Greenhouse Gas Emissions in India

India Numbers at a Glance (2014)

3,202 $MtCO_2e$*
Total GHG emissions (6.55% of world total)
World: 48,892.37 $MtCO_2e$

1,293,859,294
Population
World: 7,268,986,176

2.48
tCO_2e per capita
World: 6.73 tCO_2e

US$ 2,130,703 Million
GDP**
World: US$73,479 Billion

1,503
tCO_2e/million US$ GDP
World: 665 tCO_2e/million US$ GDP

+2,060 $MtCO_2e$ (+180%)
Change in GHG emissions (1990-2014)
World: +15,069 $MtCO_2e$ (+45%)

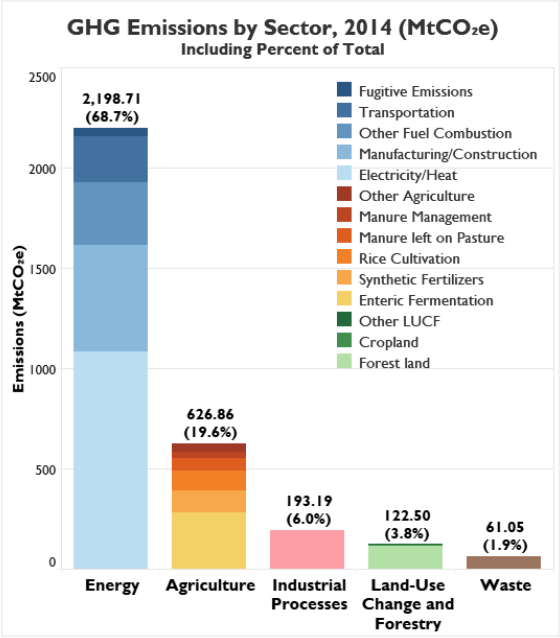
Sources: WRI CAIT 4.0, 2017. Emissions including Land-Use Change and Forestry. Global Warming Potentials are from the Intergovernmental Panel on Climate Change Second Assessment Report.

*Million metric tons of carbon dioxide equivalent.

**Gross Domestic Product (GDP) in constant 2010 US$

Greenhouse Gas (GHG) Emissions by Sector

According to the World Resources Institute Climate Analysis Indicators Tool (WRI CAIT), India's 2014 GHG profile was dominated by emissions from the energy sector, which accounted for 68.7% of total emissions.[1] Within the energy sector, 49% of emissions were due to electricity and heat generation, followed by 24% from manufacturing and construction. Agriculture was the second highest source (19.6% of total emissions), with enteric fermentation contributing 45% of agriculture emissions.[2] Industrial processes (IP), land use change and forestry (LUCF), and waste contributed 6.0%, 3.8% and 1.9% of 2014 total emissions, respectively.



Sources: WRI CAIT 4.0, 2017, FAOSTAT, 2018

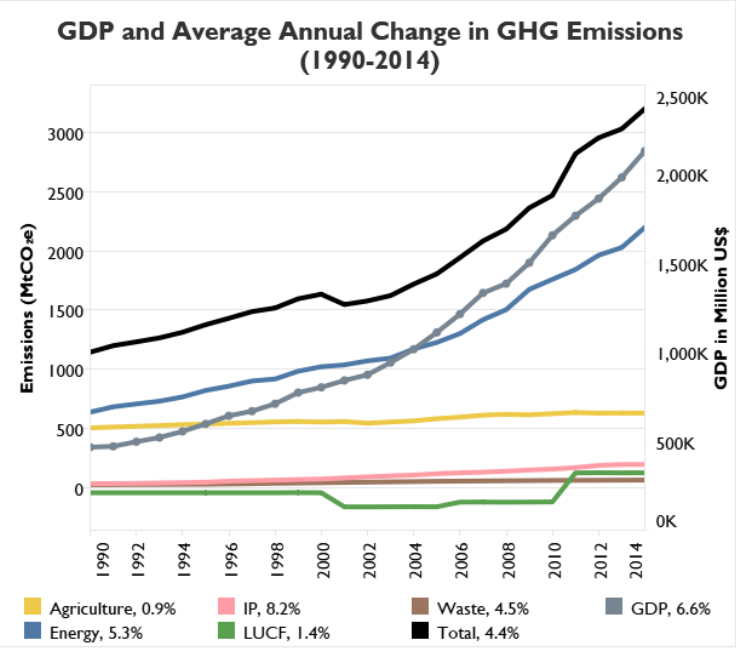
India's First Biennial Update Report (BUR) to the UNFCCC, submitted in 2015, includes a GHG inventory for 2010 and GHG trends from 2000 to 2010. The BUR shows land use, land use change and forestry (LULUCF) to have been a net carbon sink in 2010, absorbing 252.53 $MtCO_2e$ more than what was emitted that year.[3] From 2000 to 2010, WRI CAIT also shows LUCF as a net sink, but from 2011 until the most recent year for which data are available, 2014, CAIT shows LUCF to have become an emissions source. The BUR does not present data from 2011 onwards. However, the GHG Platform – India has published GHG emission estimates for 2005 to 2013, including for agriculture, forestry and other land use (AFOLU).[4] It shows the land subsector to have been an increasing carbon sink from 2005 to 2013, with removals increasing from 134.0 $MtCO_2e$ in 2005 to 177.7 $MtCO_2e$ in 2013.[5] Direct comparison of findings from multiple sources can be difficult due to the use of different estimation methodologies and data sources.[6] The BUR and WRI CAIT show energy to be the highest GHG emitting sector in India, followed by agriculture.

