

# Trend Analysis of GHG Emissions in UTTAR PRADESH

GHG Platform India is a civil society initiative providing an independent estimation and analysis of India's Greenhouse Gas (GHG) emissions across key sectors, namely- Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry & Other Land Use (AFOLU) and Waste.

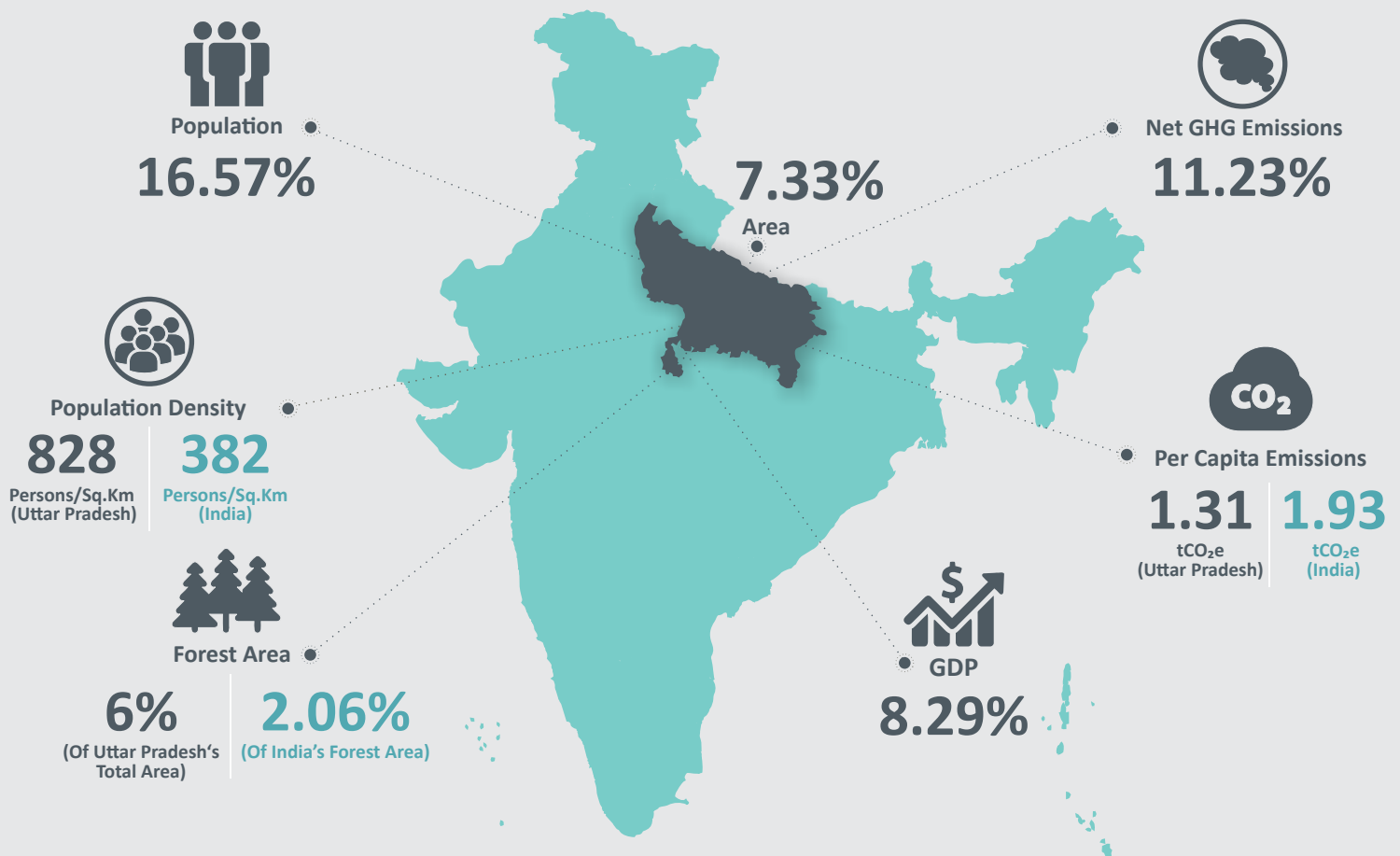
The Platform seeks to add value to the various ongoing GHG emission estimation efforts by helping address existing data gaps and data accessibility issues, extending beyond the scope of national inventories to state inventories, and by increasing the volume of analytics and policy dialogue on India's GHG emissions sources, profile, and related policies.

