits of green architecture including significantly lower running costs and a better brand image. Indian industries are increasingly acknowledging the benefits of green architecture from a cost management angle, as well as a corporate social responsibility angle. The buildings of the multinational companies which are lacking environmental friendliness principles are interested to join the race of transformation from conventional to green buildings. There is a healthy competition between multinational companies which is fuelling the demand for the green office spaces and therefore a big market for sustainable construction projects exists.

S**T**EEP **- Technological Factors**

Technology competence and energy use are the technological factors influencing the sustainable constructions in India. These factors are explained below.

Competition Technology: Currently, Indian building and construction industry is expanding driven by the increased needs from both the residential as well as commercial sectors. Emerging mega-projects, done by international consultants in India, and including Indian consultants/contractors in large international projects has led to the new combinations of materials, equipment and technologies in the Indian construction practices.

On the technological front India is currently lacking but is eager to expand their technical know how of sustainable and cost-effective building techniques by benchmarking them in international market. The less efficient industries continue to exist in India but they use almost twice energy to produce their product as compared to the most efficient industry.

Many of the construction processes in India are lacking standardization. New technological innovations, in sustainable construction would enable construction professionals in India to use a more organized and automated method in doing business. As part of the strategies for sustainable development of the construction industry in India, the new technologies for building materials should be environmental friendly, ecological appropriate, energy saving as well as be economical with respect to cost. For example, some of the improved technologies available in India are bamboo panels, bamboo reinforced concrete, masonry stub foundations, etc. But there is a need for enterprises which can provide integrated solutions. The new technologies should encapsulate green principles in order to contribute in reducing in the cost of construction and CO2 emission.

It is not compulsory for India to follow the conventional path of technology development with regard to constructions. The outdated technologies from the developed nations are often exported to India. Instead of using outdated technologies

which are new in the Indian market, more revolutionary technology options should be accessed in order to leapfrog and put the tools of modern technology to use. The method of co-operation between developing countries (India) and developed countries (like Europe, US) known as clean development mechanism (CDM) was provided in the Kyoto mechanisms which came into force in February 2005.(India country Report, USAID.2007) Under CDM (Clean Development Mechanism), developed nations assist India in setting up new technology that is eco-friendly, thereby helping developing country or its companies earn Certified Emission Reductions (CERs) in order to attain the norms for emission of gases.

Testimony to the fact that there is a rapid adoption of green technology in the construction sector in India can be observed from the replacement of outdated construction technology with new eco-friendly constructions with examples from upcoming airports in India to the new IT park construction projects.

Energy use: Modern constructions in Indian cities have high levels of energy consumption because of high requirements of air-conditioning and lighting in different climatic zones of India. The Energy Research Institute (TERI) stated during the Sustainable Development Summit that domestic and commercial buildings account for more than 30% of annual electricity consumption in India with air-conditioning and lighting being the most energy consuming end-uses in the building sector. (TERI/MoeF SUMMIT 2006, 1]

The electricity-supply is mainly owned and operated by the public sector at the state and central government levels. Currently, the Central government is also responsible for interstate exchanges. At the state level, State electricity branches (SEBs) own and provide single-state transmission and distribution systems.

Over the past decades the price for the conventional sources of energy like oil and gas has been increasing which stretches the financial budget for the Indian government. India imports around 1.4 million barrels of oil per day, 60 per cent of its total needs. This dependency on oil is projected to grow to 85 per cent by 2010 and to over 90 per cent by 2020. (Kreith, F. & Goswami Yogi, 1- 4) The Indian

states are currently running a growing risk of bankruptcy. The rising price in the electricity generation combined with the vast energy supply gap, has made Indian government to think about alternative solutions. It is important to note, that in order to face increasing investment needs, the central government is continuously focusing on attracting private investment.

The Indian government understands that the energy gap cannot be covered only by setting up new thermal / nuclear plants, but instead more emphasis needs to be given on improving efficiency of managing energy. This can be done by reducing transmission losses, reducing energy consumption in buildings by promoting green designs in constructions which are much more energy efficient than the conventional buildings. By doing so, the Indian government is able to reduce carbon emissions, commit to the environment, and decrease energy utilization which in turn reduces operating costs of the government.

The focus is to promote such sustainable green constructions which will be self sufficient to meet their electricity needs and will not increase load on the transmission grid.

STEEP **- Economic factors**

Economic growth and unemployment are the economic factors which have direct or indirect influence on promoting and implementing sustainable constructions in India.

Economic Growth: India's economy has an increasing growth curve from the past several years. This in turn has reduced poverty to some extent but still its complete eradication is one of the major challenges for Indian government. India is the second fastest growing economy in the world with positive indicators such as a stable 8-9 per cent of annual growth due to rising foreign exchange reserves, booming capital market and expanding FDI inflows.

The boom in Indian economy affects the upward trend in the purchasing power of middle class. It creates an increasing demand in the real estate sector with a major stake comprising of the residential sector. The housing report (11^{th} Five year plan: 2007-12) from the Ministry of Housing and Urban Poverty Alleviation (MHUPA) indicates the housing requirement estimates to $100 billion by 2012. (Urban housing shortage report, 24)

Unemployment: The environmental procedures in India are stated under a Five Year Plan in connection with the Millennium development goals (MDG's) adopted by the United Nations (UN). (Uemura, T. 2005) These measures are intended to serve many purposes such as prevention of pollution, global warming and mitigation of poverty.

In the context of the Indian environmental issues, social issues, such as mitigation of poverty and economic developments are intervowen. By creating job opportunities in providing raw materials for Green buildings the poverty in the rural areas could be reduced.

Poverty can be eradicated by creating job opportunities in both rural and urban areas. Job opportunities in rural areas such as manufacturing of bamboo products manufacturing for Green buildings would provide a source of living to the rural population and make them capable enough to take care of their daily needs instead of cutting wood from the forests. In urban areas, sustainable constructions would create a vast demand for new jobs in the field of green business such as green building project engineers, on-site construction workers, contractors. Thus ample of job opportunities could be created starting from the processing of raw materials to creation of final solutions.

STE**E**P **- Environmental factors**

Factors such as Environmental impact, environmental legislation, energy consumption and waste management focus on the sustainability and corporate social responsibility.

Environmental Impact: In India the constructions have been ongoing without giving much attention on environmental issues which has resulted in pressure on its finite natural resources apart from having influence on the human health and well-being. Unplanned and unsustainable urban development has lead to severe environmental pressures. The forests and ground water resources have been severely depleted to give way to new constructions in the urban areas.

At this era India is already suffering from several environmental problems related directly or indirectly to the construction industry such as waste management system, scarcity of ground water, energy crisis, and air pollution. The Indian government has started to realize that those problems related to constructions cannot be resolved without going to the root cause. The green construction trend is maturing in India in order to reduce building footprints on the environment and on the finite resources of the planet. Improvements in building life cycle are needed for example by carefully selecting materials and technologies it is possible to significantly reduce emissions. A construction made from bricks has low environmental impact than heavy use of cement and steel as in conventional buildings. (Figure 8)

Material	Unit	CO_2 emission (kg)
Steel	1 t	3000
Cement	1 t	900
Brick	1000 nos	380

Figure 8: Carbon dioxide emissions from building materials. Source: Sengupta, N. 2008. [Retrieved 13.10.08] Available at: http://www.ias.ac.in/currsci/jan102008/38.pdf

Environmental Legislation: Currently India is encountering several environmental problems such as deforestation, soil erosion, ground water depletion, soil and water contamination in certain areas and air pollution. Apart from addressing

the local environmental problems, India has also to cope with the environmental concerns at a global level such as global warming and ozone layer depletion.

The Environment Protection Act (EPA) is an umbrella legislation that sets standards covering a wide spectrum of resources and sectors, ranging from management of hazardous wastes to disposal of radioactive waste.

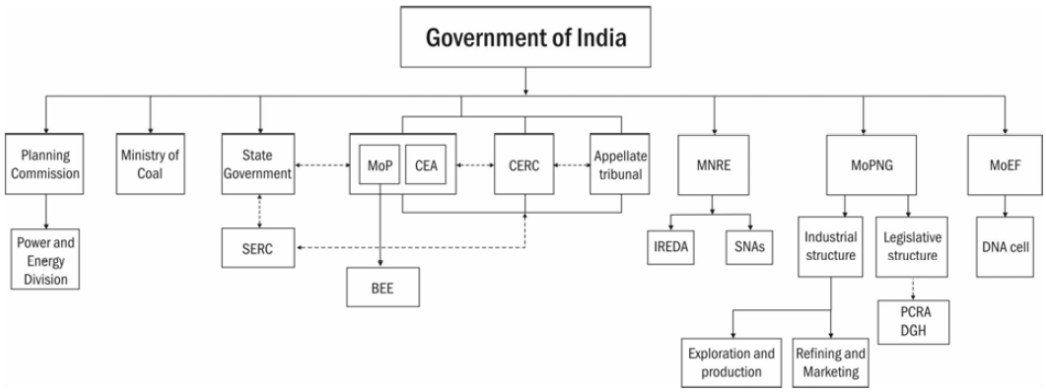

Figure 9: Nodal Ministries under Government of India. Source: India country Report, USAID.2007. [Retrieved 18.10.08] Available at http://usaid.eco-asia.org/programs/cdcp/reports/annexes/Annex%202_India.pdf

The Ministry of Environment and Forests (MoEF) is the nodal agency in India which is responsible for planning, promotion, coordination and overseeing the implementation of environmental and forestry programs. It acts as a focal point for all climate change activities in India and the Global Environmental Facility (GEF). (Figure 9)

The MoEF's "Environment Clearance (EC) process" is the only process available in India to understand environmental and social impacts of development projects/activities. This process is governed by the Environment Impact Assessment (EIA) notification under the Environment Protection Act (EPA).

The Environmental Impact Assessment (EIA) is one of the sustainable development (SD) monitoring tools used to ensure sustainable development into the new

construction projects with legitimate public participation and optimal resource consumption practices. It has a positive impact in ensuring economic development without compromising environmental and social costs.

