

# Trend Analysis of GHG Emissions in MADHYA 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:



ENERGY



IPPU\*



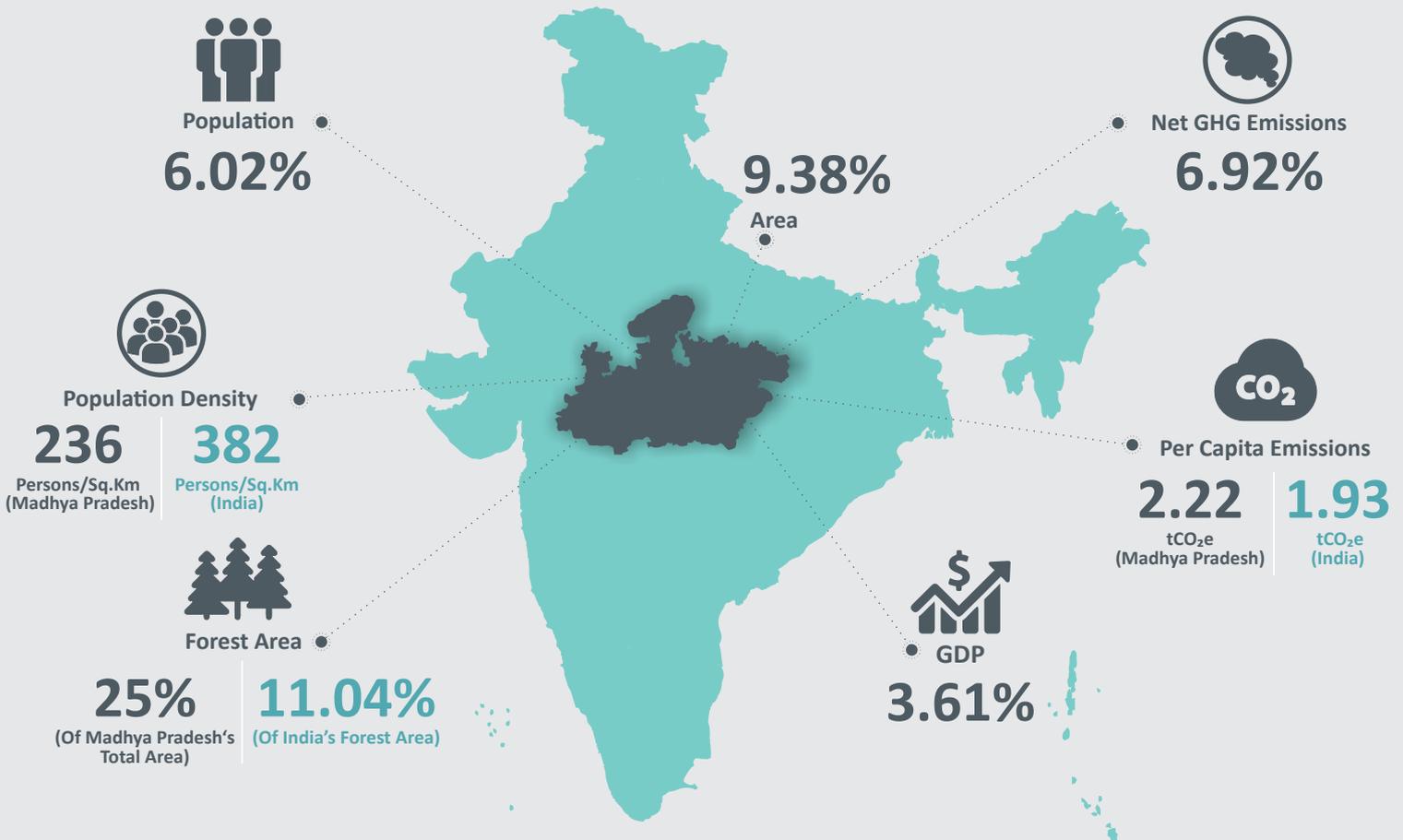
AFOLU



WASTE

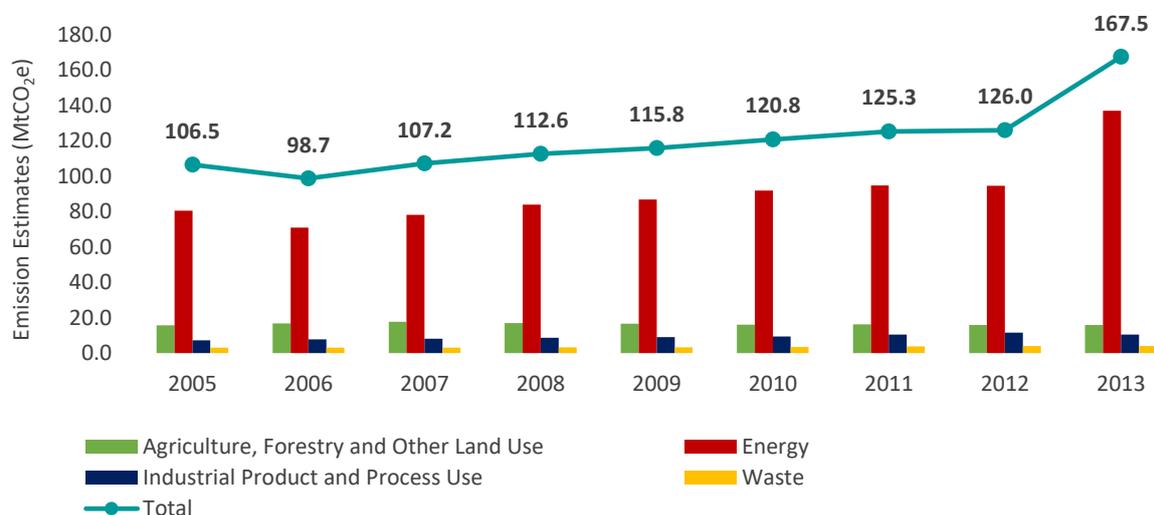
\*Fuel combusted for Captive Electricity Generation (Auto-Producers) has been reported under Energy sector.

## Madhya Pradesh at a glance (2013)



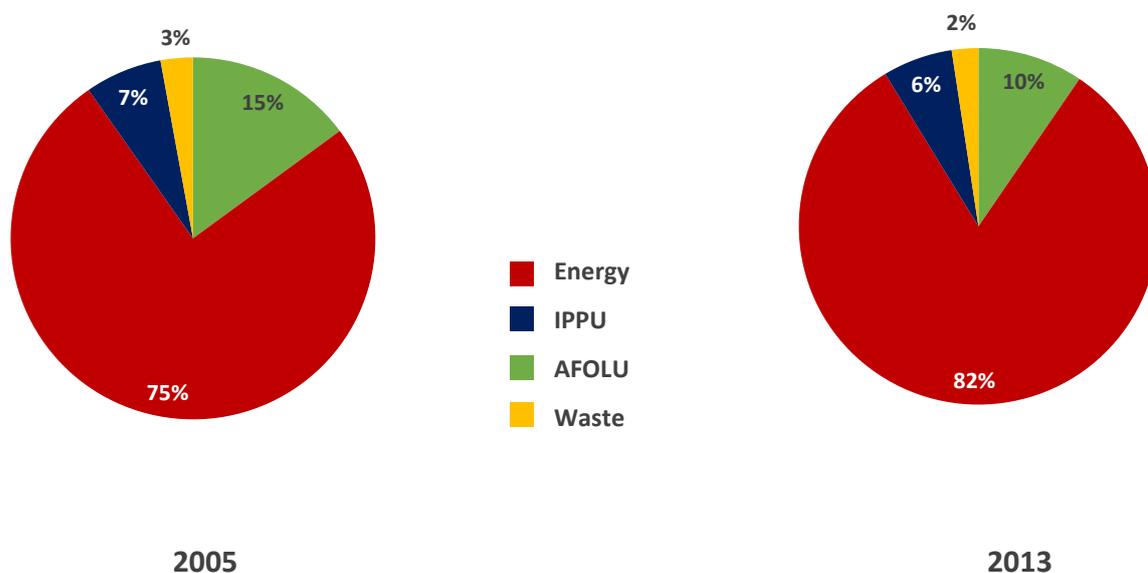
# Economy-wide Emission Estimates

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



Emissions from Madhya Pradesh grew from 106.5 MtCO<sub>2</sub>e to 167.5 MtCO<sub>2</sub>e at an estimated CAGR<sup>1</sup> of 5.82% from 2005 to 2013<sup>2</sup> as illustrated in Figure 1 above. In 2005, Energy sector represented ~75% of the total GHG emissions in Madhya Pradesh while the AFOLU sector comprised ~15% emissions. The remaining ~10% emissions originated from the IPPU (~7%) and Waste sectors (~3%) of Madhya Pradesh. In 2013, the share of Energy sector emissions increased to ~82% while that of the AFOLU sector reduced to ~10% when compared to 2005. Notably, the share of IPPU and Waste sectors reduced marginally to ~6% and ~2% respectively between 2005 and 2013. (Figure 2).