Change in GHG Emissions in India (1990-2014)

According to WRI CAIT, India's GHG emissions increased by 2,060 $MtCO_2e$ (180%) from 1990 to 2014. The graph below shows the average annual change in emissions during this period. Emissions from the two highest emitting sectors are discussed below.

Energy: According to WRI CAIT, energy emissions increased by 1,563 $MtCO_2e$ (246%) from 1990 to 2014. International Energy Agency data show that total electricity generation quadrupled between 1991 and 2014, with an increasing share of coal and a decreasing share of hydropower.[7] As of 2014, 74% of electricity was generated by coal, followed by hydro (11%), natural gas (5%), nuclear (3%), wind (3%), fuel oil (2%), and biofuels (2%).[8] Despite being the world's third largest electricity producer, India's electricity consumption per capita is among the world's lowest.[9] Industries consume 42% of the electricity generated, followed by the residential sector (26%), agriculture and forestry (15%), commercial and public services (10%), and other (8%).[10] From 2000 to 2014, the number of industries almost doubled, increasing industrial sector fuel consumption by 406%.[11]

The Center for Study of Science, Technology & Policy notes that coal has continued to dominate the electricity generation mix due to developmental aspirations, increased demand, and economic development policies, but that coal-based power generation emissions are expected to gradually decrease due to improved efficiency in newly introduced technologies such as super-critical boilers for thermal power generation. The government has doubled the coal tax (Clean Environment Cess) to Rs 400 per tonne of coal with proceeds channeled to set up the National Clean Energy and Environment Fund to finance clean energy technologies. At the sub-national level, the State Action Plan on Climate Change includes strict regulations toward reducing coal footprints.[12] Renewable energy is being promoted, with the 2003 Electricity Act and the 2005 National Electricity Policy providing the regulatory framework through tariffs, renewable purchase obligations (RPO), grid connectivity, and market development. In 2015, India set a target to install 175 GW from renewable energy sources by 2022, of which 100 GW will be from solar photovoltaic (PV), 60 GW from wind, 10 GW from biomass, and 5 GW from small hydropower stations.[13] However, other government policies, such as more than doubling the coal consumption limit and the one billion tonne coal production target, could increase power sector emissions by an estimated 1,427 $MtCO_2e$.[14] Civil society experts have noted that the next focus of India's emission mitigation policy, centered largely on electricity generation, must be expanded to the industrial sector and that it is critical to devise ways for the sector to reduce dependence on fossil energy while ensuring rapid growth in manufacturing and associated jobs and enhancing international competitiveness.[15]



Source: WRI CAIT 4.0, 2017

Agriculture: WRI CAIT data show that agriculture emissions increased 25% from 1990 to 2014, driven by emissions from synthetic fertilizers (47%) and enteric fermentation from livestock (30%).[16] FAO data show that from 2002 to 2014, use of nitrogen fertilizers (total N) increased 62%, potash (K_2O) 59%, and phosphates (P_2O_5) 51%.[17] The BUR notes that growth in total fertilizer consumption has been significant over the 2002-2012 decade and contributed (along with irrigation and availability of seeds) substantially to increased food grain productivity. It also notes that several technologies to reduce GHG emissions with sustainable crop and livestock management have been developed under the National Initiative on Climate Resilient Agriculture. The government has also proposed complementary actions to reduce methane emissions from ruminants, including modifications of diet, and from rice paddies. Between 1990 and 2014, FAO data show that the number of cattle decreased 8%, but buffaloes, sheep, and goats increased 37%, 29% and 17% respectively.[18] Emissions from enteric fermentation grew 30% during this time frame. The overall contribution of the livestock sector to total GDP was nearly 4.11% during 2012-2013, while the agriculture sector share of GDP was 17.6% in 2014.[19]

Carbon Intensity: GHG Emissions Relative to Gross Domestic Product (GDP)

According to WRI CAIT data, India's GDP increased 357% from 1990 to 2014, while GHG emissions increased 180%. In 2014, India emitted more than twice the GHGs relative to GDP than the world average.[20] However, India has taken significant steps towards initiating a low carbon economy across various sectors,[21] and pledged in its Intended Nationally Determined Contribution (INDC) to reduce GDP emissions intensity by 33-35% by 2030 from 2005 levels.