The initiative estimates and assesses GHG emissions and removals from the following sectors:



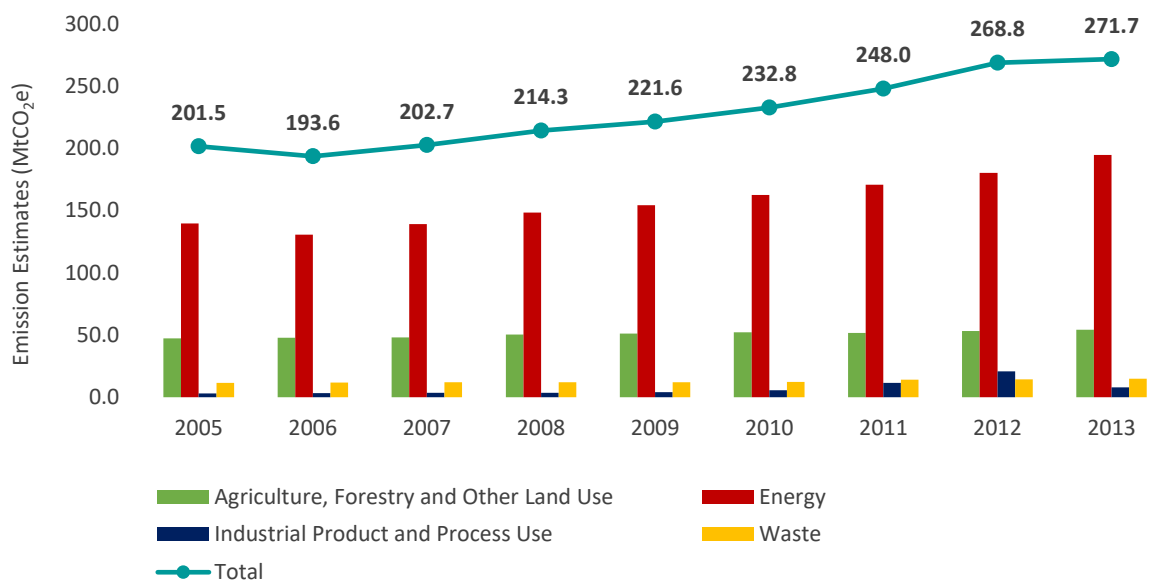
\*Fuel combusted for Captive Electricity Generation (Auto-Producers) has been reported under Energy sector.

## Uttar Pradesh at a glance (2013)



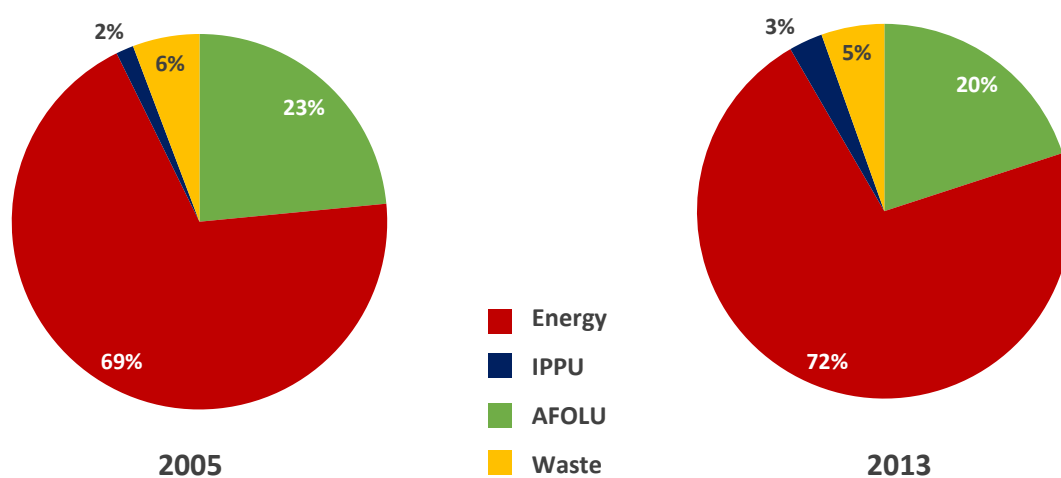
# Economy-wide Emission Estimates

**Figure 1: GHG Emission Estimates for Uttar Pradesh (2005 to 2013)**



Emissions of Uttar Pradesh grew from 201.5 MtCO<sub>2</sub>e to 271.7 MtCO<sub>2</sub>e at an estimated CAGR<sup>1</sup> of 3.8% from 2005 to 2013<sup>2</sup>. The maximum contribution of emissions in 2013 came from the Energy Sector (~72%) followed by the AFOLU sector (~20%). While the percentage share in emissions from the AFOLU sector came down from ~23% in 2005 to ~20% in 2013. However, the percentage from the Energy, IPPU and Waste sectors grew only marginally as depicted in Figure 2 below.

