

**A Survey on- A Dive towards Low Carbon Building**

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**Abstract** — Climatic change brought about by man-made emissions of greenhouse gases have been identified as the greatest challenge facing human society at the beginning of the twenty-first century. Change in temperature not only increases levels of mercury in thermometer but also increases suffering level of human kind. To avoid effects of change in temperature we need to focus on reduction in carbon emission from construction sector as lots of CO<sub>2</sub> emission takes place through construction activities. Low carbon building is one of best solution to overcome the problem of environmental threats due to climate change. Low carbon building reduces carbon dioxide emissions by changing the ways in which buildings are designed, constructed, managed and used. So it is necessary to give proper attention towards low carbon building construction today for better future.

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**Keywords-** Climatic change, construction sector, Low Carbon building, Carbon emission

**I. INTRODUCTION**

Economic growth of India has been dramatic in last two decades where Urbanization, industrialization has given boost to construction industry which results in construction of many sky- scrapers. Shopping mall, roads and many infrastructure projects are built with innovative features. But in many cases environmental aspects are ignored which result in threats to environment.

Climate change brought about by man-made emissions of greenhouse gases that have been identified as the greatest challenge that human society is facing at the beginning of the twenty-first century. Concentration of greenhouse gases play major role in raising the earth's temperature. Global warming not only cause increase in mercury level of thermometer but also increase in sufferings of human life. Tackling of climate change requires concerted and focused action. This will include reduction in carbon dioxide emissions by changing the ways in which buildings are designed, constructed, managed and used. It is important to remember the wider context for action to address climate change. Even though building holds low carbon, they should also be sustainably designed, that is, they should be created with consideration of the wider, long-term environmental, social and economic aspects of sustainability.

The construction industry is one of the major sources of pollution in which construction-related activities emits large amount of CO<sub>2</sub>. Hence, contribution of the building industry to global warming can no longer be ignored. Generally, carbon emission in building takes place in five phases. The first phase consists of manufacturing of building materials and components and this is termed as embodied Carbon. The second and third phases correspond to the carbon emission during transport materials from production plants to the building site and the carbon emission during the actual construction of the building, fourthly, carbon emission takes place at the operational phase, which corresponds to the running of the building when it is occupied. Finally, carbon released in the demolition process of buildings as well as in the recycling of their parts, when this is promoted.

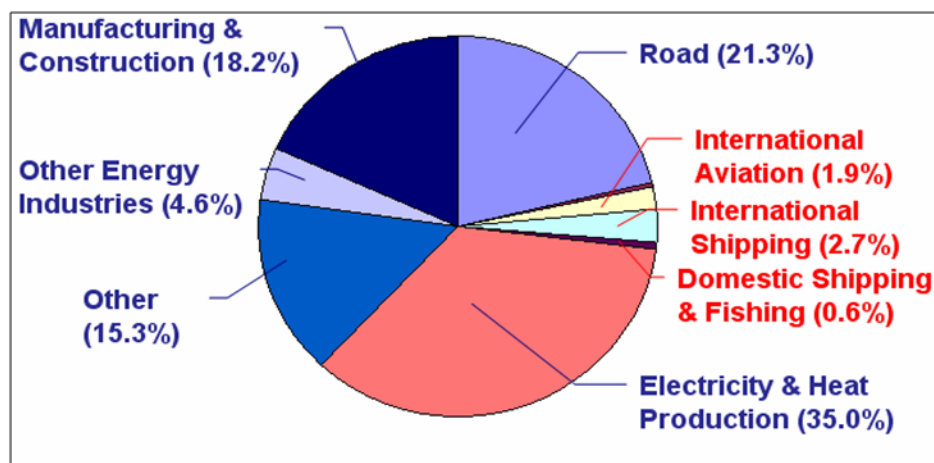
To overcome problem of emission of carbon due to construction, "Low Carbon Homes" concept come into flash. Low carbon building is nothing but the building which produces less carbon thorough its life. Therefore, there is need to work on designing buildings with low carbon emission by using low carbon emission material and natural sources.

The rest of the paper is organized as follows: section-2 describes the contribution of carbon emission by construction sector and the section-3 concentrates on carbon emission by building. The section-4 describes why India be concerned about climate change.