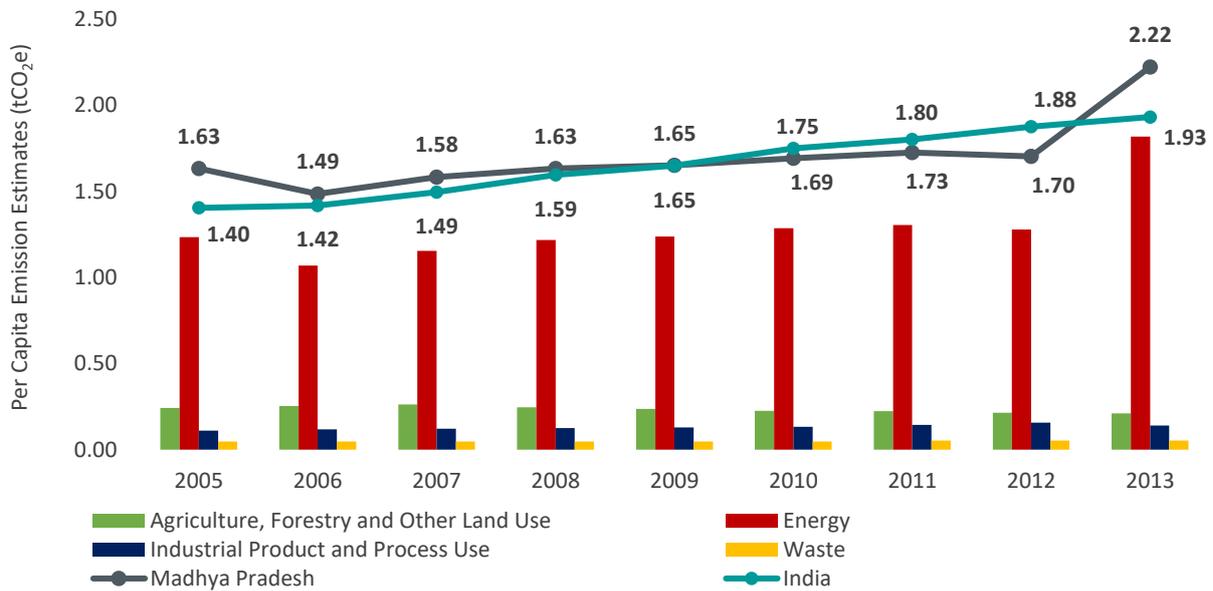
**Figure 2: Sector-wise Contribution to Economy-wide GHG Emissions of Madhya Pradesh**



<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.

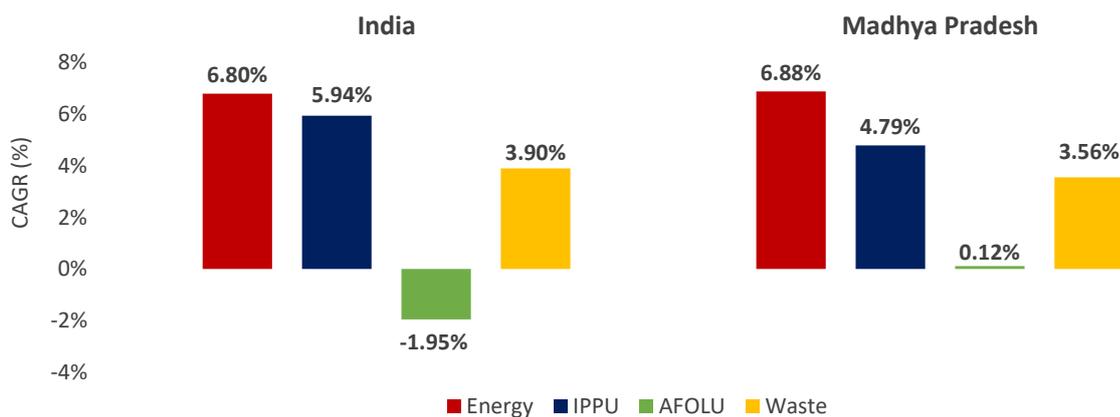
**Figure 3: Per Capita GHG Emissions for Madhya Pradesh and India (2005 to 2013)**



Per Capita emissions of Madhya Pradesh grew from 1.63 tCO<sub>2</sub>e in 2005 to 2.22 tCO<sub>2</sub>e in 2013 as shown in Figure 3 above. When compared to India, Madhya Pradesh’s per capita emissions were in the same range between 2006 to 2012, and higher than India to begin with in 2005. In 2013, Madhya Pradesh recorded a significant jump, primarily due to an increase in emissions from the Energy Sector. The CAGR of per capita emissions in India and Madhya Pradesh was 4.07% and 3.93% respectively for the reference period. This was due to a relatively higher base that Madhya Pradesh began with in 2005.