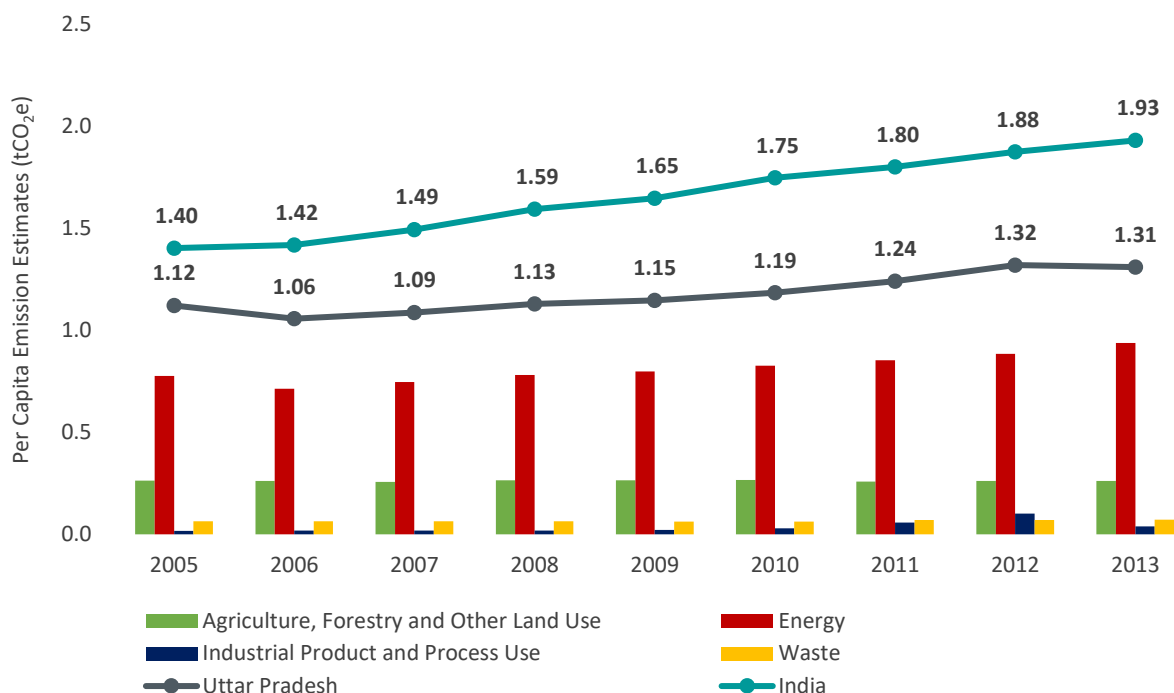
**Figure 2: Sector-wise Contribution to Economy-wide GHG Emissions of Uttar Pradesh**



<sup>1</sup> Compound Annual Growth Rate

<sup>2</sup> Calendar year values have been considered for this analysis. For Global Warming Potential (GWP) calculations IPCC-ARII values have been considered.

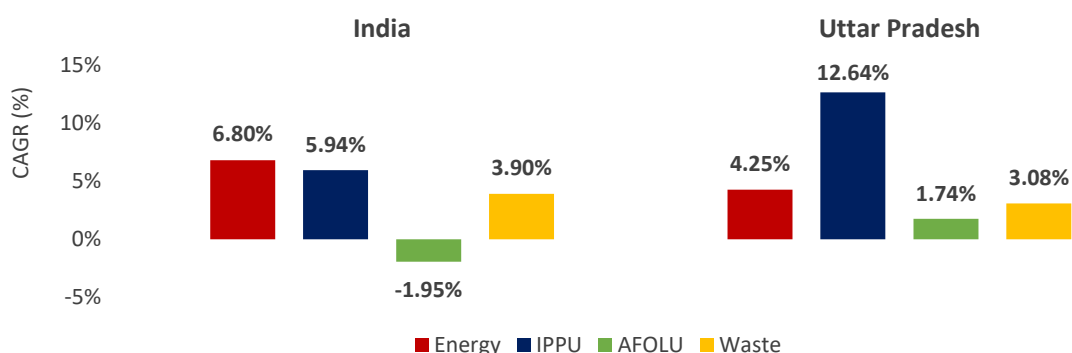
**Figure 3: Per Capita GHG Emissions for Uttar Pradesh and India (2005 to 2013)**



The per capita emissions in Uttar Pradesh grew from 1.12 tCO<sub>2</sub>e in 2005 to 1.31 tCO<sub>2</sub>e in 2013. When compared to per capita emissions in India, Uttar Pradesh recorded lower per capita emissions. This is perhaps a reflection of the relatively lower per capita income of Uttar Pradesh coupled with a relatively higher density of population when compared with the all India averages for these indicators respectively. The observed CAGR of per capita emissions for Uttar Pradesh and India was 1.96% and 4.07% respectively.

