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A case for reducing the rising carbon footprints of the world and the urgency for immediate action

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Abstract

The evolution of society since the industrial revolution is riddled with numerous instances of anthropogenic environmental crises. Nature has warned us often enough of the need to rein in our insane and illogical rush for all things material. But do we pay heed? This insatiable greed of mankind has landed the world on the brink of disaster. The deadline is now 2040. If we do not immediately alter our ways, there is absolutely no doubt that lives and 'life' on earth will change forever - for the worst. The carbon footprint of the earth has increased disastrously rapidly and most countries are fast depleting their carbon budgets. The most abundant of the greenhouse gases, carbon emissions are literally suffocating the earth. The signs are to be seen everywhere. The time to procrastinate any longer is long gone. The world, including all its stakeholders, has to act now. This paper discusses the role of human activities in exacerbating the crisis, the necessity of drastically reducing emissions and the steps been taken by some stakeholders and further possible solutions. It also examines the situation in our country. It calls for extensive action and the need for further studies on more and economical solutions to address the problem.

Keywords: Industrial, emissions, carbon footprint, disaster, solution

Introduction

Everything is subject to change in a dynamic system. So is climate. Climate change refers to changes in weather conditions for an extended period of time that may cover decades or even millions of years. The drivers of climate change may be both internal- natural processes within the climate system; as well as external- which may be natural, like change in solar radiations; or anthropogenic. Man -made or anthropogenic causes are related to emissions of greenhouse gases. Ever since human activities began on this planet, there has been emission. This is recorded even in pre-historic times- the presence of soot on the ceilings of cave dwellings and the presence of trace metals discovered in ice from Greenland pointing to mining operations by ancient Greek and Romans, all suggest spread of pollution by man. But the amount of emission was obviously very small and in no way a threat to the world. Then came Industrial Revolution that not only altered the way humankind lived and behaved, but also how resources were used. Thermal energy usage to power not only furnaces and steam engines but also power plants led the way to the current crisis. By 1885, coal became the dominant energy source. Polluted emissions surged considerably. Smogs became a common occurrence in London, leading to rising cases of health problems. The Great Smog of 1952, considered one of the worst pollution-based fog in history, leaving behind a trail of deaths, led to the passage of the historic Clean Air Act- possibly the first environmental act- calling for restrictions to the burning of coal in industrial furnace and at homes and switching to other sources of energy.

As industrialisation spread rapidly, so did emission from the large-scale use of fossil fuels. Carbon dioxide emissions from vehicle engines, power plants and industries grew manifold. This led to a rise in global warming and its consequent effects of climate change.

Rising levels of carbon dioxide

Ever since the 1970s the globe has started becoming warmer. NASA scientists revealed in November 2015 that anthropogenic CO₂ emissions continues to increase above levels not seen in hundreds of thousands of years. Greenhouse gas emissions have continued to rise. Fossil fuel burning alone accounts for about three- fourths of the rise in CO₂ levels.

Between 1990 and 2011, global CO₂ emissions had risen by 54%. Burning of coal was responsible for 43% of this total emission, the other contributors being oil-34%, gas-18%, cement and gas flaring. The IPCC report suggested that by the year 2100, atmospheric concentration of CO₂ could range between 541 and 970 ppm, which would be 90-250% above the concentration level in 1750.

Emission levels had fallen considerably in 2020 during the pandemic. As the economies opened up after the pandemic had abated, there was a rebound of economic activities globally leading to a jump of 6% in emission levels. According to the IEA, global energy related CO₂ emissions increased by 0.9% (321Mt) in 2022 alone, reaching a new high of 36.8 Gt. Most of this increase came from energy combustion which grew by 423Mt in 2022. The year 2022 witnessed extreme weather conditions, due to which heating and cooling demands grew, accounting for 60 Mt rise in CO₂. Emissions from combustion of coal rose. The global energy crisis, which was a result of supply chain disruptions caused by the pandemic and then the escalating prices of gas and oil in Europe and other regions due to the Russian invasion of Ukraine, led to a massive shift from gas- to-coal, leading to a spike by 1.6% or 243 Mt rise in CO₂ emissions from coal to reach an all-time high of 15.5 Gt, much above the past decadal average. The report said that emissions from oil grew even more rapidly- by 2.5% i.e., by 268 Mt to reach 11.2 Gt. The largest increase came from the aviation sector. Compared to this however, natural gas led emissions actually declined in 2022, by 1.6% or 118 Mt, the trend being particularly witnessed in Europe and Asia-Pacific region. This helped keep the overall growth rate of CO₂ emissions below the growth rate of global GDP at 3.2%.