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

*These growth rates have been compounded annually*



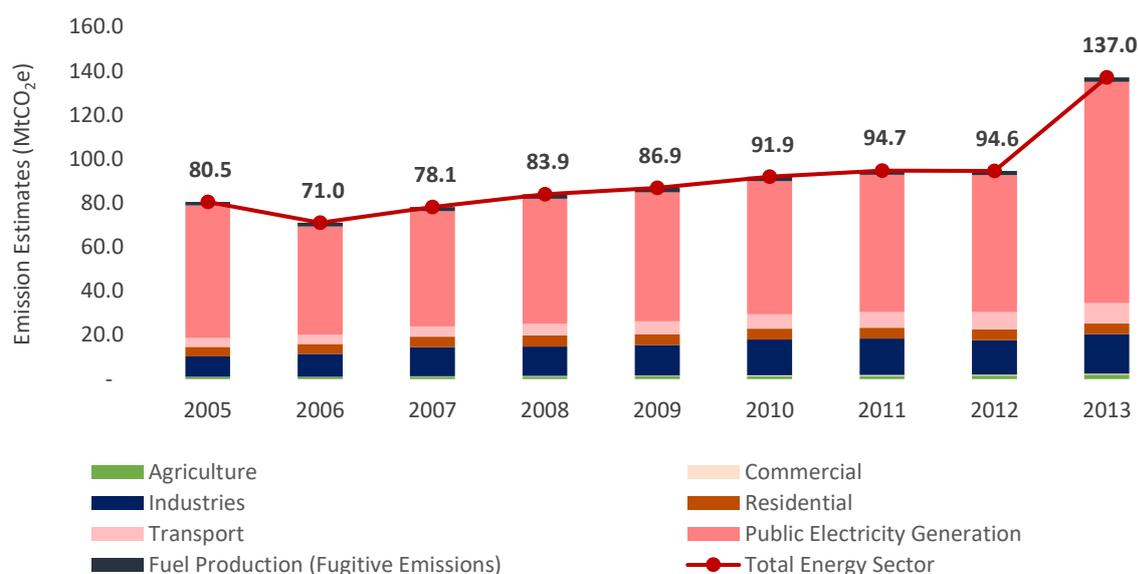
The Energy sector in Madhya Pradesh recorded the highest CAGR of 6.88% from 2005 to 2013 as shown in Figure 3 above. The IPPU sector registered a growth rate of 4.79% for the reference period followed by the Waste sector, which had a slightly lower CAGR of 3.56%. The AFOLU sector recorded the lowest CAGR of only 0.12% from 2005 to 2013. When compared to India, the Energy and Waste sectors of Madhya Pradesh had similar growth rates as that of the country., while the IPPU sector’s GHG emission growth rate was slightly below that of India.



## Energy Sector

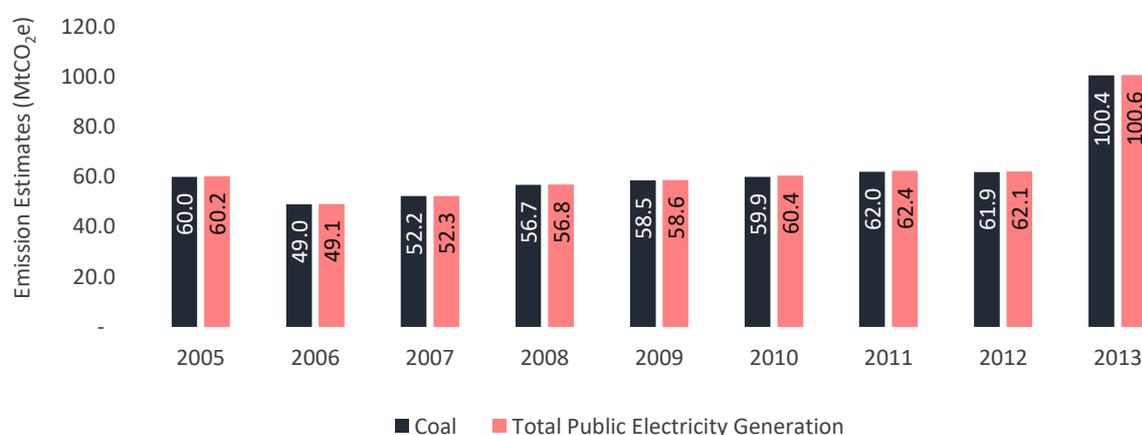
The Energy sector represented ~82% of total emissions in the state of Madhya Pradesh in 2013. In general, emissions from the Energy sector arise from two main sub-sectors – Fuel Combustion (Public Electricity Generation, Transport, Industries and Agriculture, Commercial and Residential categories) and Fugitive. In Madhya Pradesh, maximum emissions emanated from Fuel Combustion and negligible emissions from the Fugitive sub-sector. The Energy sector emissions grew at a CAGR of 6.88% from 80.5 MtCO<sub>2</sub>e in 2005 to 137 MtCO<sub>2</sub>e in 2013 as shown in Figure 5 below.