Several initiatives have been taken by the Indian central and state governments in order to push construction industry to design, develop and operate sustainable buildings. The MoEF has mandated environmental clearance (EC) for all large construction projects above a certain size and cost. In order to achieve environmental clearance (EC) the new projects need to adopt environment friendly measures and techniques as mention in the MoEF's Environmental Impact Assessment Notification", 1994 applied on 7th July 2004. All new construction projects like townships, settlement colonies, commercial complexes, hospitals, industrial estates, and office complexes above a certain size would need to obtain prior environmental clearance (EC) from the Central Government before starting any construction on the new project.

Energy consumption: The major challenge which India's energy sector is facing today is to explore a sufficient amount of supply in order to keep pace with the rising clean energy demand. According to the India country report prepared for the United States Agency for International Development (USAID) the efforts to enhance domestic energy production and diversify fuel mix are not satisfactory. India still faces energy and peak shortages of around 12 % and large part of the rural population continues to lack access to clean and efficient energy fuels to meet their daily requirements.

The National Building Code of India (NBC) provides guidelines for regulating building constructions across India and serves encapsulation administrative regulations, development control rules and general building requirements, fire safety requirements, stipulations regarding materials, structural design and construction (including safety), and building and plumbing services. (NBC, 2005)

The Energy Conservation Act 2001 facilitates mandatory use of energy efficient building products and appliances, energy labeling for appliances and equipment,

adoption of energy conservation building codes, and testing and certification for energy consumption of equipment and appliances. This act gave Bureau of Energy Efficiency (BEE) the responsibility and authority to develop the Energy Conservation Building Code (ECBC) for India and to take suitable steps to set out energy conservation guidelines for Building Codes for each of the six climatic zones of India. The Bureau of Energy Efficiency (BEE) is a statutory body under Ministry of Power, established under the Energy Conservation Act 2001

The state government of Haryana in North India has mandated the use of energy efficiency measures and renewable energy measures (use of solar water heating system, efficient lighting, and design of energy efficient buildings) in government / government aided sector.

Pradeep Sharma, the Marketing Manager of Intersolar Systems Private Ltd highlighted that they are one of the largest manufacturers of solar energy equipments in North India. Apart from manufacturing their industry also prepares solar feasibility studies as part of consultation. He also highlighted that demand in solar cell fabrication technology which is not so easily available in India. (Sharma, Pradeep. 2008) The key questions asked during the interview can be seen in the Appendix 5.

Waste Management: India has decentralized and fragmented construction industry, involving various stakeholders engaged during the design, construction, equipment provision, installation, and renovation of buildings. Each division may be organized to some extent but with limited interaction among them which disables the integrated green design and application process.

Most of the electricity generated in North India is from thermal and hydro power stations. In Punjab itself there are three thermal power plants. The coal used in electricity generation is of low quality and causes air pollution with contents of fly-ash .The environmental impact of power-sector development is interrelated with sustainable constructions. Efficiency in the Indian economy is likely to improve with market development and increased adaptation of international frame-

works in various sectors. With reference fly ash management one of the MoEF notification on 27th august 2003 states that every construction agency involved construction buildings within a radius of fifty to one hundred kilometers from a coal based thermal power plant should use fly ash as raw material for bricks, cement fly ash etc. (Rajagopalan, V. 2003)

The EIA process helps in addressing various environmental aspects such as the management of municipal solid wastes. A clear understanding on handling of construction waste should be encapsulated in the EC process. Many new sustainable design rating standards such as Leadership in Energy and environmental design (LEED-India), Energy conservation building code (ECBC), The Energy Research Institute- Green Rating for Integrated Habitat Assessment (TERI–GRIHA) are coming up in the Indian market. Those rating systems are compatible with the local legislation and energy codes in order to promote sustainable future in the India's building sector by ensuring that the buildings consume minimal resources in its entire life cycle and leave behind minimal environmental footprint.

STEE**P** - Political Factors

International pressure has implications on the sustainability change in India from the viewpoint of political infrastructure including regulatory bodies, policies and processes. These factors are explained in detail below.

Regulatory bodies and processes: There are many organizations i.e. governmental, semi-governmental and private organizations involved directly or indirectly but for a common goal:

- Promoting and implementing awareness of Green buildings

Stakeholder analysis was used to identify and analyze the regulatory bodies and processes involved in Sustainable construction developments in India. (Figure 10)

These stakeholders are working at a national level in India and hence they are applicable at the state level as well. The presented stakeholders are the most important in the Indian continent because of following reasons

1) Policy advocacy
2) Consultation
3) Green buildings and products
4) Setting standards

Governmental and Semi- Governmental Organisation	Programme Stake	Implementation Framework	Requirements	Scope
Bureau of Energy Efficiency (BEE) / Ministry of Power (MOP)	Energy conservation Building Code (ECBC)	Voluntary	Connected load > = 500 KW	Energy Efficiency in commercial buildings
Ministry of environment and Forests (MoEF)	Environmental Clearance (EC)	Mandatory	Built up area: 20,000 to 150,000 metre square	Environmental Impact for commericial / Institutional buildings
Confederation of Indian Industry-Sohrabji Godrej Green Business Centre (CII-GBC)	Leadership in Energy and Environmental Design (LEED - INDIA)	Voluntary	N.A	Sustainable construction for Commercial / Institutional buildings
The Energy and Resources Institute (TERI)	The Energy and Resources Institute - Green Rating for Integrated Habitat Assessment (TERI GRIHA)	Voluntary	N.A	Sustainable construction for Commercial / Institutional buildings

Figure 10: Stakeholders in Sustainable construction business in India

Bureau of Energy Efficiency (BEE): It is a statutory body under Indian Ministry of Power (MOP) which cooperates with national and international private energy sector experts, non-government organizations (NGO's), research institutions and technical agencies. The main goal of BEE is to reduce the energy intensity and improve energy efficiency services in the country. It provides policies and roadmap to national energy conservation activities in terms of establishing framework for measuring and monitoring Energy Efficiency (EE) improvements. Some of the main contributions of BEE in promoting energy efficiency in constructions are National Energy Labeling Programme and ECBC. BEE organizes several awareness seminars, workshops in order to emphasize the importance of energy effi-

ciency in buildings. It is important to note that ECBC implementation is voluntary at the moment but according to the India country report prepared for the USAID it would be made compulsory by year 2009. (India country Report, USAID.2007)

Ministry of environment and Forests (MoEF) is a nodal agency under the Indian government structure which oversees all environmental matters in India. Its main tasks are to implement policies and programmes on environmental protection and is guided by the principles of sustainable development. Its mandatory environmental clearance process needs to be considered in case a Nordic industry plans to start with large construction projects above a certain dimensions. At the same time MoEF is also involved with CDM projects at an international level.

Confederation of Indian Industry-Sohrabji Godrej Green Business Centre (CII-GBC) is a joint initiative of the Andhra Pradesh state Government, Confederation of Indian Industry (CII) and Godrej Ltd. with the technical support of USAID. It established the non-profit council named Indian Green Building Council (IGBC) to introduce and promote the Green Building concept in the Indian market. Its presence in India can be seen from the involvement in various services of green business such as consultancy, training, patent support, developing green technologies and green building rating system. Leadership in energy and environmental design – India is a rating system established by IGBC which comprises of tailored approach from the international LEED standards in order to meet the Indian climatic zone requirements along with the local legislations.

The Energy and Research Institution (TERI) is another pioneering, non-profit, scientific and policy research organization with global vision, but working with the goal of migrating Indian society towards a more sustainable future. It focuses on issues related to energy, environment and sustainable development. With response to the sustainable developments, it introduced a voluntary Green building rating system called TERI-GRIHA (Green Rating for Integrated Habitat Assessment). This rating system is in synchronization with the local codes, climatic divisions and other local standards and laws.

Stakeholder Mapping of Political Situation in India: After brainstorming and understanding the important stakeholders in the Green building business in India they were prioritized by power and interest on the Grid Map (Figure 11). 'Interest' measures the scale by which the stakeholders could be influenced by the degree of interest or concern in the Indian sustainable construction programmes including policies. 'Power' measures the influence which stakeholder's possess over the sustainable constructions programmes encapsulating policy frameworks.

MoEF- environmental clearance (EC) programme has high power, and its interests are aligned with the sustainable developments. It is a governmental organization fully engaged in creating policy change and decision-making.

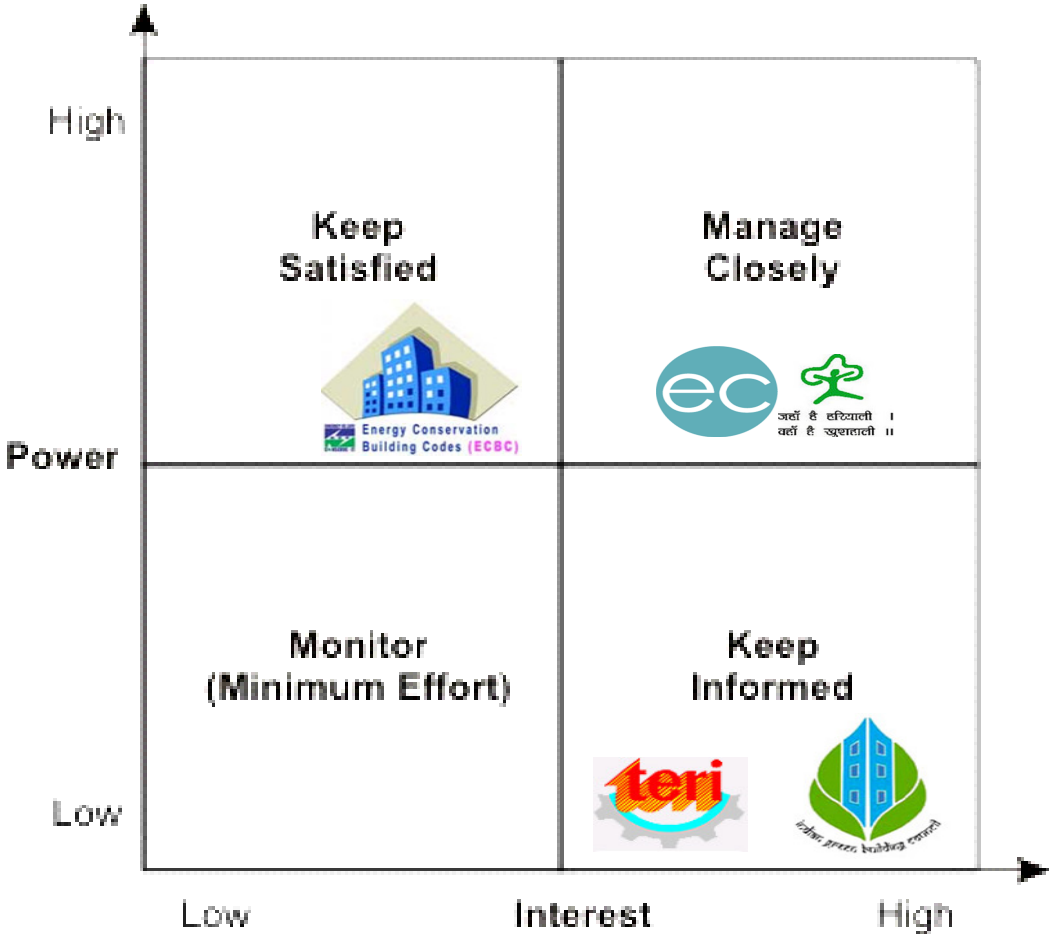

Figure 11: Power / Interest Matrix on Sustainable development programmes in India

BEE- Energy Conservation Building Code (ECBC) belongs to high power but low interested group and its level of interest in the strategies of the Indian governmental organization is low. BEE is kept satisfied and ideally brought into picture as patron or supporters for the proposed policy change.