Sector-wise emissions data showed that most of the emissions came from electricity and heat generation, which went up by 1.8% and here too by coal fired electricity and heat generation by emerging economies of Asia. Emissions from energy combustion and industrial activities rose by 0.9% or 321 Mt, to an all-time high of 36.8 Gt. Emissions saw a high growth in the power and transport sector. Region wise data showed that emissions from the emerging market and developing economies were the highest among all regions. Here, emissions grew by 4.2% or 206 Mt and the biggest cause was coal- fired power generation.

Certain sectors and regions also witnessed a decline in emissions. A number of countries, particularly in Europe and the U.S made large scale shifts to clean green energy technologies, like electric vehicles and water pumps, as well as renewable sources of energy including solar and wind energy. Industrial production was affected in China and Europe, further arresting rise in emissions. Industrial emissions of CO₂ fell by 1.7% to 9.2 Gt in 2022. This decline was particularly driven by a 161 Mt decline in CO₂ emissions by China, which saw its industrial and construction activities decline drastically. As a result, global emissions of CO₂ were lower than previously anticipated. But they were still dangerously high. (Data Source- IEA, 2023)

Major contributors of rising carbon footprints

Carbon emissions have been rising throughout the history of humankind. Sectoral breakdowns of emissions show a consistent pattern over the past few years. The major contributors have been the following.

Power Production

Power accounted for 39.3% of total CO₂ emissions in the world. According to IEA electricity and heat generation accounted for the largest sectoral increase in emissions in 2022, which went up by 1.8%. CO₂ accounts for 76% of total Greenhouse Gas (GHG) emissions. Thermal power plants use fossil fuels like coal, gas and oil for its turbines to generate electricity. The process produces a wide range of pollutants like nitrogen oxides, sulphur dioxide and particulate matter. It releases huge amounts of CO₂ into the atmosphere exacerbating global warming and climate change.

Industrial Activities

Another major source of CO₂ emissions is the large- scale industrial activity going on around the world. Manufacturing plants all over the world have mushroomed rapidly and these have become big contributors to increase in carbon footprint. Plants that produce iron and steel, aluminium, chemicals, plastics, cement, lime, plaster, rubber, plastics, glass, pulp and paper and of course petroleum refineries are amongst the biggest polluters along with production of certain non- ferrous metals like tin, zinc, lead, etc. They continuously release small quantities of harmful substances into the atmosphere, which cumulatively have assumed monstrous proportions. There have been numerous instances of accidents in manufacturing units, which suddenly release huge amounts of such substances at a single point of time. It is estimated that material production accounts for over half of the GHG emissions from industries.

Agriculture, forestry and land-use

Carbon dioxide is also released in agriculture and land-use and land-use change. Growing demand for food and raw materials have added pressure on farms and led to the practice of intensive cropping necessitating the use of chemical fertilisers, pesticides and insecticides, adding to pollution. It is estimated that AFOLU (agriculture, forestry and other land use) currently contribute 25% of the global anthropogenic carbon emissions. This is about 11% of total GHG emissions. Raising of crops such as rice and livestock rearing, particularly the ruminant variety, is known to increase the methane levels in the air. The use and manufacture of nitrogen fertilisers contribute about 5% to raising GHG emissions. As population grew, and economic activities increased, more forests were cleared to grow food and raise livestock and set up industries. It raised the albedo of the areas, making them warmer or colder according to the conditions in the place. It also cut down on the reuptake capacity of the forests, leading to higher concentrations of CO₂ in the atmosphere. According to FAO, Land is both a source as well as a sink of CO₂, both on account of anthropogenic as well as natural causes. Net carbon emissions from land use and land-use change have been rising, mostly due to deforestation and other land activity. Livestock and rearing practices add about 9% to global CO₂ emissions.