**II. CONTRIBUTION OF CARBON EMISSION BY CONSTRUCTION SECTOR**

The construction industry in India is worth over USD 51 billion (£28 billion) and accounts for more than 20% of GDP. India is the second most populous country in the world with 1.17 billion people and constitutes 16% of the world's population. Urban population has been grown significantly over the past decade. The organized real estate business in India is estimated at around £ 30 billion and is currently ranked 12th in the world, but is growing at a compounded annual growth rate (CAGR) of 30%. Due to consistency in high economic growth, a shortage of residential and commercial space, a booming retail industry and strong growth in industrial output, there is record level increase in activities and investments in this thriving sector.

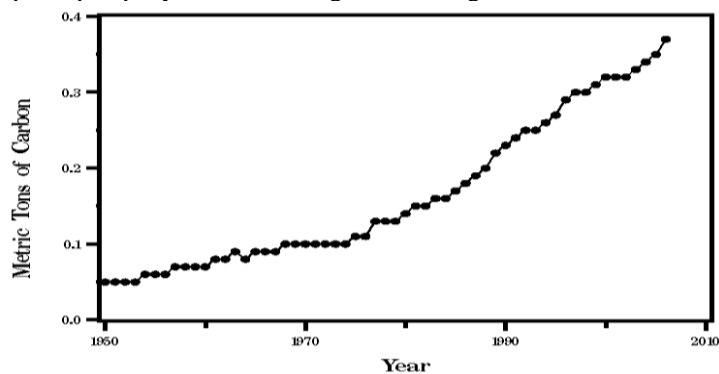
The building and construction sector is a key sector for sustainable development. Though they generate social and economic benefits to society, they may have severe negative impacts on the environment. The building and construction sector typically provides 5-10% of employment at national level and normally generates 5-15% of the GDP. It literally builds the foundations for sustainable development, including housing, workplace, public buildings and services, communications, energy, water and sanitary infrastructures. At the same time, the building and construction sector accounts for the largest share in the use of natural resources. Some of the examples of negative environmental impacts of this sector are energy use, liquid and solid waste generation, transportation of construction materials, and consumption of harmful materials etc. In OECD (Organization for Economic Cooperation and Development) countries, buildings are responsible for 25-40% of total energy use. In India, buildings account for 20-32% of energy consumption in society which contributes to release abundant amounts of carbon dioxide (CO<sub>2</sub>). The building sector thus offers the largest single potential for energy efficiency in India: more than one-fifth of the present energy consumption and up to tonnes of CO<sub>2</sub> per year could be saved by 2010 by applying more ambitious standards to new and existing buildings. A number of national and international initiatives and efforts have been developed by the building and construction sector itself to promote more sustainable buildings. A number of national and international initiatives and efforts have been developed by the building and construction sector itself to promote more sustainable buildings. Following fig-1 shows percentage of global carbon emission by different sectors in year 2008.



*Fig-1 Global carbon emission by sector*

## 2.1 Carbon Footprint

A carbon footprint is a measure of the impact of our activities has on the environment, and in particular climate change. The carbon footprint is a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product. This includes activities like burning fossil fuels for electricity, heating, manufacturing building materials, transportation of this material to the various sites, building renovation and deconstruction etc. The most important greenhouse gas produced by human activities is carbon dioxide and carbon emissions per capita per year in India is given as in fig-2.



*Fig-2 Emission of carbon per capita for India.*

The relation between carbon footprint and climate change is very close. The main factor responding for the climate change is emission of carbon or carbon foot print by various day to day activity of human kind.

## III. CARBON EMISSION BY BUILDING

The carbon released in the atmosphere during following stages of building life.

- i. Building Construction.
- ii. Building Operation
- iii. Building renovation and destruction.

### **3.1 Building Construction**

Today we see that there are many new technologies are available for construction in the market. Varieties of attractive materials are available for the construction which helps in reducing time of construction along with increase in beauty. It is one face of construction but if we see other face of large amount of carbon is emitted during the manufacturing of construction materials.

