Preface to Special Theme

Global Warming and Climate Change – Need of Nuclear Energy

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Global warming and climate change are the central point of scientific discussion and research around the world in 21st Century, the endeavor to alleviate the adverse impacts. The looming crisis of rising of global mean surface temperature by 1.5 ^{o}C and/or 2 ^{o}C over and above the pre-industrial level compelled the international community to execute the Paris Agreement in 2015. This is an agreement negotiated by 196 countries emphasizing the exigency to reduce the emission intensity of greenhouse gases and adopt measures to mitigate the adverse effect on the ecosystem. Extreme temperatures; more intense and frequent storms, droughts & floods; ocean acidifications; warmer ocean; loss of biodiversity; disruption of crops and increased health risks are reported across the regions which reflects the adverse effects of global warming and climate change. Intensity, frequency and scale of these man-made risks are going to follow an upward trend till the reduction of emissions of greenhouse gases to limit the anticipated temperature rise [1].

India, in the Asian region, is particularly vulnerable to the impacts of global warming climate change, as the region has the longer coastline, incredibly diverse and often unique marine environments, many large coastal population centres (mega-cities) and already suffers from frequent storms and floods when compared to other regions in the world. Growth in trade in fisheries resources, expansion of aquaculture production, mining and agriculture all these activities have impacted on the health and sustainability of coastal resource.

Our climate depends on the Earth's temperature. Due to rapidly increasing concentrations of carbon dioxide (CO2) and other greenhouse gases in the atmosphere, the temperature of the planet is rising quickly compared with relatively stable temperatures throughout the past millennium. Atmospheric carbon dioxide concentrations remained relatively constant at around 280 parts per million (ppm) for at least a thousand years, but concentrations have risen since the mid-1700s, presently reaching around 421 ppm as on 2022. The increasing use of fossil fuels for energy generation and transport purposes means carbon dioxide is the most critical greenhouse gas. Although India's carbon dioxide emissions increased by a whopping 5.-9 percent in post-COVID phase, with those from coal growing 10.2 percent.

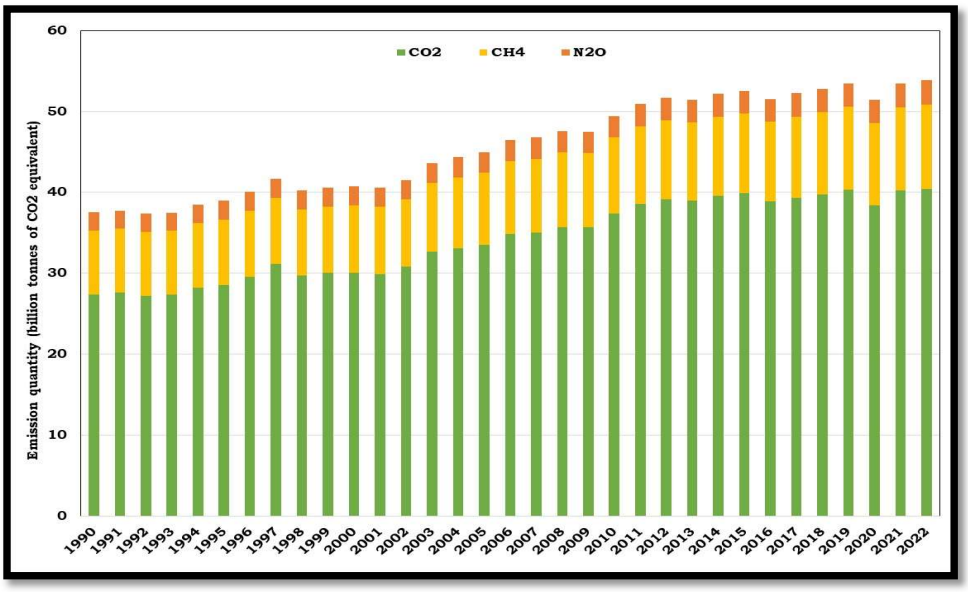

Fig.1. Global greenhouse gases emission quantity (billion tonnes of CO_2 equivalent)