Transport

This sector is a big contributor to global carbon emissions. Automobiles running on diesel, gasoline and petroleum have been increasing dramatically since the industrial revolution. Fossil fuel combustion in engines produce CO₂ and water. In case of impurities, it may also produce various kinds of

pollutants. In fact, the transport sector is responsible for one quarter of GHG emissions. The main reason is that 95% of the energy requirements of this sector is met by fossil fuels. CO₂ emissions from this sector accounted for about 23% of all anthropogenic CO₂ emissions worldwide. Between 2000 and 2019, CO₂ emissions from this sector rose in all countries except Europe, where it actually declined by 2%. In 2019, CO₂ emissions in this sector was 30% in developed countries. In 2018, aviation accounted for around 12% of transport related CO₂ emissions. In the same period CO₂ emissions in the transport related tourism sector grew by 22%. (Data source: UN Sustainable Transport Conference report, 2021). In 2021, this sector produced more than seven billion metric tonnes of carbon dioxide (GtCO₂). The biggest source within this sector were passenger cars which accounted for 33% of total global transportation emissions. According to Statista, 2023, the share of different means of transportation in total CO₂ emissions in 2021 were as follows

Table 1: Show Sub sector and Share of CO₂ emissions

Sub sector	Share of CO ₂ emissions
Passenger cars	39%
Medium and heavy trucks	23%
Shipping	11%
Aviation	9%
Buses and minibuses	7%
Light commercial vehicles	5%
Two/three wheelers	3%
Rail	3%

Construction/Buildings

Buildings are currently responsible for 39% of global energy related carbon emissions: 28% from operational emissions, from energy needed to heat and cool and power them and 11% from materials and construction. Construction is one of the most rapidly expanding sectors worldwide. As global population nears 10 billion by the middle of this century, global building stock is expected to double. Carbon footprints of materials used in construction activities i.e., 'upfront carbon' is expected to be responsible for half the carbon footprints of new construction between now and 2050.

The construction industry in itself does not directly contribute to increasing emissions as such, but it uses many such products that are manufactured and assembled to erect buildings. These release toxic GHGs. Thus, the construction industry is indirectly responsible for CO₂ pollution. The total carbon emissions of the construction industry can be put into two categories- embedded carbon emissions and operational carbon emissions. Embedded emissions are those released by the materials used in construction, while operational emissions are those produced by human activities and consumption, like using electricity for running home appliances. Embedded carbon emissions of this sector is extremely high, and once used, the materials used are difficult to replace with low carbon materials later if desired.

Operational emissions, however maybe controlled through energy saving practices.

Estimating total carbon emissions of any building is the sum of emissions in four stages- material production, material transportation, construction on site and emissions by vehicles used for the transportation of workers to and from the construction site as well as operational emissions, including the use of water pumps, lighting, etc. Therefore, we can say that:

$$C_{tot} = C_{con} + C_{mt} + C_{ope} + C_{work}$$

Materials used in buildings include plastic pipes and other plastic fittings, which at the end of their life span end up in landfills, releasing toxic substances and microplastics in the environment. Transportation of materials and workers, use fossil fuels, adding to emissions.

Material production is a major source of emission. Two-fifths of carbon footprint of materials is attributed to construction. Building and construction has become the number one destination for materials such as iron and steel, glass, tin, lead, zinc and plastic along with wood. All of these are responsible for greatly enhancing the levels of emissions. Not only in the construction stage, but also in its entire life span and after this span ends, all embedded carbon will release into the atmosphere.