Carbon emission associated with building construction is mainly coming from embodied carbon. Embodied carbon is nothing but carbon associated with the embodied energy used for construction. Embodied energy is nothing but the commercial energy such as fossil fuels, nuclear etc which was used in making a product. Embodied energy aims to find the total amount of energy required for an entire product lifecycle. This product lifecycle consists of raw material extraction, transport, manufacture, assembly, installation, disassembly, deconstruction and decomposition.

Constructions consume a variety of building material. Abundant raw materials are to be transported from far off distances to the industry which requires further processing thus consuming primary and commercial resources. The finished products from the industry further need to be distributed to the local areas and construction sites which increases the pressure on the commercial fuels. The most common building material used in construction activity today are cement, steel, bricks, stones, glass, aluminum, timber, paints etc.

### **3.2 Building Operation**

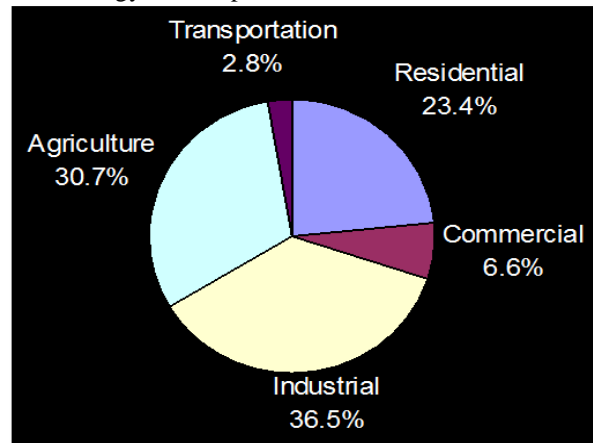
India, the seventh largest country in the world, is a leading economy and home to over one billion people living in various climatic zones. The country's economy has been growing at a fast pace ever since the process of economic reforms started in 1991. Construction plays a very important role in its economy contributing on an average 6.5% of the GDP. Commercial and residential sectors continue to be a major market for the construction industry. Throughout the life cycle of buildings, sectors consume abundant amount of energy. Hence, they become a major contributor of emission of greenhouse gas.

Due to urban growth, the number of buildings, lots of energy consumption, and the carbon emissions reaches to height in the country. According to the 17th Electrical Power Survey (EPS) done by the Central Electricity Authority, demand for electricity is expected to increase by 39.7% in 2011-12 as compared to 2006-07, by another 43.7% in 2016-17 as compared to 2011-12 and by yet another 37.5% in 2021-22 as compared to 2016-17. With a near consistent 8% rise in annual energy consumption in the residential and commercial sectors, building energy consumption has seen an increase from 14% in the 1970s to nearly 33% in 2004-05. Electricity which is used in residential and commercial sectors provides usage for lighting, space conditioning, refrigeration, water heating etc.

The rural residential sector continues to rely heavily on traditional non-commercial fuels. In India, as per 2001 Census, only 43.5% of rural households have an electricity connection and more than 85% of electrified rural households use it for lighting purpose only. The urban sector depends heavily on commercial fuels for its energy needs. It is estimated that on an average in a typical commercial building in India, around 60% of the total electricity is consumed for lighting, 32% for space conditioning, and less than 8% for refrigeration. In typical residential building, around 28% of the total electricity is consumed for lighting, 45% for space conditioning, 13% for refrigeration, 4% for televisions and 10% for other appliances<sup>2</sup> in urban sector. The average electricity consumption for space conditioning and lighting in India is around 80 kWh/m<sup>2</sup>/annum and 160 kWh/m<sup>2</sup>/annum for residential and commercial buildings respectively. The energy pattern of building varies with the climate of the region and building envelope. In a given climate for any one building type, energy usage varies from building to building depending on size, shape orientation, space, planning, envelope, design, choice of air conditioning and lighting systems, operational and maintenance schedule, user's habits and so on.