TERI- GRIHA and LEED-India are the stakeholders with high interest but low power but they can influence the more powerful stakeholders like providing guidance to the Indian government on policy advocacy.

Policies: Indian government supports foreign investments in India through its policies and other supportive frameworks. There is not a single document in the Indian legislation that states all the policies relevant to sustainable constructions. The most relevant policies concerned in the study are National Electricity Policy and Foreign Direct Investment Policy because of their implications for the Green building business potential in India.

The National Electricity Policy was notified by the Central Government of India in compliance with section 3 of the Electricity Act 2003. The main objectives of this policy were to provide electricity access to all households, providing rural electrification and meeting the energy gap by 2012. Indian government needs to improve energy efficiency in the buildings in order to meet the energy gap. (NEP.2005, 1)

Foreign Direct Investment (FDI) policy permits foreign investments up to 100 % from Non resident Indian (NRI) investor without prior approval in the construction development projects under automatic route which requires no prior approval from the Government or the Reserve Bank of India (RBI). In order to attract foreign investments tax holidays are given to new industrial and residential construction projects. These tax holidays are applicable also in the special economy zones (SEZ) construction projects. FDI policy is reviewed on an ongoing basis. (FDI.2006, 41, 44, 58)

International Pressure: Climate change is a global challenge and cannot be resolved by any single nation. India is engaging proactively in the multilateral negotiations with the UN framework convention on climate change (UNFCCC) with objective to establish an effective, cooperative and equitable global approach.

The Kyoto Protocol is a legally binding agreement regulated by international treaty linked to the UNFCCC which focuses on reducing emissions that cause climate change. in India, the environmental actions are addressed under a five-year plan in connection with the Millennium Development Goals (MDGs) adopted by the United Nations (Figure 12). These measures are intended to serve multi purpose local problems such as prevention of pollution, global warming and mitigation of poverty

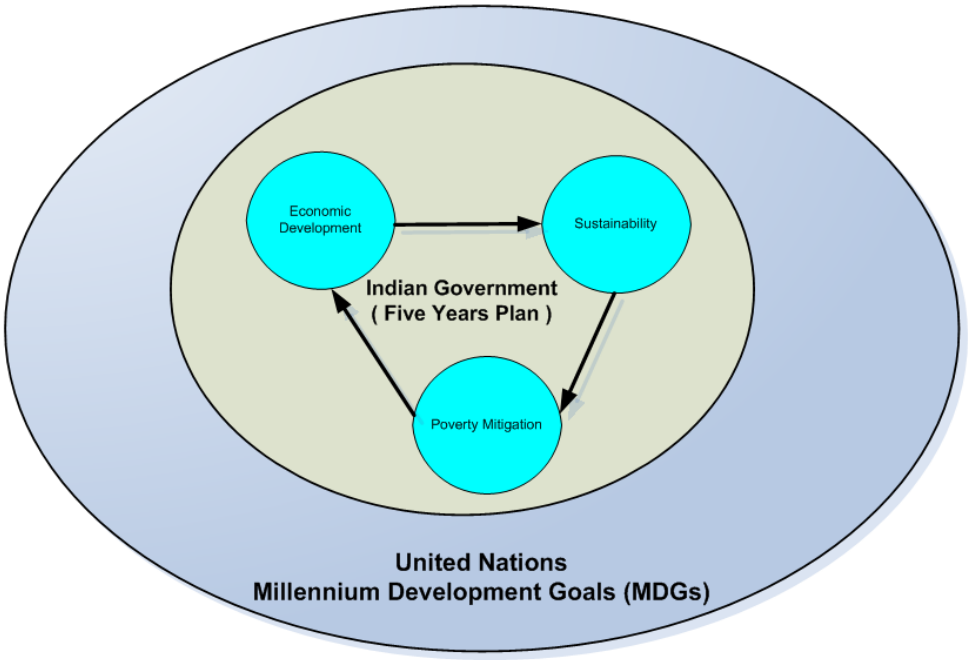

Figure 12: MDG and India's Five year plan relationship

In response to International pressure on the climate change "India's National Action Plan on Climate Change" was released on 30th June 2008. (National Action plan on Climate Change, 4-8).It incorporates India's vision of sustainable development, mitigation of global warming. The National Action Plan focuses on following eight priority missions:

1. Solar Energy
2. Enhanced Energy Efficiency
3. Sustainable Habitat
4. Conserving Water
5. Sustaining the Himalayan Ecosystem
6. A “Green India”
7. Sustainable agriculture
8. Strategic Knowledge Platform for Climate Change

3.2 Approach to understanding Micro environment

To get a clear view on the available options, it is useful to list all the strengths, weaknesses, opportunities and threats of doing environmental friendly construction business in India. In my research work STEEP analysis is used as an input to the SWOT analysis.

The SWOT analysis is an important component of strategic development that helps in identifying the internal and external factors that are favorable and unfavorable in achieving the objective of doing environmental friendly construction business in India. SWOT analysis helps businesses to be successful by focusing on their overall business environment and spot and exploit new opportunities faster than competitors.

All the strengths, weaknesses, opportunities and threats of doing Green building business listed in the SWOT analysis will be placed into confrontation matrix for understanding the different combinations.

Confrontation matrix or expended SWOT analysis is useful for getting an idea about new strategies from information we already have from the SWOT analysis. It is made by combining the strengths, weaknesses, opportunities and threats of a product (Figure 13).

Strengths

S.1 Emerging market: India is an emerging market with the growing economy. The Indian continent is migrating to energy efficient solutions for construction developments in order to meet the future energy and water needs.

S.2 Policy and legislative support: Indian government is continuously updating the laws and policies in order to migrate to more environmental friendly world. Many new programmes and laws are revised in order to improve efficiency in the construction sector and reduce energy losses.

S.3 Middle class and Non-Resident Indians having purchasing potential: With the increase in the Business Process Outsourcing (BPO) jobs to India, the salary levels of the middle class society have grown. Simultaneously people from the Indian origin but living abroad have good capital for investment in India. Real estate sector is one of the favorable sectors for NRI's and the local Indians to invest for long term savings.

S.4 Tax holiday under FDI policies and in special economic zones: Currently FDI policy allows 100% direct investment in the Real Estate sector for Non Resident Indians.

Weaknesses

W.1 Gaps in Indian governmental policies: The policies made by the Indian government is not necessarily implemented. There is possibil ity that some policies exist only in papers but are not implemented in practice.

W.2 Lack of interest by local builders: The local builders in India could lack interest in learning new technologies such as computer aided

simulation models.

W.3 Lack of educational awareness on environmental issues: Benefits of building energy efficient constructions are known only to limited amount of people in India.

W.4 Myth about costs for constructing environmental friendly construc tions: As the energy efficient construction is quite a new concept in India, people have mixed feelings and assume that the cost of these buildings are higher than conventional buildings.

W.5 Diverse construction activities stakeholders: Building activities in India involves different stakeholders throughout the entire building construction process. The local architects are interested only in the short term benefits and are not much interested in the operational savings of the residential who will come to live in the newly con structed buildings.

Opportunities

O.1 Energy Gap in the demand and supply: Currently many parts of India suffer from electricity breakdown throughout many parts of India. About one fifth of the energy is consumed in operating and maintain ing buildings in India. The Indian government is struggling to explore different options to meet the energy gap and meet the future needs.

O.2 Lack of availability of green building solutions: Lack of modern technology solutions for energy efficient buildings such as Build ing Integrated Photo Voltaic (BIPV) creates a business opportunity in providing those solutions.

O.3 Need for a complete solution as a package for installation: An inte grated approach and governance is lacking in the process for con structing buildings. This creates an opportunity for consultation and

audit industries to provide the solution.

O.4 Emerging middle class in India which requires housing: As the population of India continues to grow there is a need to meet the emerging housing needs. The immigrated population from the rural to urban areas and migrated population from the neighboring countries like Bangladesh and Nepal increases pressure on the housing needs. This creates a vast business potential in the residential real estate sector.

O.5 Changing lifestyle from joint to nuclear family which adds to emerging housing needs. Because of the lifestyle changes from joint to nu -clear family style in India there is need for new homes which adds to the business potential in the residential real estate sector of India.

O.6 Need for cost effective houses to save long term operational costs: As the Indian society is becoming more and educated they understand that by investing in the energy efficient constructions they could reduce their electricity and water bills.

O.7 Possibility for utilizing 365 days of solar energy: India enjoys ample of sunshine which could be utilized efficiently in the energy efficient constructions. This would make the buildings self efficient in meeting their energy requirements and reduce the dependency on the electric grid.

O.8 Urge for representing green image in many sectors like IT parks: The corporate businesses in India want to give themselves a green outlook in order to attract foreign investors. As the outsourcing continues to grow in India there is a need for more office space and more IT parks in the future

O.9 International pressure on India to reduce GHG's emissions by im

-proving efficiency: Currently India is working at an international level to reduce carbon emissions through several Clean Development Mechanism (CDM) projects. Many new clean energy projects are already running in the Northern state of Punjab and the Indian government is working together with the United Nations through India's Five Year Plans. As India's National Plan on climate change launched in august 2008 focuses on promoting energy efficient buildings this would create a business potential for new eco-friendly and cost effective residential and commercial construction projects.