Demography

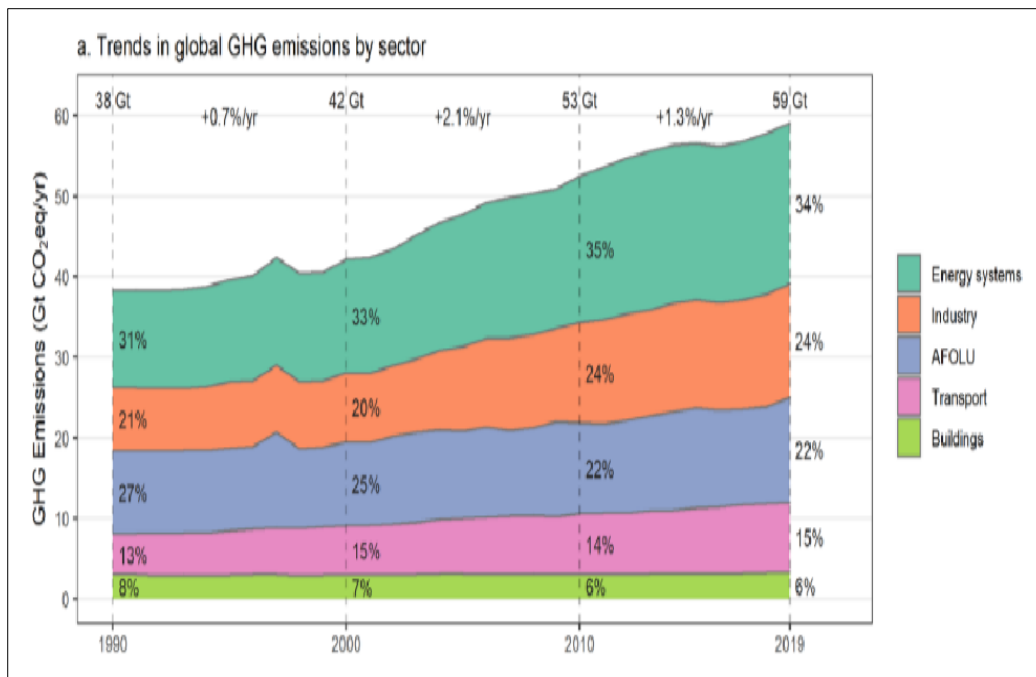
Rising global population has become one of the key drivers to increasing levels of emissions over the past years. As numbers rise, agricultural and industrial activities have gone up to provide for them and to meet their growing demands for consumer durables. This factor and the growth of urbanisation has added to the problem. Urbanisation tends to spread with economic growth. A direct effect of this trend has also been seen to be associated with rise in the number of nuclear families, leading to higher demand for consumer goods and houses, all of which involve activities releasing large amounts of GHGs including carbon dioxide.

Deforestation

The continuous clearing of forests to make space for industries, agriculture and housing needs of the expanding population, has added to the woes of the world. Forests add as the lungs of the world and are the main sources to absorb the carbon emissions. Reducing their areas and spread has lead to increasing concentrations of emissions that remain in the atmosphere, causing untold harm.

Regional emissions

Carbon footprints of the entire world has been escalating particularly since the industrial revolution. The contributions of countries have been varied. Countries with higher concentration of manufacturing units have naturally been the bigger contributors. An idea about the regional distribution of emissions can be had by the following figure.



