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Green House Gas Emissions In India – Statistics, Facts And Control Strategies

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Abstract

Greenhouse gases (GHGs) are gases in the Earth's atmosphere that trap heat, contributing to the **greenhouse effect**, which is essential for keeping the planet warm enough to support life. However, human activities have significantly increased the concentration of these gases, leading to **global warming** and **climate change**. India is the third-largest emitter of greenhouse gases (GHGs) globally, contributing about **7%** of the world's total emissions, primarily due to its reliance on fossil fuels for energy and its large agricultural sector.

However, the country has been proactive in implementing policies and making international commitments to mitigate its emissions while balancing development needs. While challenges like coal dependency and financial constraints remain, India's proactive strategies and growing investments in green technologies reflect its commitment to tackling climate change.

Keywords: Green house gases, climate change, policies etc

Introduction

India is one of the largest emitters of greenhouse gases (GHGs) in the world, primarily due to its reliance on fossil fuels for energy, growing industrial sector, and significant agricultural activities.

India's GHG emissions have roughly doubled since the turn of the century, with the country now emitting approximately four billion metric tons of carbon dioxide equivalent ($GtCO_2e$) per year. During this time, India's fossil CO_2 emissions have nearly tripled, reaching a record high of 2.7 $GtCO_2$ in 2022[1].

India was ranked seventh among the list of countries most affected by climate change in 2019, emits about 3 gigatonnes (Gt) CO_2 of greenhouse gases each year[2]. The country emits 7% of global emissions, despite having 17% of the world population[3] .The climate change performance index of India ranks eighth among 63 countries which account for 92% of all GHG emissions in the year 2021[4].

Temperature rises on the Tibetan Plateau are causing Himalayan glaciers to retreat, threatening the flow rate of the Ganges, Brahmaputra, Yamuna and other major rivers.

A 2007 World Wide Fund for Nature (WWF) report states that the Indus River may run dry for the same reason[5]. Severe landslides and floods are projected to become increasingly common in such states as Assam[6] .

Heat waves' frequency and intensity are increasing in India because of climate change[7]. Temperatures in India have risen by 0.7 °C (1.3 °F) between 1901 and 2018[8]. According to some current projections, the number and severity of droughts in India will have markedly increased by the end of the present century[9].

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Table 1: Major Greenhouse Gases Emitted in India

S.No	Name of the Gas	Sources	Impacts
1.	**Carbon Dioxide (CO_2)**	Fossil fuel combustion for electricity (coal-fired power plants), transportation (petrol and diesel vehicles), and industries (cement, steel).	CO_2 is the largest contributor to India's GHG emissions, accounting for approximately **65-70%** of the country's total emissions. India's dependence on coal for about **55%** of its electricity generation is a major reason for high CO_2 emissions.
2.	Methane (CH_4)	Agriculture (livestock digestion, rice paddies), landfills, coal mining, oil and gas extraction.	Methane is a potent GHG, with a **global warming potential** (GWP) **25 times** higher than CO_2 over a 100-year period. Agriculture contributes significantly to methane emissions in India, accounting for about **16-18%** of total GHG emissions, mainly from livestock (cattle) and rice farming.
3.	Nitrous Oxide (N_2O)	Agricultural soil management (use of nitrogen-based fertilizers), livestock manure, industrial processes.	Nitrous oxide is another potent GHG with a **GWP 300 times** higher than CO_2. It contributes about **6%** of India's total emissions, mainly from agricultural practices that involve the excessive use of synthetic fertilizers.
4.	**Fluorinated Gases(F-gases)**	Industrial applications (refrigeration, air conditioning, electrical insulation), chemical production.	Though they are emitted in smaller quantities, F-gases like hydrofluorocarbons (HFCs) have a very high GWP. They are used in cooling systems and are becoming a growing source of emissions as India's refrigeration and air conditioning demand increases with economic growth and rising temperatures.