**Figure 4: Sector-wise GHG Emissions Growth Rate from 2005 to 2013**

*These growth rates have been compounded annually.*



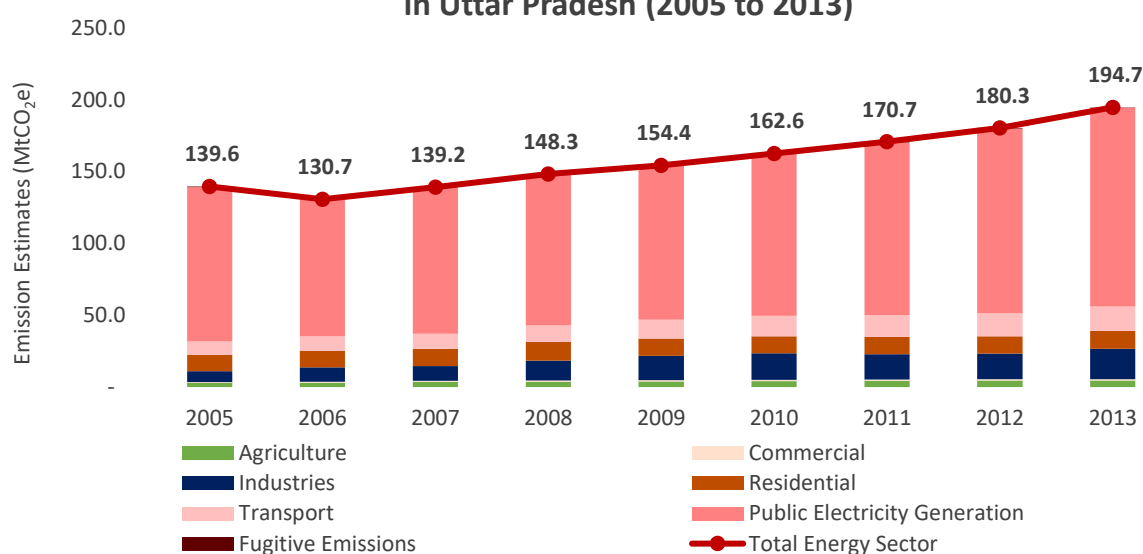
The IPPU sector recorded the highest growth of 12.64% among all the sectors but had an insignificant contribution to the overall emission of Uttar Pradesh during the reference period. The AFOLU sector emissions grew at 1.74% during the reference period, unlike the negative growth of emissions from this sector for the rest of the country. The rate of growth of emissions for both the Energy and Waste sectors was below that of India as a whole for the reference period.



## Energy Sector

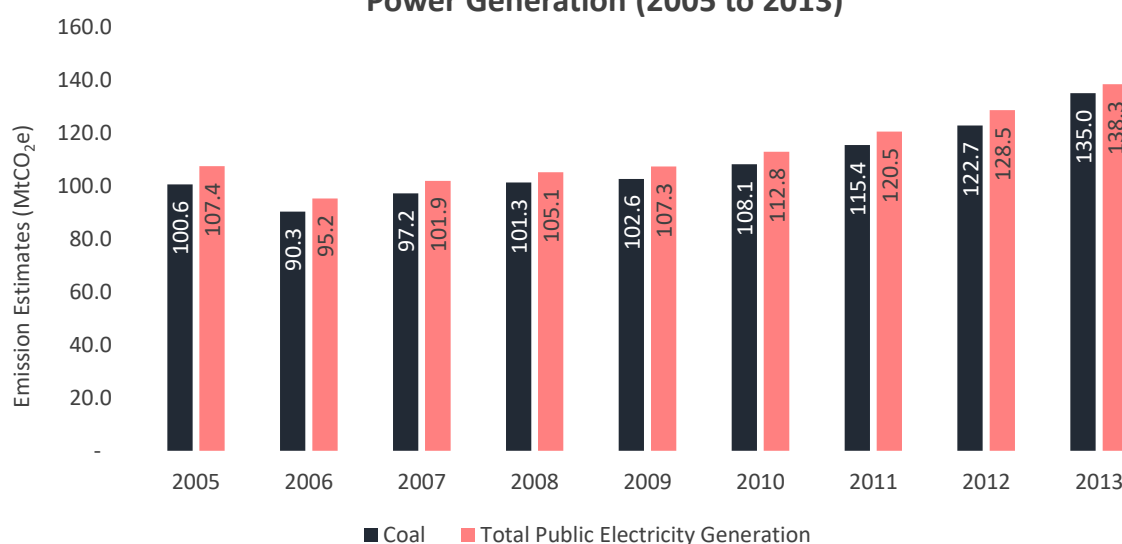
Energy sector represented ~72% of total emissions in Uttar Pradesh in 2013. In general, emissions from Energy sector arise from two main sub-sectors – Fuel Combustion (Public Electricity Generation, Transport, Industries and Agriculture, Commercial and Residential categories) and Fugitive. In Uttar Pradesh, maximum emissions arose from Fuel Combustion and negligible emissions (~0.1%) from Fugitive sub-sector. The Energy sector emissions increased at a CAGR of 4.2% from 139.6 MtCO<sub>2</sub>e in 2005 to 194.7 MtCO<sub>2</sub>e in 2013 as depicted in Figure 5 below.