Source: IPCC, 2022. AFOLU-agriculture, forestry and Other Land use

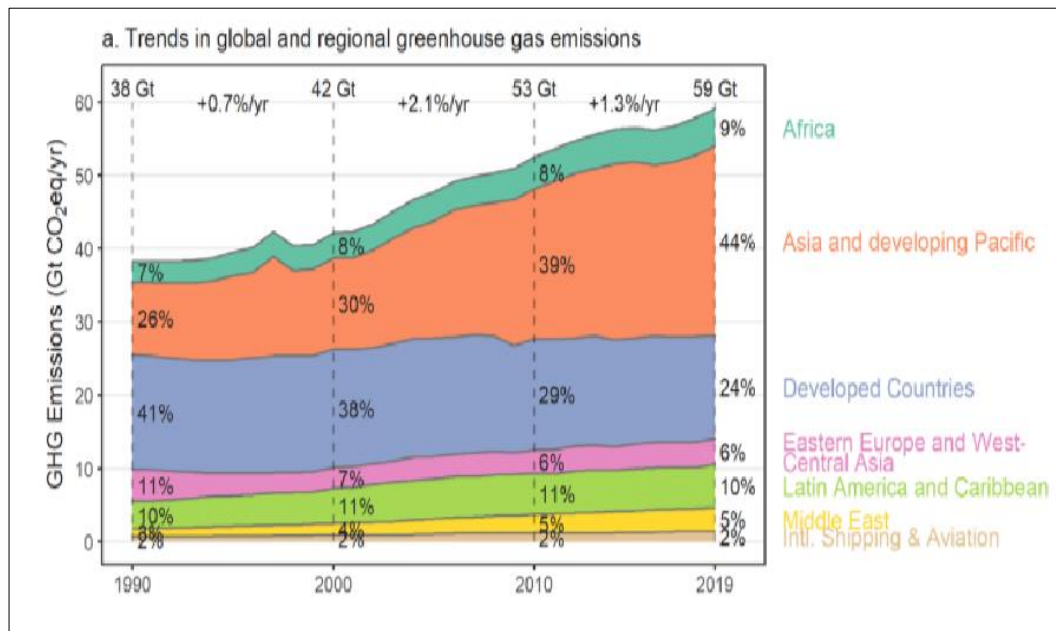
Fig 1: Trends in global GHG emissions by sector and GHG Emissions (Gt CO₂ ew/yr

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Source: IPCC, 2022

Fig 2: Trends in global and regional greenhouse gas emissions and GHG Emissions (Gt CO₂ ew/yr

Data on CO₂ emissions in metric tons per capita in 2019 showed that in high income countries per capita CO₂ emissions was 9.6 metric tons, compared to only 0.3 metric tons of low income countries. The corresponding figures for lower middle income and upper middle income countries were 1.7 and 6.4 metric tons respectively. The data for

North America was 14.7 metric tons, while for OECD members it was 8.5 metric tons. The figure for South Asia was 1.5 metric tons per capita. The per capita CO₂ emissions of China was 7.61 metric tons. (Data source-data-worldbank.org). China emits 27% of global carbon dioxide. Some of the biggest carbon polluters in the world were

China, the U.S., India, Russia, Japan, Germany and Iran. It is estimated that the 100 least emitting countries generate 3% of total emissions, while the 10 largest emitters generate 68%.

COP26 & 27

The 26th session of UNFCCC (United Nations Framework Convention on Climate Change) which conclude on November 13, 2021 in Glasgow, Britain, had member countries reiterating their commitments to the promises made in the Paris Agreement 2015, of keeping global temperature rise within 1.5 to 2 degrees C, reduce carbon emissions, phase out the use of carbon to reach the target of 'net-zero' by 2030 and to assist the most vulnerable countries affected by the impact of climate change. It stressed on the urgency to cut down carbon emissions by 45% by 2050. It called for the phasing out of coal power and of fossil fuel subsidies and decide on the norms for the carbon market. The summit also emphasised on the need to protect forests Over 30 countries and 6 major vehicle manufacturers pledged to switch to zero emission vehicles by 2040 globally and by 2035 in leading markets. Similarly, UK, US, France, Germany and the EU agreed to a partnership with South Africa to help it switch from coal to for producing electricity and turn into a low carbon economy.

The COP27 climate summit in Sharm-el- Sheikh, Egypt, concluded in November 2022, with some good announcements but also with some disappointments. After tough negotiations, countries finally agreed to set up a dedicated fund for loss and damage suffered by poor families who suffer the most due to the adverse impacts of climate change. But COP27 agreed to policies reflecting only slight reduction in carbon emissions far from their pledge in COP26 of drastic reductions to limit temperature rise to 1.5 degrees C. Most rules for carbon markets made in COP26, could not be ironed out in this summit. Carbon credit use and emissions and how carbon markets operate, remained a subject of further negotiations.