Threats

T.1 Instability in the Indian government: There is a possibility for changes in the policies and laws as the new government comes into rule. This could have some impact on the operation of the existing and new businesses.

T.2 Corruption: In some cases the approval process from the government and non- governmental offices could require a small payment as an easier way for legislative approval.

T.3 Competition from other countries such as Germany and U.S for get ting into Indian market: The clean energy sector is an attractive and profitable sector in India. The regulatory frameworks are updated continuously to attract foreign investment. The Finnish companies could face competition from US and German companies which have already made their base in India.

T.4 Economic situation: Some downfall could be seen in the construction business in case the Indian economy tends to fall over the passage of the time. This in turn could affect the buying potential of the Indian people.

T.5 Global crisis impact: Due to the global credit crunch, India could suf

fer economic downfall which has effects on the local businesses and has impact on the buying potential of the people.

T.6 Cost of Energy efficient buildings: In case the energy efficient building costs double than a conventional building it could be challenging to sell the solution to the local residents.

3.2.1 Confrontation Matrix

The confrontation matrix gives an insight on how the organizations should position themselves in the Indian market and with its product. From the confrontation matrix four strategies can be found; the attack strategy, the defense strategy, the strengthening strategy and the withdrawal strategy.

The following combinations could be made within the matrix:

Strength and opportunity (Offensive/Attack strategy): Intersecting strengths and opportunities we can find how strength can be used to participate in an opportunity.

Strength and threat (Defense/Reactive strategy): Intersecting strengths and threats we can find how strength can be used to defend ourselves from a threat.

Weakness and opportunity (Adjust / Strengthening strategy): Intersection of weakness and opportunity will help in exploring how a weakness can be improved to avail an opportunity?

Weakness and threat (Withdrawal / Defensive strategy): Intersecting weakness and threats answers question on how a weakness can be improved to defend ourselves from a threat.

ANALYSIS	**OPPORTUNITIES:** **O1**: Energy Gap in demand and supply. **O2**: Lack of availability of green building solutions. **O3**: Need for complete solution as a package for installation. **O6**: Need for cost effective houses to save long term operational costs. **O7**: Possibility of utilizing 365 days of solar energy.	**THREATS:** **T3**: Competition from other countries such as Germany and U.S for getting into Indian market. **T4:** Economic Situation **T5:** Global Crisis impact
STRENGTHS: **S1**: Emerging Market **S2**: Policy and legislative Support. **S3**: Middle class and Non-Resident Indians having purchasing potential **S4**: Tax holiday under FDI policies and in special economic zones.	**OFFENSIVE STRATEGY:** **O1,O2,O7,S1,S2**: Intensive brand Promotion for providing energy efficient solutions for sustainable constructions.	**REACTIVE STRATEGY:** **T3,S3,S4**: Excellence in Cost effective Solutions.
WEAKNESSES: **W2**: Lack of interest by local builders **W3**: Lack of educational awareness on environmental issues. **W4**: Myth about costs for constructing green buildings. **W5**: Diverse construction activities stakeholders.	**ADJUST STRATEGY:** **O3,O6,W2,W3,W4**: Investing in setting up demo Project for all in one Installed Cost effective solutions.	**DEFENSIVE STRATEGY:** **T3,T4,T5,W2,W3,W5**: Green Construction principle to be communicated to all stakeholders involved during construction life cycle of the building.

Figure 13: Confrontation Matrix

4 APPROACH

To achieve the collective objectives of energy security and combating climate change, sustainable buildings or ‘green buildings’ should be considered as a long term solution for India’s new constructions.. In order to attain sustainability the construction sector needs to adopt the green practices into the industry which would not only benefit the builders but the society also.

4.1 The need for Green Buildings

When India is already facing environmental crisis it is essential that the resources are utilized wisely, emissions are reduced and waste management systems are more efficient. By adopting green construction principles in the construction industry the dependency on the resources would be reduced and thus protecting them from being overstretched.

The following subsections provide a better overview in understanding the role played by Green buildings in order to assist in mitigation of environmental problems in India.

4.1.1 Energy gap

Modern buildings in the Indian cities consume high levels of energy whereas the production capacity is much lower and thus leads to the energy gap.

New constructions with green building principles can save up to about 30 to 40 % of energy by appropriate design interventions in building envelope, lighting and air-conditioning system. Energy efficient and environment conscious building

design is essentially an integrated approach towards sustainable development for India.

It is also worth observing the Gazettes of Punjab and Haryana state governments to shape their policy frameworks towards promoting the use of energy efficient buildings in future. (Appendix 2, 3)

Green buildings not necessarily require heavy installation of air conditioners but instead use geo-thermal or insulation solutions to reduce reflection of outside heat to inside temperature. North India has good potential for bio and solar energy which can be effectively utilized to meet the energy loads in the buildings.

In general, energy efficiency in new Green buildings can be achieved through:

- Bioclimatic architectural principles.
- Load minimization by the using hybrid renewable energy systems such as solar and bio energy.
- Using energy efficient electrical gadgets.
- Utilizing energy efficient heating, ventilation and air conditioning (HVAC) systems in the buildings.
- Adapting solar passive techniques at the time of designing the building.
- Use of low energy materials and energy efficient methods of construction.

Thus the energy saving potential in the green building industry will not only relieve the load on the power sector to meet its demands but also help the society in reducing their electricity bills.

4.1.2 Air pollution

The source of pollution of air already begins before starting the construction of a building in where fossil fuels are consumed to manufacture the raw materials for buildings such as brick kilns and manufacturing process of cement in the industry. In addition to the installed air conditioners add to the carbon dioxide emissions. Green building materials are manufactured keeping eco-friendly principles in mind such as use of fly ash in manufacturing of cement and bricks would enormously have impact in reducing the load on the cement and brick industry and cut the emissions.

Similarly green building solutions such as geo-thermal air conditioner has negligible emissions and improve the indoor air quality of the buildings.

4.1.3 Water Scarcity

Studies and reports have shown that water tables in India are at alarming level. Some parts of India lack access to adequate water due to dry area or high pollutions levels in river and ground waters. This has an impact on the health of the society. Conventional buildings consume abundant quantities of water for operational use and the grey water is dispatched to rivers without giving a thought on re-usability.

Green buildings can bring benefits in conservation of water such as complete recycling of grey water. In terms of operational savings the Green buildings have potential to save 20-30 % more water than conventional buildings by using latest green products such as waterless urinals.

In order to secure water resources for the future, Indian government can't cope with the present path in demand for utilities.

4.1.4 Waste management

Solid construction wastes from the buildings reach dumping sites with negligible resource recovery. The construction waste comprises of various materials such as plastics, paper, glass and steel that can be recycled and reused.

Green buildings ensure that the waste is minimized at every stage during the construction and operation of the building. It make use of the recycled construction waste material like shuttering timber, paint cans, cement bags and thus results in lowering the costs. Bamboo based products are widely available in Himalayas and can be considered as good raw material for Green buildings in Punjab due to their easy availability.

The waste material from the thermal power stations can be used efficiently in manufacturing of building products like fly ash blocks, fly ash concrete, blended fly ash cement etc. By using fly ash products in upcoming Green constructions like airports, dams and stadiums there would be dramatic reduction in the energy costs, environmental pollution and waste.

4.1.5 Housing needs for emerging population

The boom in the urbanization and requirement for electricity has led to the need for self sustainable Green buildings and houses to meet the needs of the emerging middle class society. The concept is to have Green buildings which are not dependent at the conventional sources of energy and provide long term savings. During electricity breakdowns these buildings are not dependent on diesel generators which cause air pollution. India enjoys 365 days of sun which can be tapped to meet the electricity requirements in these buildings. By constructing new Green buildings for the emerging population needs there would be a significant drop in the amount of energy consumed for lighting, heating and cooling the building.

4.2 Solution: Green buildings for new developments

A green building can be interpreted in different parts of the world by different names such as energy efficient buildings, solar buildings or sustainable buildings.

4.2.1 What is a Green Building ?

A Green Building could be defined as one, which encompasses the use of clean energy, efficient use of water, use of recycled or recyclable materials and provides healthy indoor air quality. It can be understood as a holistic approach to construct and to integrate environmental friendly structure.

It makes the maximum possible use of natural light and relaxes utilization of energy and water. It uses industrial byproducts, emphasizes on recycling of waste water, harvesting of rain water, least use of air-conditioning, less production of carbon dioxide and tries to safeguard the environment in every possible way.

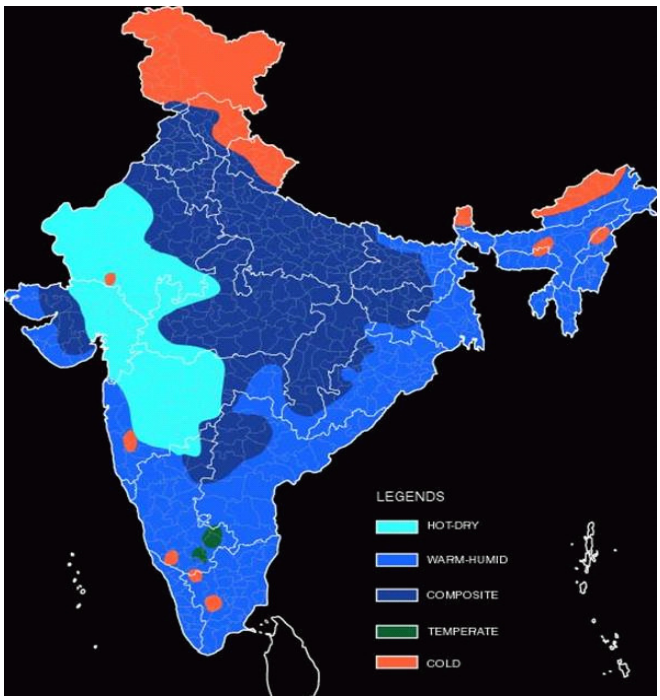

Figure 14: Diverse climatic zones found in India, 2005. Source: Bureau of Energy Efficiency [Retrieved 28.10.08] Available at http://www.bee-india.nic.in/sidelinks/ECBC/img/ClimateZone_India.jpg

India has five climatic zones which should be considered while planning to build / provide Green building solutions. (Figure 14)

The popularity of Green building is increasing in India as the society is becoming more and more aware of the operational savings and environmental friendliness. Carbon credits seek to encourage countries to reduce their greenhouse gas (GHG) emissions, as it rewards those countries that meet their targets and provides financial incentives to others to do so as quickly as possible. An increase in the number of Green buildings creates the potential for carbon credit trading under the Kyoto Protocol's Clean Development Mechanism.