**Figure 5: GHG Emission Estimates for Energy Sector in Uttar Pradesh (2005 to 2013)**



Public Electricity Generation was a major category under the Fuel Combustion sub-sector in Uttar Pradesh's Energy emissions portfolio. Maximum Public Electricity Generation emissions in Uttar Pradesh emanated from Coal-based Power Plants followed by Natural Gas-based Plants. The total emissions from Coal-based Power Plants increased at an estimated CAGR of 3.7% from 100.6 MtCO<sub>2</sub>e in 2005 to 135 MtCO<sub>2</sub>e in 2013. Emissions from Public Electricity Generation increased from 107.4 MtCO<sub>2</sub>e in 2005 to 138.3 MtCO<sub>2</sub>e in 2013 at a rate of 3.2% (compounded annually) as illustrated in Figure 6 below.

**Figure 6: GHG Emission Estimates for Coal-based Power Generation (2005 to 2013)**





## IPPU Sector

IPPU sector represented ~3% of the total GHG emissions of Uttar Pradesh in 2013. Emissions from IPPU sector are largely driven by Chemical, Metal, Mineral Industries and Non-Energy Products from Fuels and Solvent Use. Between 2005 to 2013, overall IPPU emissions in Uttar Pradesh rose at a CAGR of 12.6% from 3.1 MtCO<sub>2</sub>e in 2005 to 7.9 MtCO<sub>2</sub>e in 2013. However, there was a significant jump in the overall IPPU emissions in the year 2012 as depicted in Figure 7 due to an increase in the emissions from Ammonia Production.