Under a Business As Usual (BAU) scenario and based on a 10% annual raise in new developed area, the expected annual increase in electricity demand in commercial and residential buildings would be 5.4 billion kWh<sup>3</sup>. Energy consumption in Indian buildings is expected to increase substantially due to various reasons such as economic & construction growth, human development etc. The demand for energy to run appliances such as TVs, air conditioning and heating units, refrigerators and mobile phone chargers will increase substantially as living standards rise in India. Also the growth in commercial sector and the shift from rural to urban living will continue to take place. This will result in a substantial increase in resultant emissions from the buildings sector alone. Hence, there is a need to take concerted efforts to decrease the energy consumption by buildings through various measures. The IPCC Fourth report also reiterates the necessity of taking appropriate efforts to bring down carbon emissions from the buildings sector. In the comparative study of energy savings potential of the building sector vs. economic sectors, it is observed that the building sector has the greatest potential among all sectors, in all countries, and at all cost levels. This holds true for India as well given the

high growth rate in construction industry. Amount of Carbon emission from building operation is calculated by multiplying the total energy required for building operation to the carbon emission factor per unit of electricity generation in India. The following fig-3 shows energy consumptions in various sectors in India.



*Fig- 3 Sector wise Energy Consumption*

### **3.3 Building Destruction**

Destruction carbon is nothing but the amount of carbon created at the end of the building lifespan looking at removing each material and product. This could be demolition, disposal and preparation of the land for the next construction OR deconstruction and dismantling for salvage, recycling, reuse and reclaim.

Beside the above carbon emission take place in the building in the form of management / project management carbon and construction carbon. Management / project management carbon is nothing but the amount of carbon created for everything that happens off site from project concept to completion. This includes travel, administration, all personnel involved in the project: designers, architects, project managers, sales, contractors, suppliers and the client. Construction carbon is nothing but the amount of carbon emitted through the building process – site development, construction, installation, site equipment, site labor, material delivery, energy used on site, vehicles used for transportation of material within the site, equipments use for various purposes on site like lifting materials, compaction, cutting machines etc. but the amount of construction carbon and management carbon is in small amount.

## **IV. INDIA BE CONCERNED ABOUT CLIMATE CHANGE**

With more than one billion inhabitants India ranks second globally in terms of population and accounts for about three per cent of total global energy use — its per capita energy use as well as carbon emissions are much lower than the world average. Even then, its total carbon emissions exceeded 250 million metric tons of carbon equivalents in 2000. These emissions are expected to grow apace with further economic advancement in the coming years. In India nearly 700 million rural population directly depending on climate-sensitive sectors such as agriculture, forests and fisheries etc. and natural resources such as water, biodiversity, mangroves, coastal zones, grasslands etc. for their survival and livelihoods. The adaptive capacity of dry land farmers, forest occupant, fisher folk and nomadic shepherds is very less. Climate change is likely to impact all the natural ecosystems as well as socio-economic systems. The three main categories of impacts are on agriculture, sea level rise as well as increased frequency of extreme events. Each of these categories poses serious threats to India.

## **V. SUMMARY**

The world has witnessed immeasurable technological achievements, population growth, and corresponding increase in resource use. As we enter a new century, we are witnessing the “side effects” of our activities. The side effects include pollution, landfills at capacity, toxic waste, global warming, resource and ozone depletion, and deforestation. These efforts are straining the limits of the Earth’s “carrying capacity”—its ability to provide the resources required to sustain life while retaining the capacity to regenerate and remain viable. As the world’s population continues to grow, it becomes essential to implement resource-efficient measures in all areas of human activity. The built environment is one clear example of the impact of human activity on resources. Buildings produce considerable impact on the environment. This may include activities like withdrawal of one-sixth of the world’s freshwater, one-quarter of its wood harvest, and two-fifths of its material and energy flows etc. Structures also produce some impact on areas beyond their immediate location, affecting the watersheds, air quality, and transportation patterns of communities. Hence it is necessary to find such solution which overcomes problems of environment due to built environments.

To minimize the impacts of built environment “Low Carbon Content Building / Low Carbon Building” comes in flash. Low carbon content building or low carbon homes is nothing but one of technique of Green Building or Sustainable Building in which attempt is made for reducing emission of carbon by using low carbon emission materials and low carbon emission techniques for construction or low carbon content building. Low carbon building is a building which has been engineered to release significantly less GHG than a regular building over its lifetime. Typically a low carbon content building or low carbon building will consume much less energy than a traditional building and integrate distinctive technologies, such as renewable energy system, which will reduce its GHG emission .

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