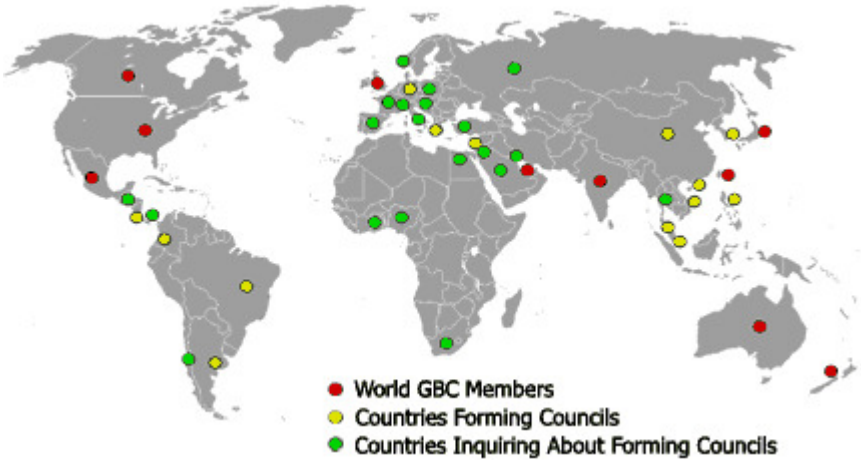

Figure 15: World Green Building Council Activity. Source: WGBC, 2007. [Retrieved 28.10.08] Available at http://earthtrends.wri.org/updates/node/232

The World Green Building Council (WGBC) is the leading international organization which sets the guidelines to promote green building and serves as an umbrella for national Green Building Councils consisting of member countries including Australia, Canada, Japan, United States, United Kingdom, India, Mexico, Argentina, Taiwan, Brazil, Germany and China (Figure 15).

4.2.2 Advantages of Green buildings

The key benefits which Green buildings provide are as follows:

Operational Savings: Green buildings can save about 30 to 40 % in operational costs. They consume 40-50 % less energy and 20-30 % less water as compared to a conventional building. There is an incremental cost of about 5-8 % which gets paid back in 3-5 years time. Use of recycled building materials saves 12 to 40 % of the total energy used during materials production. Energy efficient appliances create energy savings while reducing greenhouse gas emissions. (Srinivas, S.2006, 2)

Daylights & Views: Green buildings provide a healthy working environment consisting of daylight access and the views which together provide a soothing effect on the mind. Various studies prove that the productivity of people who have access to day lighting and views is 12-15 % higher. Strategic building design can maximize natural lighting and ventilation, which reduces energy needs and improves indoor air quality.

Air Quality: Green buildings provide more fresh and healthy atmosphere inside the building. The Green buildings use interior materials with low volatile organic compound (VOC) emissions. Using non-toxic paints, glues and building materials prevent additional environmental impact and high waste treatment / disposal costs during demolition.

Green corporate image: Nowadays multinational companies in India are putting 'going green' as their mission. By doing so they want to convey that are not lagging behind on environmental awareness.

4.2.3 Current situation of green building in India

The real estate sector in India is driven by many factors such as the growth of the middle class, rising foreign direct Investment (FDI) levels, easy availability of finance and increase in per-capita income. India has about 300 million people in the middle income group and about 260 million people living below poverty line in India. If Green Building technology could reach to them, the massive construction effort will form the backbone of Indian economy and help in combating climate change. Keeping the new constructions and climate change in mind the Green buildings would act as a long term solution to ripen the economic and environmental benefits. (President Kalam Abdul A.P.J, 2005)

The Indian green building council's website statistics show that India has currently 300 registered buildings and 34 certified buildings. It is expected that this number will rise considerably in coming years, but it is a very small number for India having a population of more than 1 billion. (Figure 16) There is a tremendous potential for construction of Green buildings in India with an estimated growth potential of 4000 Million USD by year 2012.

Year	Projected Certified Green Buildings (Nos. per year)	Estimated Market Potential in Million US$
2006	20	80
2007	50	200
2008	150	500
2012	1000	4000

Figure 16: Green buildings market potential. Source: Lakshmi, D. 2008. [Retrieved: 03.11.2008] Available at: http://www.igbc.in/igbc/mmbase/attachments/378/Green_Building_Materials_Potential_Oct_2006.pdf;jsessionid=0F2063A7DDC132358E8B0FF773B46E14

Increased inflow of investments due to flexible FDI policies is having a direct and positive impact on the real restate scenario of India. North Indian states of Haryana and Punjab are expected to get a major share of an estimated potential of

2,674,346 $ in real estate by 2010. Real estate in the North India is governed by the development authorities and the role of private developers has been insignificant. Haryana urban development association (HUDA) & Punjab urban development association (PUDA) are the major developers involved in real estate development in the North India

These states are increasing their interest in commercial sector development and this implies a potentially profitable business for the Green building construction industry if they are able to respond to this interest. Thus there would be ample of opportunities for several stakeholders like construction industry, architects, material and equipment manufacturers in meeting the demand for Green building constructions. The IT boom has also resulted in an investment from young age group with high-income jobs. Many have chosen real estate as an investment option. India produces an estimate of 2 million new graduates each year from various educational universities, creating demand for 100 million square feet of office and industrial space. (Real estate Portal for India, Indian Ground)

There is a large population of Indians who plan to settle in India after they complete their period in the US, Europe, Middle East and Africa. Lately there is a trend of Non-Resident Indians (NRI's) returning back to India because of better job opportunities especially in the IT sector. Those NRI's have developed a taste for a good, comfortable life and a high standard of living. Hence when they plan to return back to India they are interested in real estate investment which is environmental friendly as well as compatible with their previous standards of living.

It is also important to note, that the cost of green building materials and equipment is showing a decreasing trend as the green movement accelerates in India. For example, waterless urinals which used to cost around 287.95 $ in 2001 are nowadays available for 123.41 $ in the Indian market. The installed eco-friendly equipments in a building have impact to the final costs of an overall building. There is a decreasing trend in the incremental cost over the years which will continue and that day is not far when the cost of a green building is lower than a conventional build-

ing in India. The table below captures the typical payback period in the recently constructed Green buildings in India by IGBC. (Table 1)

Building	Built-in Area (Sqft)	Rating Achieved	% increase in cost	Payback (Yrs)
CII-Godrej GBC	20,000	Platinum (56 points)	20 %	7 years
ITC Green Centre, Gurgaon	1,70,000	Platinum (52 points)	15 %	6 years
Wipro, Gurgaon	1,75,000	Platinum (57 Points)	8 %	5 years
Grundfos Pumps, Chennai	40,000	Gold (42 Points)	6 %	3 years

Table 1: LEED-India certified buildings with Payback period. Source: Srinivas, S.2006. [Retrieved: 07.09.2008] Available at: http://www.igbc.in/igbc/mmbase/attachments/380/Green_Buildings_in_India_-

Constructing a green building is not an issue in India since there is abundant land outside the smaller towns and in rural areas. Constructing new buildings could be a challenge in the center of the cities because of scarcity of land. A green building costs about 2-15 % more than a conventional building, but the costs are recovered in the next 7-8 years. Table 1 illustrates the different Green buildings and the period of time required for the return on an investment to "repay" the sum of the original investment.

Figure 17: Various LEED Rated Green buildings in India. Source: Srinivas, S.2006. [Retrieved: 16.11.2008]. Available at: http://www.igbc.in/igbc/mmbase/attachments/380/Green_Buildings_in_India_-

The transformation from current constructions to Green buildings is challenging in India. Figure 17 demonstrates the various green building projects with LEED ratings carried out in India recently. There are two main reasons due to which it is not very feasible to convert existing buildings into green building. Those reasons are as follows:

Firstly, the typical criteria for a green building usually include energy, water, soil erosion and amenity, indoor air quality and material. It is really unrealistic for an existing building to adopt all five of those criteria when renovating a building.

Secondly, the conversion of an existing building is actually more expensive than new construction. The equipments used in Green buildings are different from conventional building and cannot be simply replaced. In nutshell conversion of a conventional building to green building requires changing the whole structure.

4.2.4 Business potential

The availability of Green Building materials & equipment is one of the major issues in India. To combat this challenge, the Green Business Centre (GBC) is networking with several manufacturers in India to create new markets.

A few green materials and equipment available in India are fly-ash cement, fly-ash block, recycled aluminum, recycled steel, recycled tiles, low volatile organic chemicals (VOC) paints, bamboo based products, Hydro fluorocarbons (HFC's) based high efficiency chillers, building controls, green roof and recycled wood.

Tremendous potential exists for materials & equipment like heat resistive paints, fly ash blocks, insulation materials, high efficiency chillers, variable frequency drives (VFD), high efficiency cooling towers, building management systems (BMS), lighting controls, BIPV (Building Integrated Photo Voltaic), wind towers, geothermal systems etc. (Table 2)

Green Building Materials & Equipment (Product-wise) Business Potential in India by 2010				
Sl No	**Materials & Equipment**	**Potential for Green Buildings Million US$ per year**	**Potential for Non Green Buildings per year in million USD**	**Total potential Million US $ per year**
	Select Materials			
1	Fly ash based blocks	90	810	900
2	Recycled flooring tiles	10	90	100
3	CRI Certified Carpet	10	90	100
4	Recycled materials for false	10	90	100
5	Low VOC Paints	10	90	100
6	Recycled Particle & Gypsum boards	10	90	100
7	Recycled Aluminum works	10	90	100
8	FSC Certified Wood	15	135	150
9	Energy efficient Windows	10	90	100
10	High performance Glazing & Glass	15	135	150
11	High Albedo roofing paints	10	90	100
12	Eco Friendly Modular	25	225	250
13	Bamboo Products	15	135	150
	Select Equipment			
1	HFC Based High Efficiency chillers	50	450	500
2	Variable Frequency Drives	10	90	100
3	Building Automation System	30	270	300
4	Solar PV	10	90	100
5	High efficiency light sources	10	90	100
6	Waterless Urinals	5	45	50
7	Composting toilets	5	45	50
8	Living machines	5	45	50
	Total	**365**	**3285**	**3650**

Table 2: Business potential in Green building solutions. Source: Lakshmi, D. 2008. [Retrieved: 16.11.2008]. Available at: http://www.igbc.in/igbc/mmbase/attachments/378/Green_Building_Materials_Potential_Oct_2006.pdf;jsessionid=0F2063A7DDC132358E8B0FF773B46E14

As the new technologies gains importance the business opportunity for these products and technologies in India is expected to cross 25 billion USD / annum by 2010.