**Figure 7: GHG Emission Estimates for IPPU Sector in Uttar Pradesh (2005 to 2013)**

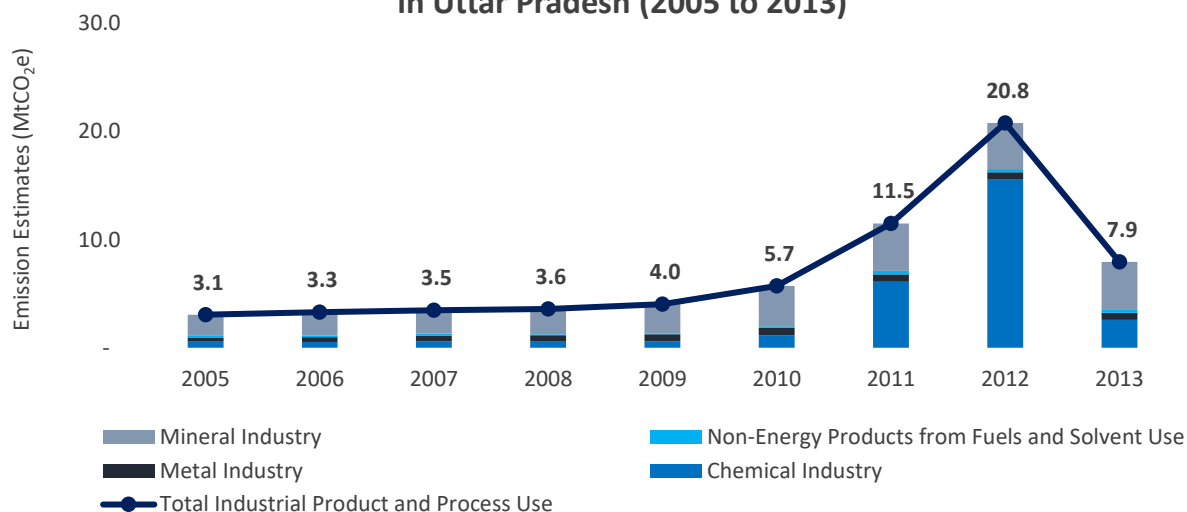
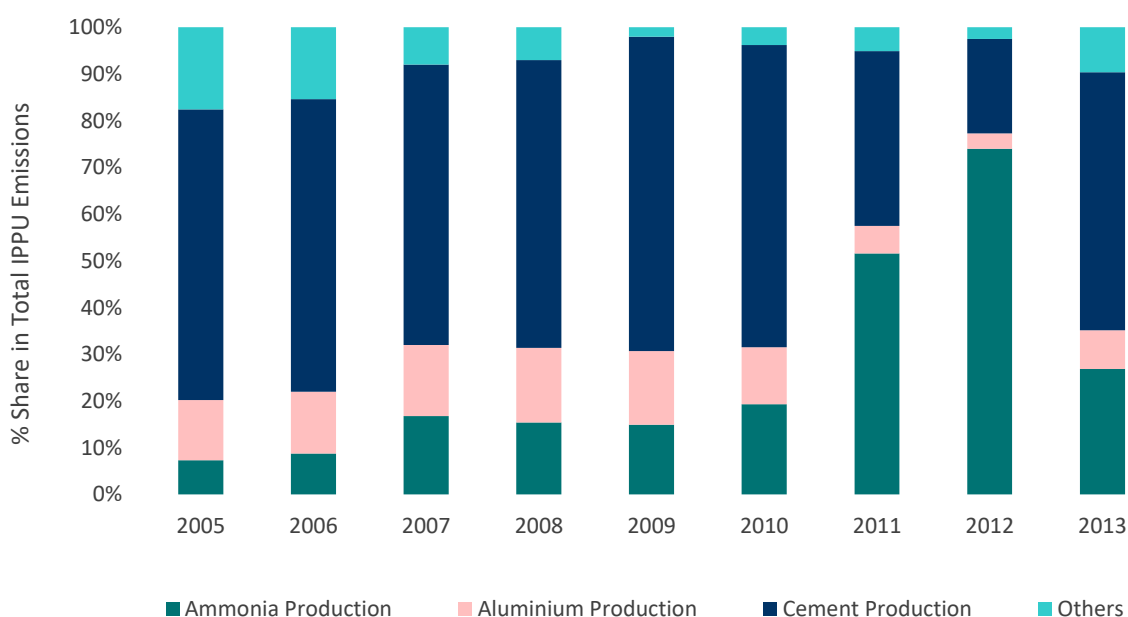


Figure 8 below depicts a trend of GHG emissions by various IPPU categories. Cement was a key driver of IPPU emissions throughout 2005 to 2013 except in 2011 and 2012. For the years 2011 and 2012, Ammonia Production contributed to majority of the IPPU emissions in the state. In 2013, the combined share of Cement and Ammonia Production in the overall IPPU emissions was close to 82%. However, detailed information on Ammonia Production at the state level wasn't available to validate this trend and perform recalculations.