Table 2: Sector-wise Contribution to Greenhouse Gas Emissions in India

S.No	Sector	Share	Contributors	Initiatives
1.	**Energy Sector (Coal, Oil, Natural Gas)**	**68%**	**Power generation** from coal-fired plants is the largest source of CO_2 emissions. **Oil consumption** in transportation (vehicles, shipping) contributes significantly to CO_2 emissions. **Natural gas** used in industries and electricity generation also contributes to GHG emissions.	India is investing heavily in renewable energy (solar, wind) to reduce its dependence on coal and cut CO_2 emissions from the power sector.
2.	**Agriculture**	**18%**	**Methane** from enteric fermentation in livestock and rice cultivation (which produces methane due to waterlogged conditions in paddy fields). **Nitrous oxide** from excessive use of fertilizers in crops.	India is promoting climate-resilient agricultural practices under the **National Mission for Sustainable Agriculture** to reduce methane and nitrous oxide emissions.

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3.	**Industrial Processes**	**6-7%**	**Cement and steel production**, which emit CO_2 during manufacturing processes. **Production of chemicals and fertilizers** also emits CO_2, N_2O, and F-gases.	Improving energy efficiency in industries through programs like the **Perform, Achieve, and Trade (PAT)** scheme, which aims to reduce energy consumption and emissions.
4.	**Waste Management**	**3-5%**	**Methane** from landfills and solid waste disposal. **Wastewater treatment** emits both methane and nitrous oxide.	India is working on improving waste management systems, promoting recycling, and increasing methane capture from landfills to reduce emissions.

Impacts On The Natural Environment

Temperature and weather changes

Temperatures in India have risen by 0.7 °C (1.3 °F) between 1901 and 2018, thereby changing the climate in India[10]. In May 2022 severe heatwave was recorded in Pakistan and India. The temperature reached 51 °C. Climate change makes such heatwaves 100 times more likely. Without climate change heatwaves, more severe that those who occurred in 2010 are expected to arrive 1 time in 312 years. Now they are expected to occur every 3 years[11].

A 2018 study projects droughts to increase in Northern and North-western India in the near future. Around the end of the century, most parts of India will likely face more and more severe droughts[12]. Severe landslides and floods are projected to become increasingly common in such states as Assam[6].

Sea level rise

Meghalaya and other north-eastern states are concerned that rising sea levels will submerge much of Bangladesh and spawn a refugee crisis. If severe climate changes occurs, Bangladesh and parts of India that border it may lose vast tracts of coastal land[13]. Thousands of people have been displaced by ongoing sea level rises that have submerged low-lying islands in the Sundarbans.[14]

Water resources

Temperature rises on the Tibetan Plateau are causing Himalayan glaciers to retreat, threatening the flow rate of the Ganga, Brahmaputra, Yamuna, and other major rivers; the livelihoods of hundreds of thousands of farmers depend on these rivers[15]. A 2007 World Wide Fund for Nature (WWF) report states that the Indus River may run dry for the same reason[5].

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Ecosystems

Ecological disasters, such as a 1998 coral bleaching event that killed off more than 70% of corals in the reef ecosystems off Lakshadweep and the Andamans and was brought on by elevated ocean temperatures tied to global warming, are also projected to become increasingly common[16][17] .

IMPACTS ON PEOPLE

Socio-economic impacts

India has the world's highest social cost of carbon[18] . A report by the London-based global think tank Overseas Development Institute found that India may lose anywhere around 3–10% of its GDP annually by 2100 and its poverty rate may rise by 3.5% in 2040 due to climate change[19][20]. Climate Change in India will have a disproportionate impact on the more than 400 million that makeup India's poor community. This is because so many depend on natural resources for their food, shelter and income. More than 56% of people in India work in agriculture, while many others earn their living in coastal areas[21]. The impact of climate change on Indian agriculture was investigated through the National Innovations in Climate Resilient Agriculture (NICRA) study. The findings indicate that rainfed rice yields in India are expected to experience a marginal reduction of less than 2.5% in the years 2050 and 2080. On the other hand, irrigated rice yields are projected to decline by 7% in 2050 and 10% in 2080 scenarios. Moreover, the study forecasts a decrease in wheat yield ranging from 6% to 25% in the year 2100, while maize yields are estimated to decrease by 18% to 23% during the same period. However, there is a potential positive impact on chickpea, with anticipated productivity increases of 23% to 54% in the future climates[22].