There is a need for skilled professionals who have an understanding of green architecture and energy systems. Educational awareness is another important key factor in promoting sustainable developments through Green buildings in India. IGBC and state governments of Punjab and Haryana are involved in training and awareness programmes in the north zone of India. Energy simulation tools and techniques are used to design energy efficient buildings. The number of trained professionals with the knowledge capital on using those tools is scarce.

5 CONCLUSION AND RECOMMENDATIONS

The Green building can be thought of as the efficient and easiest solution to combat global warming.

The lifecycle of a building along with rising operational costs from energy and water consumption are the main concerns of an average middle class person. It is challenging for a middle class society to cope with rising operational cost trends. For India's growing middle class the green building can be considered as a sustainable and budget friendly investment for the long run.

The key drivers supporting the demand for residential construction in India are the demand-supply gap, improving affordability levels and availability of home loans. Apart from the residential sector there is demand for office space as more and more IT industries continue to grow due to emergence of India as a preferred outsourcing destination. According to industry estimates, the Indian real estate industry is expected to grow at a compounded rate of 33% between FY05 to FY10, mainly driven by the residential segment. Many constructions mushroom in India every year and environmental damage can be reduced if all buildings are green.

Ecologically sustainable lifestyles in India will cutback the green house gas emission and will meet the norms mentioned in the CDM protocol and India's National Action Plan on Climate change. Sustainable development involves cross-sectoral contribution from public, private, civil society, academia, funds and agencies. It

cannot be undertaken by single agency or Indian Ministry alone. Society's perception that the Indian government is only responsible to handle environmental issues is totally wrong. The public sector is responsible for setting the policies framework and targets on how to achieve them. Civil society should act as promoter of such approaches and represent society's voice. Once the sustabanility concept get's more matured and well communicated in the Indian society there would be a healthy competition between the states to develop and implement new green building projects. This would also dramatically increase the need for green building solutions in India.

Developers involved in the construction activities should be educated and made aware that their focus should be on long term goals rather than short term benefits. Government should make mandatory framework of policies and regulation in order to enforce the builders towards sustainable developments. The state governments of Punjab and Haryana should offer lesser developmental charges for developers and a rebate in property tax for the residents in order to go green.

The President of India A.P.J. Abdul Kalam's inaugural speech at `Green Building Congress 2005' reconfirmed the promotion of sustainable constructions for future India. "There are about 300 million people in the middle income group and about 260 million people are living below poverty line in India. If Green Building technology could reach to the emerging middle income population, the massive construction effort will form the backbone of Indian economy". (President Kalam Abdul A.P.J, 2005)

5.1 Possible Business opportunities from Finnish industries

Re- Energy solution for Green buildings: North Indian states of Punjab and Haryana have high potential for producing Bio, solar and hydro energy. Some of the Finnish industries into Re-energy solutions business are mentioned below with the possible business scope.

MW Power Oy is the joint venture of Metso Corporation's Heat & Power business and Wärtsilä's Biopower business. It provides the following Bio- energy solutions:

- BioEnergy thermal plants: BioEnergy plants are designed to meet the thermal energy needs of local industrial sites or municipalities, which often have a local supply of biofuels. The heat energy produced can take the form of steam or hot water or a combination of the two, as required. Figure 18 explains the variants of the BioEnergy plant to meet the industry specific needs.

	Thermal power (MW_{th})	Steam pressure (Bar)	Efficiency (%, LHV)
BioEnergy 3	3	10 or 16	85-90
BioEnergy 5	5	10 or 16	85-90
BioEnergy 8	8	10 or 16	85-90
BioEnergy 10	10	10 or 16	85-90
BioEnergy 12	12	10 or 16	85-90
BioEnergy 15	15	10 or 16	85-90
BioEnergy 17	17	10 or 16	85-90
With flue gas condenser			>100

Figure 18: Standard BioEnergy heating plants. Source: Bio-energy solutions from Wärtsilä. [Retrieved: 01.12.2008]. Available at: http://www.energy.rochester.edu/wartsila/bio_energy_solutions.pdf

North Indian states of Punjab and Haryana have abundant supplies of Bio mass which can be easily used as a fuel for the BioEnergy thermal plants. These energy plants from the Finnish companies can provide a tailored approach in producing hot water or steam according to the requirements of the local industries in the North India.

This solution is focused to meet the industrial needs and can be sold to the Punjab Energy Development Agency (PEDA) and Haryana Renewable Development Agency (HREDA) which can utilize this kind of plants to meet the needs of several Small and Medium Enterprises in the Industrial zones of Mohali and Chandigarh.

- BioPower CHP plants: These BioPower plants are designed and optimized for combined heat and power (CHP) production using biofuels. These plants, like the BioEnergy plants, incorporate patented BioGrate combustion with its high combustion efficiency and advantageous environmental features.

BioPower 2 CHP:			
Plant type	MW_e	MW_{th}	Heat parameters
BioPower 2 DH	1.7	7.7 MW	50 / 90 °C District heating water
BioPower 2 HW	1.3	8.0 MW	90 /115 °C Hot Water
BioPower 2 ST	1.0	11.5 t/h	4 bar
BioPower 5 CHP:			
Plant type	MW_e	MW_{th}	Heat parameters
BioPower 5 DH	3.5	13.0 MW	50 / 90 °C District heating water
BioPower 5 HW	2.9	13.5 MW	90 /115 °C Hot Water
BioPower 5 ST	2.3	20.5 t/h	4 bar
BioPower Condensing Plants:			
Plant type	MW_e	Steam parameters	Gross Efficiency
BioPower 2	2.3	23 bar / 450 °C	20%
BioPower 5	4.5	50 bar / 450 °C	23%

Figure 19: Standard BioPower Combined Heat and Power (CHP) plants. Source: Bio-energy solutions from Wärtsilä. [Retrieved: 01.12.2008] Available at: http://www.energy.rochester.edu/wartsila/bio_energy_solutions.pdf

The product range comprises of two basic plants, BioPower 2 and BioPower 5, each of which has four different thermal energy applications. (Figure 19)

The BioPower solution will meet the industrial and residential heat and power requirements. The solution can be sold to the Punjab Energy Development Agency (PEDA) and Haryana Renewable Development Agency (HREDA).

Those agencies act as an interface between the Finnish business representatives and the local clients in the states of Punjab and Haryana. The Combined Heat Plant (CHP) can provide sufficient energy to meet the requirements of the upcoming urban estates under the authorization of Punjab Urban Development Association (PUDA) and Haryana Urban Development Association (HUDA). Simultaneously the heat and power from the BioPower plant can be distributed to the industrial zones. This would help in

reducing the energy gap in North India and the access electricity could be diverted for rural electrification.

The local industries in North India are interested in this tailored energy and Heat solution because it helps them in increasing their productivity by reducing the electricity utilization in generating heat energy. In this way the Small and Medium Enterprises don't need to burn fossil fuels like charcoal, diesel separately in order to generate heat for producing hot water or steam. Overall this helps those small industries in reducing their pollution emissions resulting in meeting the pollution norms set by the State Governments.

The above mentioned solutions can be used for both the existing and new commercial and residential constructions in North India.

The Pöyry Energy business group provides integrated project management as well as consulting, advisory and engineering services for both the energy recovery of biofuels and waste and for the use of wind power, solar and geothermal energy.

As discussed earlier the North Indian states have good potential of biomass and solar energy. Pöyry can provide the integrated project management approach for new Green Building Real estate projects in order to provide a complete solution. Pöyry can provide Waste To Energy (WTE) solutions for generating clean energy by combustion of waste materials.

Engineering solution for Green Buildings: Finnish engineering products such as energy efficient Alternation Current (AC) drives could be installed in the green building which utilize less energy but provide the same level of energy service. This would reduce the dependency on conventional sources of energy and recover the existing energy gaps in India.

Vacon Oy is a leading supplier of variable speed AC drives. An AC drive often uses less energy than an alternative fixed speed mode of operation. Vacon can provide AC drives for electrical applications such as fans and pumps used in the Green building. This would help in increasing the electricity efficiency of the building by reducing the load on the electricity grid.

Kone Oy is a leading provider of the elevator and escalator equipments and services. It manufactures energy-efficient elevators and escalators typically suited for Green buildings. These elevators and escalators can be installed in new Green building construction projects in India to save electricity.

The upcoming shopping malls and IT office spaces in the Northern India are a good example where these elevators and escalators could be installed. Punjab Energy Development Agency (PEDA) and Haryana Renewable Energy Development Agency (HREDA) will work as interface between the Finnish Industry and the local construction projects in India , which are in need for such energy efficient products.

Energy Consultation / Audit: In order to succeed in the goal of achieving sustainability the consultation services could help North India in benchmarking standards and promoting use of energy and materials that are environmental friendly.

Motiva Oy provides expertise and project services to promote more efficient energy usage and to accelerate the renewable energy sources. There is a need for technology know-how in using computer aided building energy stimulation tools. The Finnish Industries can provide consultation in integrated project management solution for complete Green building construction process. Punjab Energy Development Agency (PEDA) and Haryana Renewable Energy Development Agency (HREDA) work in cooperation with Bureau of Energy Efficiency (BEE) to provide training to the Energy managers and construction architects. Finnish energy consultation companies could sell the expertise and project services to the different construction projects through the Bureau of Energy Efficiency (BEE).

Recommendations

As green building is a new solution for sustainable developments in North India it should be marketed by “Attack / Offensive “strategy.