**Figure 8: Share of GHG Emissions from IPPU Categories (2005 to 2013)**

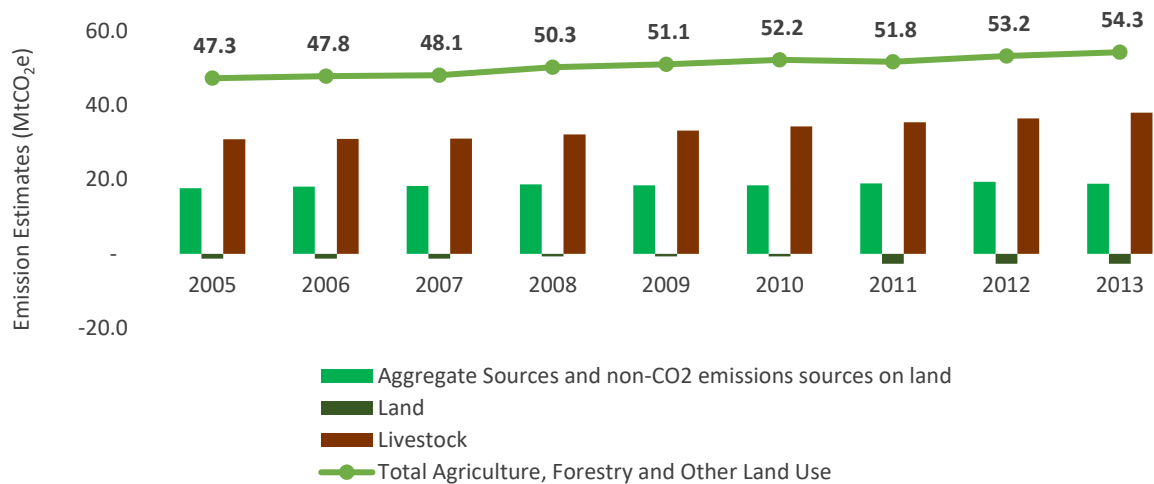




## AFOLU Sector

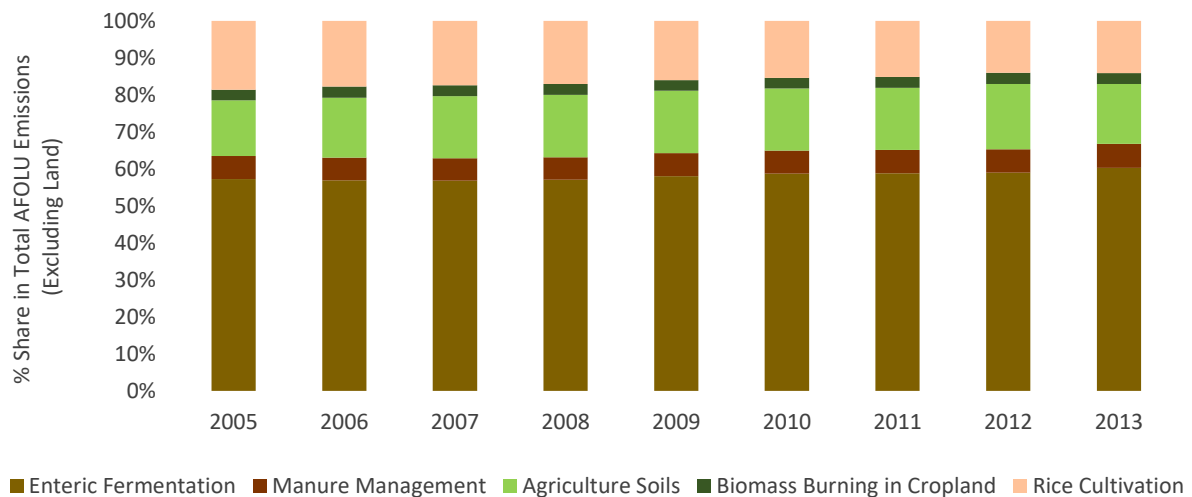
Emissions from AFOLU sector represented ~20% of emissions in Uttar Pradesh in 2013. Emissions from AFOLU sector arose from three main sub-sectors namely Livestock, Land and Aggregate sources and Non-CO<sub>2</sub> Emissions Sources on Land. AFOLU emissions grew at a CAGR of 1.7% from 47.3 MtCO<sub>2</sub>e in 2005 to 54.3 MtCO<sub>2</sub>e in 2013 denoting a remarkably flat growth curve for a predominantly rural economy. Notably, Land sub-sector was a sink throughout the reference period, and removals of GHGs observed an increase from 2011 onwards due to an increase in the carbon stock in Uttar Pradesh.

**Figure 9: GHG Emission Estimates for AFOLU Sector in Uttar Pradesh (2005 to 2013)**



Out of the three sub-sectors, the maximum emissions in 2013 were from Livestock sub-sector i.e. Enteric Fermentation and Manure Management. This was mainly due to an increase in Livestock population in the state that is perhaps a reflection of the importance of dairy and other associated activities in the animal husbandry sector. Enteric Fermentation with ~60% contribution towards AFOLU emissions in 2013 was a major contributor. The growth curve of emissions due to Agricultural Soils and Biomass Burning in Uttar Pradesh remained flat from 2005 to 2013. However, the share of emissions due to Rice Cultivation declined from ~19% in 2005 to ~14% in 2013 as depicted in Figure 10 below.