Health impacts

Heat waves, prolonged periods of excessive heat, have become more frequent and intense due to climate change. They pose severe health risks, particularly in countries like India with high population density and widespread poverty. The health impacts of heat waves are extensive, particularly affecting vulnerable groups like the elderly, children, outdoor workers, and those with pre-existing health conditions. In India, exposure to heat waves is said to increase by 8 times between 2021 and 2050, and by 300% by the end of this century. The number of Indians exposed to heat waves increased by 200% from 2010 to 2016. Heat waves also affect farm labour productivity. The heat waves affect central and north-western India the most, and the eastern coast and Telangana have also been affected. In 2015, over **2,500 deaths** were reported in one of India's deadliest heat waves. The government is being advised by the Indian Institute of Tropical Meteorology in predicting and mitigating heat waves. India has recognized the growing threat posed by heat waves and has taken several measures at both national and state levels to protect public health and mitigate the impacts of extreme heat.

POLICIES AND LEGISLATION

The Indian Government as well as various state governments have taken certain steps in accordance with India's energy policy and the Paris Agreement. Following are some of those steps:

- Doubling India's renewable energy target to 450 gigawatt (GW) by 2030 [23]
- National Solar Mission
- Wind power in India

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In 2008, India published its National Action Plan on Climate Change (NAPCC), which contains several goals for the country. These goals include but are not limited to: covering one third of the country with forests and trees, increasing renewable energy supply to 6% of total energy mix by 2022, and the further maintenance of disaster management. All of the actions work to improve the resiliency of the country as a whole, and this proves to be important because India has an economy closely tied to its natural resource base and climate-sensitive sectors such as agriculture, water, and forestry[24].

While presenting the fiscal year 2020-2021 state budget for the Indian state of Odisha, Finance Minister of the state Niranjan Pujari introduced the Climate Budget[25] . Climate budget aims to keep track of the expenses made by the government for climate change or to support mitigation and adaption actions to address climate change. As per the document, It will help the government to decide whether to redesign or safeguard the existing projects by seeing their impact on the climate change[26]. Odisha has become the first state in India to introduce climate budget[27].

Niti Aayog is in the process of devising a policy framework and its deployment mechanism in India for carbon capture and utilization or storage (CCUS) to reduce greenhouse emissions per unit of economic activity[28].

The right "to be free from adverse impacts of climate change" was legally recognized as a fundamental right in India by the Supreme Court, in 2024. This decision can impact further climate legislation in India.[29]

For achieving the aims of the Paris agreement India must peak power sector emissions by 2026. Until recently the country was expected to reach this target, but the recent governmental push for coal undermined it[30].

Carbon emission trading and pricing

Carbon emission trading is yet to be implemented in India. However, related instruments such as energy saving certificates (PAT), various renewable purchase obligations (RPO), and renewable energy certificates (REC) are traded on the power exchanges regularly[31][32].

India does not have a carbon tax, but since 2010 the country has had a tax on both domestically produced and imported coal, which powers more than half of its electricity generation[33] .Originally set at ₹50 (60¢ US) per tonne of coal, it was raised to ₹100 in 2014[71] and ₹200 in 2015. As of 2020 the coal tax stands at ₹400 (US$4.80) per tonne[34].