From a macroeconomic viewpoint the key strategies for Finnish companies entering into the developing green building sector are briefly described below

Implementing the Regulatory and Institutional Framework: Apart from the mandatory environmental clearance process it is also worth considering the ECBC standards when planning to start green building project in India. At present ECBC compliance is voluntary but it is estimated that in year 2009 it will become mandatory. Thus from 2009 onwards building plans will not be approved by local authorities unless they comply with the ECBC.

Punjab Urban Development Agency (PEDA) can be considered as a good starting point for guidance and consultation on initiating the green building business in North India.

Promoting educational awareness as part of solution package: The scope for energy efficiency improvement in the construction sector is huge and growing as the north Indian region continues to develop rapidly. Finnish companies should include training and educational tool kit as part of delivering the product or solution. This will not only add value to the customer service but would also work as free advertisement in promoting your business solution from one doorstep to another.

All the necessary stakeholders involved in the project should be provided access to virtual online learning courses and tools so that they could be more efficient in terms of understanding the technology platform.

By knowing the regional /local climatic conditions the Finnish industries can focus their solutions specific to Northern part of India. Nordic companies should invest in North India because of the following key factors:

- **Real estate boom**: Real estate sector is one of the fastest growing sectors in North India and simultaneously helps in achieving goals of employment generation, economic development and human development. Investment in the real estate offers possibility of capital appreciation. Presently, up to 100 % of FDI has been approved under the automatic route for several built-up infrastructure and construction development projects

- **Become a Pioneer:** Since most of the foreign companies are currently operating in South India. North India has not been well known to the foreign world. Hence it could be good opportunity for the Nordic industries who would like to be the first ones in the state and become the leaders.

- **Policy initiatives**: The Government of Punjab is making several policy announcements on timely basis for attracting investments into the State. Recently Non Resident Indians (NRIs) and foreign investors can invest up to 100 % (FDI) in the Real Estate Sector for construction of built-up residential premises and commercial premises.

- **Purchasing potential of people**: Outsourcing is changing the face of commercial real estate in North India. There is an increasing trend in the number of call centers and other Business Process Outsourcing's (BPO) coming up in coming years. This in turn will increase the buying potential of people by. Furthermost the NRI planning to return back to India have handsome cash to invest for residential purpose or real estate investment.

Finnish companies could sponsor a "Green Buildings" trade shows/ seminars in order to familiarize the Finnish energy efficient products and other solutions for Green buildings. This will further create a new job market and opportunities in the rural and urban India for green building projects.

It is also worth noticing that the business opportunity not only in the Green buildings but also in business linked directly or indirectly to Green buildings such as Re-energy generation and waste management projects.

I strongly feel that the society should awake in understanding the long term impacts of the environmental issues. Society and politicians together should make every effort to promote use of sustainable developments so that we can diminish the emissions and safeguard the environment for future generations.

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ATTACHMENTS

1) LIST OF ABBREVIATIONS

BEE	Bureau of Energy Efficiency
BIPV	Building Integrated Photo Voltaic
BMS	Building Management Systems
BPO	Business Process Outsourcing
CEA	Central Electricity Authority
CER's	Certified Emission Reductions
CERC	Central Electricity Regulatory Com mision
CDM	Clean Development Mechanism
CFC's	Chlorofluorocarbon's
CII	Confederation of Indian Industries
CII-GBC	Confederation of Indian Industry-Sohrabji Godrej Green Business Centre
EC	Environment Clearance
ECBC	Energy Conservation Building Code
EE	Energy Efficiency
EIA	Environment Impact Assessment
EPA	Environment Protection Act
FDI	Foreign Direct Investment
GBC	Green Business Centre
GDI	Gross Domestic Income
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG's	Greenhouse Gases
HFC	Hydro fluorocarbons
HUDA	Haryana Urban Development Association
IGBC	Indian Green Building Council
IT	Information Technology

LEED	Leadership in Energy and Environmental Design
MOP	Ministry of Power
MDG's	Millennium Development Goals
MOEF	Ministry of Environment and Forests
MHUPA	Ministry of Housing and Urban Poverty Alleviation
NBC	National Building Code of India
NIBM	National Institute of Bank Management
NGO	Non-Government Organizations
NRI	Non-Resident Indians
PEDA	Punjab Energy Development Agency
PRB	Population Reference Bureau
PUDA	Punjab Urban Development Association
SD	Sustainable Developments
SEB	State Electricity Branches
SME's	Small and Medium Enterprises
SNA	State Nodal Agencies
TBL	Triple Bottom Line
TERI	TATA Energy Research Institute
TERI-GRIHA	TATA Energy Research Institute- Green Rating for Integrated Habitat Assessment
UN	United Nations
UNFCCC	UN framework convention on climate change
USAID	United States Agency for International Development
VFD	Variable Frequency Drives
VOC	Volatile Organic Compound
WGBC	WORLD GREEN BUILDING
COUNCIL	

2) HARYANA STATE GOVERNMENT GAZETTE

Regd. No. PB/0176/2003-2005

Haryana Government Gazette

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हरियाणा सरकार

अक्षय ऊर्जा विभाग

आदेश

दिनांक 29 जुलाई, 2005

संख्या 22/52/2005-5 विद्युत.—ऊर्जा संरक्षण अधिनियम, 2001 (2001 का 52), की धारा 18 द्वारा प्रदत्त शक्तियों का प्रयोग करते हुये, हरियाणा के राज्यपाल इसके द्वारा, हरियाणा राज्य में ऊर्जा के फलोत्पादक उपयोग तथा इसके संरक्षण के लिये निम्नलिखित निर्देश जारी करते हैं, अर्थात् :—

1. सौर जल तापीय प्रणाली का आज्ञापक उपयोग

1. सौर जल तापीय प्रणाली का उपयोग भवनों के निम्नलिखित प्रवर्गों में आज्ञापक होगा, अर्थात :—

(क) उद्योगों में जहां प्रसंस्करण के लिये गर्म पानी अपेक्षित है।

(ख) हस्पताल और नर्सिंग होम जिसमें सरकारी हस्पताल भी शामिल हैं।

(ग) होटल, मोटल और समारोह हाल।

(घ) जेल बैरक्रें और कैन्टीनें।

(ङ) समूह आवास समितियों/हाउसिंग बोर्ड द्वारा स्थापित हाउसिंग काम्पलेक्स।

(च) नगरपालिका समितियों/निगमों तथा हुडा के सैक्टरों की सीमा के भीतर आने वाले 500 वर्ग गज तथा इससे अधिक आकार के भूखंड पर निर्मित सभी आवासीय भवन।

(छ) सभी सरकारी भवनों, आवासीय निवासनों, शैक्षणिक महाविद्यालयों, होस्टलों, तकनीकी/व्यवसायिक शिक्षा संस्थानों, डिग्री शिक्षा एवं प्रशिक्षण संस्थान, पर्यटन काम्पलैक्सों तथा विश्वविद्यालय इत्यादि।

2. हरियाणा अक्षय ऊर्जा विकास अभिकरण (हरेडा) विशिष्टियों के अनुसार श्रेष्ठ रूप से डिजाईन किये गये उत्तम गुणवत्ता प्रणाली की स्थापना सुनिश्चित करने के लिये राज्य में सौर जल तापीय प्रणालियों की आपूर्ति तथा स्थापना के लिये अनुमोदित स्त्रोत के रूप में कार्य करेगा।

3. सभी सम्बन्धित विभाग जैसे नगर तथा ग्राम आयोजना विभाग, शहरी विकास विभाग, लोक निर्माण (भवन तथा सड़क) विभाग, आवास बोर्ड, जन-स्वास्थ्य विभाग और वास्तुकला विभाग आदेश जारी होने की तिथि से दो मास के भीतर सौर जल तापीय प्रणालियों का उपबंध करने के लिये अपने नियम उप-विधियां को संशोधित करेंगे।

Price : Rs. 5.00

4. ये विभाग राज्य सरकार के निर्णय को मोनिटर करने तथा लागू करने की प्रगति अक्षय ऊर्जा विभाग को निर्धारित प्रपत्र में त्रैमासिक आधार पर भेजने हेतु जिला एवं राज्य स्तर पर भी नोडल अधिकारी पदाभिहित करेंगे।

2. सरकारी भवनों/सरकारी सहायता प्राप्त संस्थानों/बोर्डों/निगमों में काम्पैक्ट फलोरोसैंट लैम्प (सी०एफ०एल०) का आज्ञापक उपयोग

1. सरकारी सैक्टर/सरकारी सहायता प्राप्त सैक्टर/बोर्ड तथा निगमों/स्वायत निकायों में सभी नये निर्मित सभी नये भवनों/संस्थानों में इन्कैंडेसैंट बल्बों के प्रयोग पर तुरन्त प्रभाव से प्रतिबन्ध किया जाता है।

2. यह आज्ञापक होगा कि विद्यमान भवनों में खराब इन्कैंडेसैंट बल्बों को जब बदला जाये तो केवल काम्पैक्ट फलोरोसैंट लैम्प (सी०एफ०एल०) से ही बदला जायेगा।

3. विद्युत उपयोगिता में, नये कनैक्शन अथवा नया लोड जारी/स्वीकृत करते समय पारंम्परिक बल्ब के स्थान पर सी.एफ.एल. के प्रयोग को बढ़ावा देने के लिये इस आदेश के जारी होने के दो महीने के भीतर लोड डिमांड नोटिस में आवश्यक उपांतरण करना होगा।

3. कृषि क्षेत्र में आई०एस०आई० मार्कड मोटर पम्प सैट, पावर कैपिसीटर, फुट/रिफलैक्स वाल्व का आज्ञापक उपयोग

1. सभी नये ट्यूबवैल कनैक्शनों के लिये आई०एस०आई० मार्कड पम्प सैट्स तथा एसैसरीज का उपयोग आज्ञापक होगा।

2. राज्य में केवल आई०एस०आई० मार्कड पम्प सैट्स का उपयोग सुनिश्चित करने के लिये इस आदेश के जारी होने के दो महीने के भीतर उत्तर हरियाणा बिजली वितरण निगम/दक्षिण हरियाणा बिजली वितरण निगम ट्यूबवैल कनैक्शनों के लोड डिमांड नोटिस में आवश्यक संशोधन करेगा।

4. ऊर्जा कुशल भवन डिज़ाईन को बढ़ावा देना

1. सरकारी/सरकारी सहायता प्राप्त क्षेत्र में निर्मित किये जाने वाले सभी नये भवनों में 30 जून, 2006 से ऊर्जा कुशल भवन निर्माण डिज़ाईन धारणा जिसमें अक्षय ऊर्जा तकनीक भी शामिल है, सम्मिलित करेंगे।