Climate Change Mitigation Targets and Plans

In its INDC, India pledged to achieve electric power installed capacity of about 40% from non-fossil fuel-based energy resources by 2030 with the help of technology transfer and low-cost international finance, create an additional carbon sink of 2.5 to 3 billion tonnes of CO_2 equivalent by 2030 through additional forest and tree cover, mobilize domestic and additional funds from developed countries to implement mitigation actions, and build capacity, create a domestic framework and international architecture for quick diffusion of cutting edge climate technology in India, and for joint collaborative research and development for future technologies. Upon India's ratification of the Paris Agreement in October 2016, the INDC became its first NDC.

[1] World Resources Institute Climate Analysis Indicators Tool (WRI CAIT 4.0, 2017). GHG emissions are expressed in units of carbon dioxide equivalents. Global Warming Potentials (GWPs) are the 100-year GWPs from the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report (SAR).
[2] Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT). India, Emissions – Agriculture total, viewed on September 18, 2018.
[3] India. India's First Biennial Update Report (BUR) to the UNFCCC, 2015. The BUR uses GWPs from the IPCC SAR. The BUR shows total GHG and sector emissions in $GgCO_2e$. For this factsheet, the 2010 data were converted to $MtCO_2e$ ($GgCO_2e$/1000) for ease of reference: energy (1510.12 $MtCO_2e$), agriculture (390.17 $MtCO_2e$), IP (171.50 $MtCO_2e$), waste (65.05 $MtCO_2e$), LULUCF (-252.53 $MtCO_2e$), total GHGs incl. LUCF (1884.31 $MtCO_2e$).
[4] Dhingra, S. Mehta, R. (2017). AFOLU Emissions. Version 2.0 dated September 28, 2017, from GHG platform India: GHG platform India-2005-2013 National Estimates - 2017 Series http://ghgplatform-india.org/data-and-emissions/afolu.html. The GHG Platform - India shows emissions/removals from three AFOLU subcategories: Livestock, Land, and Aggregate sources and non-CO_2 emissions sources on land. AFOLU emissions are calculated based on GWPs from the IPCC SAR.
[5] The GHG Platform – India shows land emissions/removals from settlements, other land, grassland, forest land, and cropland.
[6] The estimation methodologies and data sources are as follows. The GHG Platform: The land subsector emission estimations follow the 2006 IPCC guidelines, and Tier 2 level methodologies. Emission factors are country specific. Estimations of emissions/removals from the land subcategories are based on the following data sources: the Forest Survey of India (FSI) for forest land, and the land use change matrix prepared by the National Remote Sensing Centre (NRSC) for cropland, grassland, settlements and other land (For more details see: GHG Platform India - National Level Greenhouse Gas Estimates for the Agriculture, Forestry and Other Land Use Sector (AFOLU) 2005-2013, 2017). WRI CAIT: For LUCF sector emissions, WRI CAIT draws on data from the Food and Agriculture Organization Statistics Division (FAOSTAT). Land Use Total contains total emissions and removals from forest land, cropland, grassland and burning biomass. The FAOSTAT emissions database is computed following Tier 1 IPCC 2006 Guidelines for National GHG Inventories. GHG emissions are provided by country, regions and special groups, relative to the period 1990-present (with annual updates). For subcategories including forest land, FAO also provides the implied emission factor as well as activity data (area, net area difference, total forest area and carbon stock in living biomass).
[7] International Energy Agency (IEA). Statistics: India, Electricity and Heat, 1991 and 2014, viewed on September 18, 2018. In 1991, 23% of electricity was generated by hydroelectric plants.
[8] IEA Statistics: India, Electricity and Heat, 2014, viewed on September 18, 2018.
[9] IEA Atlas of Energy – Total Electricity Generation, viewed on September 19, 2018.
[10] IEA Statistics: India, Electricity and Heat, 2014, viewed on September 19, 2018.
[11] Government of India. Ministry of Statistics and Programme Implementation. Statistical Yearbook India 2017 – Industry – Annual Survey of Industries (Factory Sector) - All India & State.
[12] The Center for Study of Science, Technology & Policy (CSETP). Policy Note - GHG Emissions from India's Electricity Sector, October 2017.
[13] Government of India, Ministry of New and Renewable Energy. Press Information Bureau - A target of installing 175 GW of renewable energy capacity by the year 2022, viewed on September 19, 2018.
[14] CSTEP Policy Note, 2017.
[15] Vaibhav Chaturved, Poonam Nagar Koti and Anjali Ramakrishnan Chordia, Council on Energy, Environment and Water (CEEW). Sustainable Development, Uncertainties, and India's Climate Policy Pathways towards Nationally Determined Contribution and Mid-Century Strategy, April 2018.
[16] FAOSTAT, 2018.
[17] FAOSTAT, India – Agriculture Use - Fertilizers by Nutrient (2002-2014), viewed on September 19, 2018.
[18] FAOSTAT, India – Live Animals, viewed on September 19, 2018.
[19] India. India's First Biennial Update Report (BUR) to the UNFCCC, 2015.
[20] WRI CAIT 4.0, 2017.
[21] India. India's First Biennial Update Report (BUR) to the UNFCCC, 2015.