International cooperation

As a party to the Paris Agreement India is due to submit its first biennial transparency report to the UNFCCC by 2024 and inventory figures in standard format[35]. In September 2021 India announced that it will submit a new Nationally Determined Contribution before COP26[36]. At COP26, India set the latest target date planning to be net-zero by 2070[37]. This was the first time in that a date for carbon neutrality has been given as part of India's climate policy[37].

At COP26 Indian prime minister Narendra Modi announced 5 main commitments called Panchamrit – "India's gift to the world":

- Reaching carbon neutrality by 2070.
- Expand the energy capacity not coming from fossil fuels to 500GW by 2030.

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- Cut the carbon intensity of economy by 45% by 2030.
- Draw half of its energy requirement from renewable sources by 2030.
- Cut 1 billion tons of GHG emission from the amount projected to the year 2030.

Prime Minister Narendra Modi introduced the Lifestyle for Environment (LiFE) initiative at the 26th United Nations Climate Change Conference of the Parties (COP26) in Glasgow in 2021 that meant to changing lifestyle for benefit the environment.

"Mission LiFE can become a mass movement of Environmental Conscious Lifestyle. What is needed today is Mindful and Deliberate Utilisation, instead of Mindless and Destructive Consumption."- Hon'ble Prime Minister Shri Narendra Modi introduces Mission LiFE to the world at the 26th UN Climate Change Conference of the Parties (COP26) in Glasgow [38].

Table 3: Key Policies and Programs to Control Greenhouse Gas Emissions

1.	**National Action Plan on Climate Change (NAPCC)**	**Launched in 2008**, it includes eight missions aimed at reducing GHG emissions and promoting sustainable development. The **National Solar Mission** and the **National Mission for Enhanced Energy Efficiency (NMEEE)** focus on transitioning to renewable energy and improving energy efficiency, respectively.
2.	**Renewable Energy Initiatives**	India has set an ambitious target of achieving **500 GW of renewable energy capacity by 2030**, focusing on solar and wind energy. As of 2023, India had installed more than **172 GW of renewable energy**, significantly contributing to reducing emissions from the energy sector.
3.	**Electric Vehicles and FAME Scheme**	The **FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles)** scheme promotes the use of electric vehicles (EVs) to reduce emissions from the transport sector. India aims to have **30% of its vehicles** as electric by 2030.
4.	**Carbon Pricing and Trading**	India is working on establishing a **domestic carbon market** that will enable industries to trade carbon credits, encouraging emissions reductions through market mechanisms. The **Perform, Achieve, and Trade (PAT) scheme** incentivizes industries to adopt energy-efficient practices and reduce emissions, allowing them to trade energy-saving certificates.
5.	**Green Hydrogen Mission**	India is promoting the use of **green hydrogen**, produced using renewable energy, to decarbonize hard-to-abate sectors like steel, cement, and transportation.
6.	**Afforestation and Carbon Sinks**	The **National Mission for a Green India** aims to increase forest and tree cover, helping to create **carbon sinks** that absorb CO_2. India has committed to creating an additional **2.5 to 3 billion tonnes** of carbon sinks by 2030.

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7.	**Paris Agreement and COP26 Commitments**	India is a signatory to the **Paris Agreement** and has committed to reducing its **emissions intensity** (GHG emissions per unit of GDP) by **33-35% by 2030** from 2005 levels. At **COP26**, India pledged to achieve **net-zero emissions by 2070** and to reduce its carbon emissions by **1 billion tonnes by 2030**.

Conclusion- While challenges remain, India's policies and international commitments reflect its commitment to combating climate change and transitioning to a more sustainable future. Education is an integral tool that can be used in the adaptation of the measures that have been put in place to curb climate change. When considering the adaptation of measures that have been established to curb climate change, it is important to ensure that the education system has been included in such a project. By improving people's knowledge of climate change, it would be easier for them to adopt different mitigation measures. Also, there is a need to instil a culture among the younger generation on the best practices when it comes to environmental matters. The government must seek to ensure that systems that support learning, which undergirds adaptation are supported to enhance adaptation.

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