2. वास्तुकला विभाग भविष्य में सरकारी/सरकारी सहायता प्राप्त क्षेत्र में निर्मित किये जाने वाले सभी भवनों में ऊर्जा कुशल भवन निर्माण डिजाईन धारणा को सम्मिलित करना सुनिश्चित करेगा। वास्तुकला विभाग में सरकारी/सरकारी सहायता प्राप्त क्षेत्र निर्मित किये जाने वाले सभी नये भवनों की योजना/मानचित्रों की जांच करने तथा सुनिश्चित करने के लिये कि ऊर्जा कुशल भवन निर्माण डिजाईन धारणा की सभी विशेषताओं को इसमें सम्मिलित कर लिया गया के लिये एक समिति गठित की जायेगी।

3. वास्तुकला विभाग इन उपायों के समन्वय तथा मोनिटरिंग के लिये एक नोडल अधिकारी पदाभिहित करेगा जो निदेशक, अक्षय ऊर्जा विभाग को इस बारे में प्रगति की सूचना देगा।

इस मामले में पूर्व में जारी किये गये सभी आदेशों को अधिक्रमित करते हुये यह आदेश तुरन्त प्रभाव से लागू होंगे।

एस० सी० चौधरी,
वित्तायुक्त एवं प्रधान सचिव, हरियाणा सरकार,
अक्षय ऊर्जा विभाग।

HARYANA GOVERNMENT

RENEWABLE ENERGY DEPARTMENT

Order

The 29th July, 2005

No. 22/52/05-5P.—In exercise of the powers conferred by Section 18 of the Energy Conservation Act, 2001 (52 of 2001), the Governor of Haryana hereby issues the following directions for efficient use of energy and its conservation in the State of Haryana, namely :—

1. **Mandatory use of Solar Water Heating Systems**

1. The use of solar water heating systems will be mandatory in the following categories of buildings, namely :—

(i) Industries where hot water is required for processing.

(ii) Hospitals and Nursing homes including Government Hospitals.

(iii) Hotels, Motels and Banquet halls.

(iv) Jail Barracks, Canteens.

(v) Housing Complexes set up by-Group Housing Societies/Housing Boards.

(vi) All residential buildings built on a plot of size 500 square yards and above falling within the limits of municipal committees/corporations and Haryana Urban Development Authority sectors.

(vii) All Government buildings, Residential Schools, Educational Colleges, Hostels, Technical/Vocational Education Institutes, District Institutes of Education and Training, Tourism Complexes and Universities etc.

2. Haryana Renewable Energy Development Agency will act as an approved source for supply and installation of solar water heating systems in the State to ensure the installation of optimally designed quality systems as per the specifications.

3. All the line departments like Town and Country Planning Department, Urban Development Department, Public Works Department (Building and Roads), Housing Board, Public Health Department and Architecture Department will amend their rules/bye-laws within a period of two months from the date of issue of this order to make the use of solar water heating systems mandatory.

4. These departments will also designate a district and a state level nodal officer to monitor and report the progress of enforcement of the State Government decisions to the Department of Renewable Energy, Haryana on Quarterly basis in the prescribed format.

2. Mandatory use of Compact Fluorescent Lamp (CFL) in Government Buildings/Government Aided Institutions/Boards/Corporations

1. The use of incandescent lamps in all new buildings/institutions constructed in Government sector/ Government Aided sector/Board and Corporation/Autonomous bodies is banned with immediate effect.

2. It will be mandatory that in existing buildings the defective incandescent lamps when replaced, would be replaced by only compact fluorescent lamps (CFL).

3. Power utilities will affect necessary modification in the load demand notices within two months time from the date of issue of this order to promote the use of Compact Fluorescent Lamps instead of conventional bulbs while releasing/sanctioning new connections/loads.

3. Mandatory use of ISI marked Motor pump sets, Power capacitor, Foot/Reflex valves in Agriculture Sector

1. For all new tubewell connections, the use of ISI marked pump sets and accessories will be mandatory.

2. Uttar Haryana Bijli Vitran Nigam/Dakshin Haryana Bijli Vitran Nigam will make the amendments in the load demand notices for tubewell connections within two months time from the date of issue of this order to ensure use of ISI marked pumps in the State.

4. Promotion of Energy Efficient Building Design

1. All the new buildings to be constructed in the Government/Government Aided sector will incorporate energy efficient building design concepts including Renewable Energy Technologies with effect from 30th June, 2006.

2. The Architecture Department will ensure the incorporation of energy efficient building design concepts in all buildings to be constructed in future in the Government/Government Aided sector. A committee shall be formed in the Architecture Department to examine all new building plans/drawings to be constructed in the Government/ Government Aided sector to ensure that all the features of the energy efficient building design concepts, have been incorporated in these.

3. The Architecture Department will designate a nodal officer for coordination and monitoring of these measures who will report the progress in this regard to the Director, Renewable Energy Department, Haryana.

The above orders supersede all previous orders in this matter and come into force with immediate effect.

S. C. CHAUDHARY,
Financial Commissioner and Principal Secretary to
Government Haryana, Renewable Energy Department

3) PUNJAB STATE GOVERNMENT GAZETTE

[Extract from Punjab Government Gazette, dated the 17th March, 2006]

GOVERNMENT OF PUNJAB

DEPARTMENT OF SCIENCE, TECHNOLOGY, ENVIRONMENT AND NON-CONVENTIONAL ENERGY

Order

The 20th January/6th February, 2006

No. 2/123/05-STE(3)370.—In exercise of the power conferred by Section 18 of the Energy Conservation Act, 2001 (52 of 2001), the Governor of Punjab is pleased to issue the following directions for the efficient use of energy and its conservation in the State of Punjab namely :—

I. **Mandatory use of Solar Water Heating Systems :**

1. The use of BIS marked solar water heating systems will be mandatory in the following categories of buildings, namely :—
   (i) Industries where hot water is required for processing.
   (ii) Hospitals and Nursing Homes including Government Hospitals.
   (iii) Hotels, Motels and Banquet Halls.
   (iv) Jail Barracks, Canteens.
   (v) Housing Complexes set up by Group Housing Societies/Punjab Urban Development Authority.
   (vi) All residential buildings, built on a plot of size 500 square yards and above, falling within the limits of Municipal Committees/Corporations and Punjab Urban Planning and Development Authority sectors.
   (vii) All Government buildings, Residential Schools, Educational Colleges, Hostels, Technical/Vocational Education Institutes, District Institutes of Education and Training, Tourism Complexes and Universities etc.

2. Punjab Energy Development Agency will act as an approved source for supply and installation of solar water heating systems in the State to ensure the installation of optimally designed quality systems as per the BIS specifications.

3. All the line departments like Town and Country Planning Department, Urban Development Department, Public Works Department (Building and Roads), Punjab Urban Planning and Development Authority, Public Health Department and Architecture Department will amend their rules/bye-laws within a period of two months from the date of issue of this order to make the use of solar water heating systems mandatory.

4. These departments will also designate a district and a state level nodal officer to monitor and report the progress of enforcement of the State Government decisions to the Department of Science, Technology, Environment and Non-Conventional Energy Sources, Punjab, on Quarterly basis in the prescribed format.

II. **Mandatory use of Compact Fluorescent Lamps (CFLs) in Government Buildings/Government Aided Institutions/Boards/Corporations :**

1. The use of incandescent lamps in all new buildings/institutions constructed in Government Sector/Government Aided Sector/Board and Corporation/Autonomous Bodies is banned with immediate effect.

2. It will be mandatory that in existing buildings the defective incandescent lamps when replaced, would be replaced by only compact fluorescent lamps (CFL).

3. Power utilities will affect necessary modification in the load demand notices within two months time from the date of issue of this order to promote the use of Compact Fluorescent Lamps instead of conventional bulbs while releasing/sanctioning new connections/loads.

III. Mandatory use of BIS marked Motor pump sets, Power capacitor, Foot/Reflex valves in Agriculture Sector :

1. For all new tubewell connections, the use of BIS marked pump sets and accessories will be mandatory.

2. Punjab State Electricity Board will make the amendments in the load demand notices for tubewell connections within two months time from the date of issue of this order to ensure use of only BIS marked pumps in the State.

IV. Promotion of Energy Efficient Building Design :

1. All the new buildings to be constructed in Government/Government aided Sector will incorporate energy efficient buildings design concepts including Renewable Energy Technologies with immediate effect.

2. The Chief Architect, Punjab will ensure the incorporation of energy efficient building design concepts in all buildings to be constructed in future in the Government/Government aided Sector. A committee shall be constituted by the Chief Architect, Punjab to examine all existing and new building plans/drawings in Government/Government Aided Sector to ensure that all the features of the energy efficient building design concepts have been incorporated in these buildings.

3. The Chief Architect, Punjab will designate a nodal officer for co-ordination and monitoring of these measures who will send quarterly progress report to the Chief Executive, Punjab Energy Development Agency.

The above orders supersede all previous orders, if any, in this matter and shall come into force with immediate effect.

ROMILA DUBEY,

Principal Secretary, Science, Technology,
Environment and Non-Conventional Energy.

7452 CS (P)—Govt Press, U.T., Chd.

4) KEY QUESTIONS ASKED WHILE INTERVIEWING PEDA

- What is PEDA and its role in sustainable developments?
- How much is the green building concept familiar here in the North?
- Would PEDA be interested in foreign investments for energy efficient housing?
- What kind of role PEDA would play there in case a foreign company is interested in investment?
- Is government doing enough to promote energy efficiency in buildings?
- What's the reason behind focusing initially only to Public sector in promotion of energy efficient building designs?
- What kind of projects you have ongoing in the Real estate? If any?
- What are the challenges in setting energy efficient constructions?

5) KEY QUESTIONS ASKED WHILE INTERVIEWING THE INTER SOLAR SYSTEMS PRIVATE LIMITED.

- What kind of solutions does your company manufacture?
- What is the future prediction for the solar solutions into the market?
- What is the cost range of the products?
- Do we manufacture solar photovoltaic cells in India?
- Would your company be interested in Joint-venture projects?
- What is the influence of government policies on your business?
- Who are the major buyers of your products?