Anthropogenic sources of carbon dioxide, methane and nitrous oxide are the predominant components of greenhouse gases which is responsible for global warming and climate change. From the Fig.1, it may be observed that globally carbon dioxide in the range of 30 – 40 billion tonnes while 8- 10 and 2 – 3 billion tonnes equivalent to CO_2 of methane and nitrous oxide emitted per year [2]. The corresponding percentage contribution observed to be around 75%, 20% and 5% w.r.t. CO_2, CH_4 and NO_2, respectively. Therefore, globally the prime focus on carbon dioxide and efforts to reduce the emission intensity of it. However, it is pertinent to underscore here the global warming potential (GWP) of different greenhouses gases considering the radiative efficiency and atmospheric lifetime. Though the emission quantity of methane and nitrous oxide is much lesser than that of carbon dioxide but the global warming potential of both these gases is 21 and 310, respectively [3].

In addition to this context, multiple anthropogenic sources like electricity & heat, transport, manufacturing & construction, agriculture, industry, energy production, etc. contribute to the global emission of carbon dioxide. The percentage contribution of various anthropogenic sources is given in Fig. 3 and clearly shows that 70% of global carbon dioxide emission is shared by four sources [2]. Global atmospheric average carbon dioxide concentration in the last century is depicted in Fig. 4 [2]. It is, therefore, efforts made globally to reduce the carbon dioxide emission intensity of these sources fueled by fossil fuels. Nuclear energy and renewable energy sources are best possible options to meet the net carbon zero.