**Figure 10: Share of GHG Emissions for AFOLU Sub-sectors (Excluding Land)**

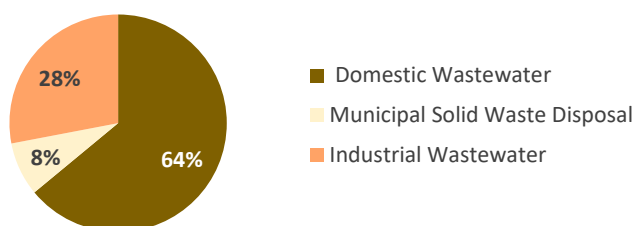




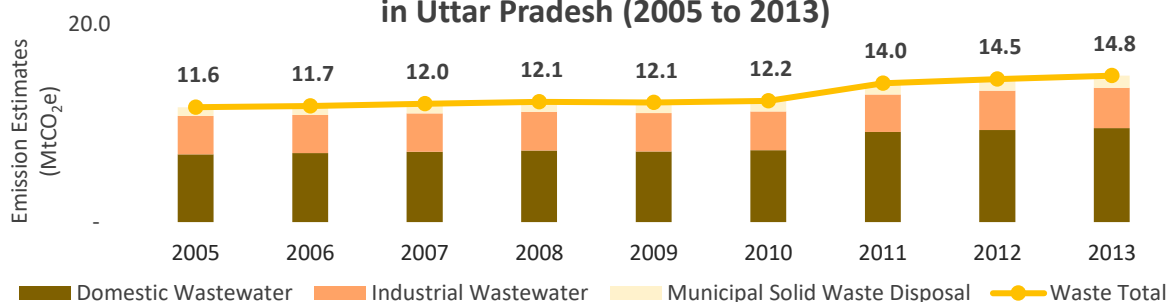
## Waste Sector

The Waste sector contributed to ~5% of total emissions of Uttar Pradesh in 2013. Municipal Solid Waste<sup>3</sup>, Domestic Wastewater and Industrial Wastewater were the key sources of GHG emissions in the Waste sector. The Waste sector emitted 14.8 MtCO<sub>2</sub>e in 2013 as compared to 11.6 MtCO<sub>2</sub>e in 2005 as depicted in Figure 12 below. GHG emissions from the Waste sector grew at a CAGR of 3.1% from 2005 to 2013. A spike in emissions in 2011 was observed which can be attributed to higher Domestic wastewater emissions, which reflects changing trends in use of various treatment systems as reported in Census of India 2011.

**Figure 11: Category-wise Share of GHG Emissions for Waste Sector (in 2013)**



**Figure 12: GHG Emission Estimates for Waste Sector in Uttar Pradesh (2005 to 2013)**

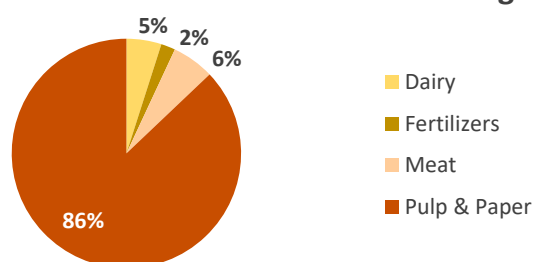


Domestic Wastewater comprised ~64% of the total emissions of the Waste sector in Uttar Pradesh in 2013. Emissions in Uttar Pradesh from Domestic Wastewater increased at a CAGR of 4.2% from 6.8 MtCO<sub>2</sub>e in 2005 to 9.5 MtCO<sub>2</sub>e in 2013. Almost 71% of Domestic Wastewater emissions were from the rural areas of Uttar Pradesh in 2013. Discharge of untreated wastewater and use of septic tanks are key drivers of emissions in this sub-sector.

Industrial Wastewater contributed to almost 28% of emissions in 2013 from Uttar Pradesh's Waste sector. Deep diving into the various Industries, it was observed that almost 86% of Industrial Wastewater emissions arose from Pulp and Paper Industries in 2013 followed by Meat (~6%), Dairy (~5%) and Fertilizers (~2%).

Municipal Solid Waste represented ~8% of the Waste sector emissions in the year 2013. Changing Solid Waste composition over the years resulted in an increase in the GHG emissions generated from every tonne of Solid Waste disposed off in Uttar Pradesh and emissions from this sub-sector increased at 4% (CAGR) from 0.9 MtCO<sub>2</sub>e in 2005 to 1.2 MtCO<sub>2</sub>e in 2013.

**Figure 13: Share of GHG Emissions for Industrial Wastewater Categories (in 2013)**



<sup>3</sup> Refers to emission in urban areas. Emissions from Municipal Solid Waste Disposal in rural areas are not considered, as disposal predominantly occurs in a dispersed manner and does not generate significant CH<sub>4</sub> emissions.



The GHG Platform India is a civil society initiative providing an independent estimation and analysis of India's Greenhouse Gas (GHG) emissions across key sectors, namely- Energy, IPPU, AFOLU and Waste.

The Platform comprises of the following civil society:



*An initiative supported by*



The **Council on Energy, Environment and Water (CEEW)** is one of South Asia's leading not-for-profit policy research institutions. It uses data, integrated analysis and strategic outreach to explain – and change – the use, reuse, and misuse of resources.

The **International Maize and Wheat Improvement Center (CIMMYT)** is the global leader in agricultural research for development in wheat and maize-based farming systems.

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**Shakti Sustainable Energy Foundation** works to strengthen the energy security of the country by aiding the design and implementation of policies that encourage energy efficiency, renewable energy and sustainable transport solutions.

**Vasudha Foundation**, set up in 2010, is a not for profit organisation, working in the clean energy and climate policy space.

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