Target 'Net-Zero'

Since 1995 the United Nations Framework Convention on Climate Change (UNFCCC) has been hosting Conferences of Parties (COP) to discuss, debate and form frameworks for policies on various aspects to mitigate and deal with the causes and effects of climate change. In this series the ambitious goal of achieving net zero targets were set. Bhutan was the first country in the world to set net zero target in 2015, a concept that is now being widely adopted by countries throughout the world, including some of the biggest emitters like China, the U.S. and India. COP21 which was held in Paris in 2015, concluded with the adoption of the Paris Agreement governing climate change reduction measures from 2020. It specifically set a long-term goal of achieving 'a balance between anthropogenic emissions by sources and removal of sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty.' This is the target of reaching 'net-zero'. 'Net-zero' is a set of two steps. First the reduction of anthropogenic emissions to near zero and second, balancing the remainder with carbon removal measures, including restoring forests and adopting various technologies to scrub out carbon from the atmosphere. Targets for countries were decided and it was urged to reach them before the mid of this century. The Glasgow Pact of

COP26, signed in November 2021 urged countries to move quickly towards their targets, as most countries were way off the mark, and global warming was rising. Countries have set targets for 2050, but the UN is now urging them to act faster. To limit global warming to 1.5 degrees C, it is essential that net GHG emissions are cut by half by 2030 to ultimately reach net zero. CO2 emissions must reach net zero by 2050. To meet the 1.5 degrees C goal, fossil fuel production will have to reduce by 6% per year by 2030. But our world is far from potentially meeting the target. According to the UN, climate policies that are currently in place, point to a 2.8 degrees C temperature rise by the end of the century which will be disastrous.

Remedial Measures

There are many ways of reducing CO2 emissions to reach the target of 'net-zero'. Almost all the electricity generation will have to be done by non- carbon resources. Fuel efficiency measures will have to be adopted on a large scale. A very important need is to phase out the use of coal necessarily by 2030. Along with this all efforts must be made to stop deforestation and increase the area under forest cover.

The world is quickly adapting. The technologies to reduce emissions are available and green technologies are being increasingly used. Alternative sources of energy like wind power and solar power are being increasingly harnessed in many countries. Cost of solar energy has fallen by almost 80% in a decade, making it one of the cheapest sources of energy. The IEA stated that renewables met 90% of global growth in electricity generation in 2021-22. Wind and solar PV generation made new records. The U.S. and many countries of Europe have made the switch dramatically, reducing emission levels significantly. India has assured to reduce its carbon emissions by 2070. Countries have also agreed to phasing out fossil fuel subsidies. Many countries, 6 major vehicle manufactures and numerous cities have decided to use zero emission vehicles by 2040. Countries are forming partnerships to enable low income countries make the transition to low carbon economies. Large corporate firms are switching over to green technology and green accounting. Improving the efficiency of food production, changing dietary choices, restoring degraded lands and reducing food loss and waste will also have significant potential of reducing emissions.

The UN secretary General urged nations to reach their net zero deadlines by 2040, to phase out coal in OECD by 2030 and other countries by 2040; to end giving license to any new fossil fuel project; to ensure net zero electricity by 2040; to decarbonise major emitting sectors like aviation, shipping, steel, cement, tin, aluminium and agriculture, to put a price on carbon and to do away with fuel subsidies. He also urged the developed countries to fulfil their commitment of providing \$100 billion a year to developing countries to enable them to make the adaptation to low carbon economies.

Conclusion

It is amply clear that rising carbon emission is a big threat to the survival of this planet. Economic growth that is uncontrolled has been the major cause of this. Thus, the need of the hour is to take immediate action on this. There is no time to procrastinate. We are hurtling towards climate disaster. A major cause is rising levels of CO2. To ensure that our future generations may live in a safe and secure world, our carbon footprints have to be reduced to 'net-zero'

levels and the time to do this is Now. Countries must keep a close watch on their carbon budgets on a regular basis. This also presents a wide scope of research into a variety of subjects on carbon emission- effects, and more importantly solutions which are cost-effective.

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