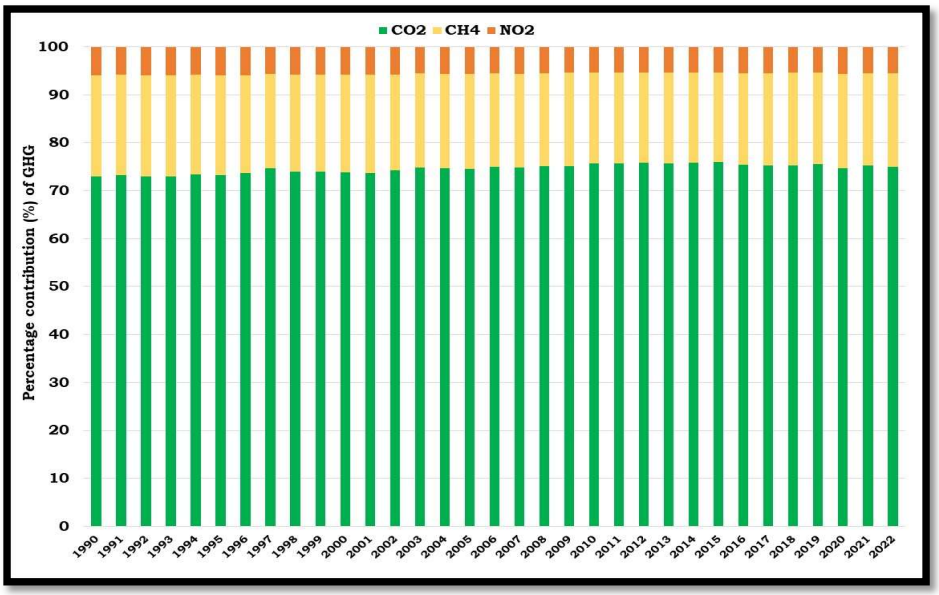

Fig.2. Percentage contribution of global greenhouse gases emissions

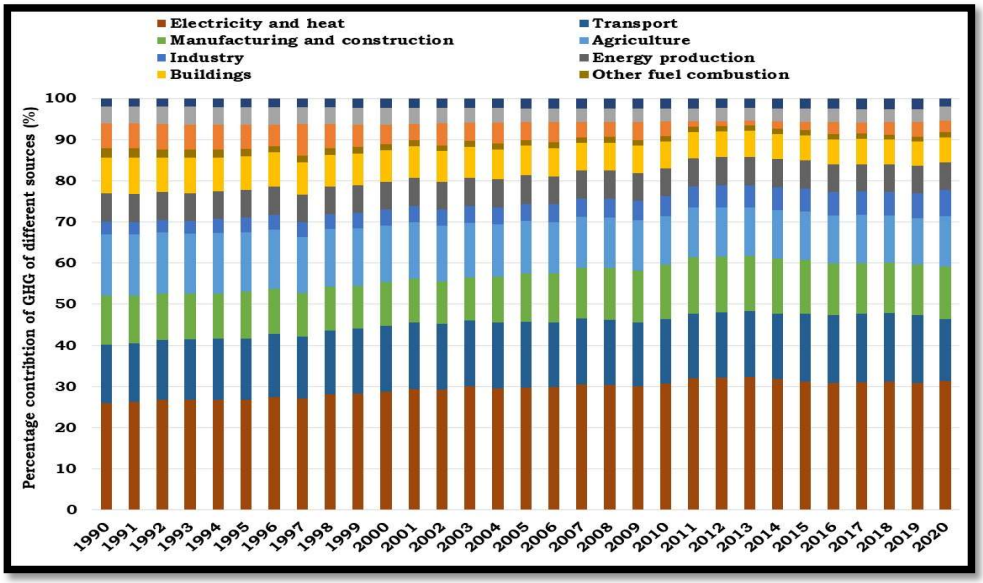

Fig.3. Percentage contribution of different sources to Global GHG emission

Emblematic of India's electricity transition is its national target of achieving 500GW of non-fossil electricity capacity by 2030 and its global commitment to achieve net-zero by 2070. However, a focus on energy capacity and emissions only captures a part of India's transition story. Apart from a shift from fossil-based to clean power generation, India is experiencing multiple simultaneous transitions, such as: a shift from public to private control over energy infrastructure; growing per capita energy demand; expanding domestic power markets; and transitions in coupled sectors such as transport and industry. Therefore, solar power, wind power, clean and green nuclear energy, biopower and hydrogen fuel are the contenders of future energy need of the country. However, reliable and low-cost nuclear power has multiple advantages over other energy sources like constant base load power, concentrated, small land

foot print, climate compatible, non-dependent on weather, higher capacity factor, etc.. Like global trend, nuclear energy is very much part of the energy mix and considered sincerely to enhance the national contribution to reduce emission of greenhouse gases. Similarly, India has a national policy to enhance installed nuclear capacity to 100 GWe by 2047 from current less than 10 GWe [4].

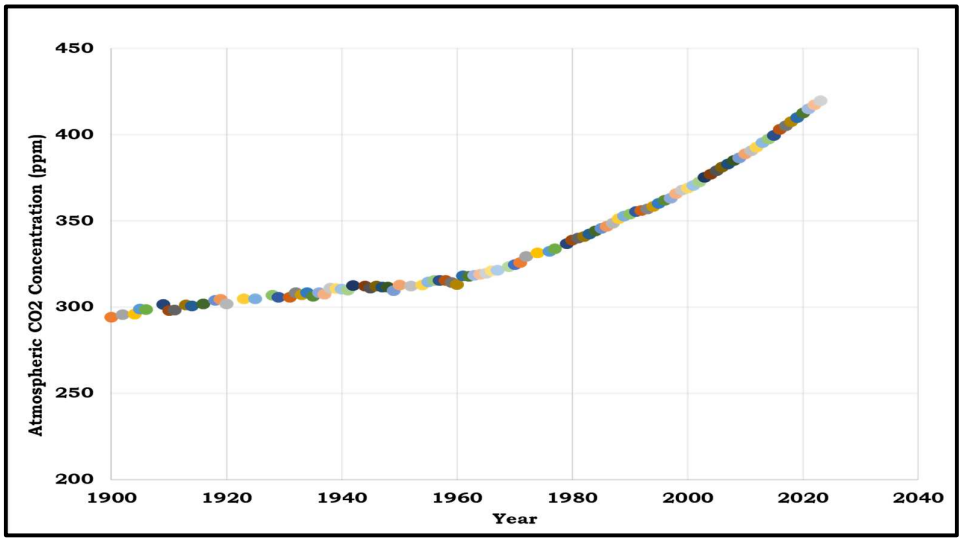

Fig.4. Global atmospheric average CO_2 concentration (ppm) in last century

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