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



Public Electricity Generation was a major category under the Fuel Combustion sub-sector with ~73% contribution in Madhya Pradesh's Energy emissions portfolio in 2013. Under Public Electricity Generation maximum emissions emanated from the Coal-based Power Plants (99.8% in 2013). The total emissions from Coal-based Power Plants increased at an estimated CAGR of 6.65% from 60.0 MtCO<sub>2</sub>e in 2005 to 100.4 MtCO<sub>2</sub>e in 2013 as shown in Figure 6 below.

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





## IPPU Sector

The IPPU sector represented ~6% of the total GHG emissions in Madhya Pradesh in 2013. Emissions from the IPPU sub-sectors are largely driven by Chemical, Metal, Mineral Industries and Non-Energy Products from Fuels and Solvent Use. Between 2005 and 2013, the overall IPPU emissions in Madhya Pradesh rose at a CAGR of 4.79% from 7.2 MtCO<sub>2</sub>e in 2005 to 10.5 MtCO<sub>2</sub>e in 2013. However, an interim peak is evident in year 2012 due to increase in emissions from the iron and steel sector as shown in Figure 7 below.

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

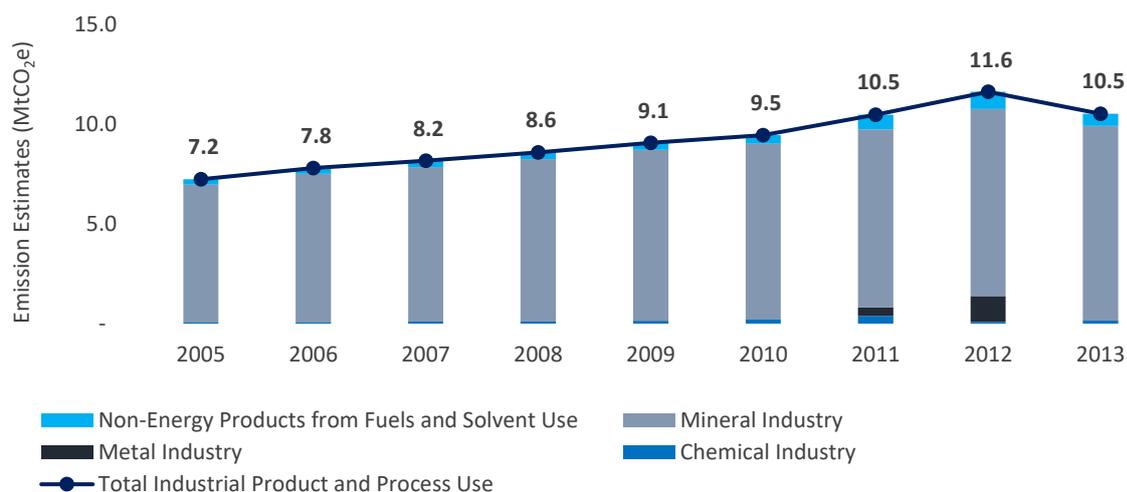


Figure 8 below, depicts the trend of GHG emissions by various Industrial categories during the reference period. Cement Production was found to be the key driver of IPPU emissions throughout 2005 to 2013. However, emissions from limestone consumption in iron and steel industries were only observed in the year 2011 and 2012. In 2013, share of Cement Production in overall IPPU was roughly 92% and the remaining ~8% emissions were recorded from ammonia production and other categories.

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

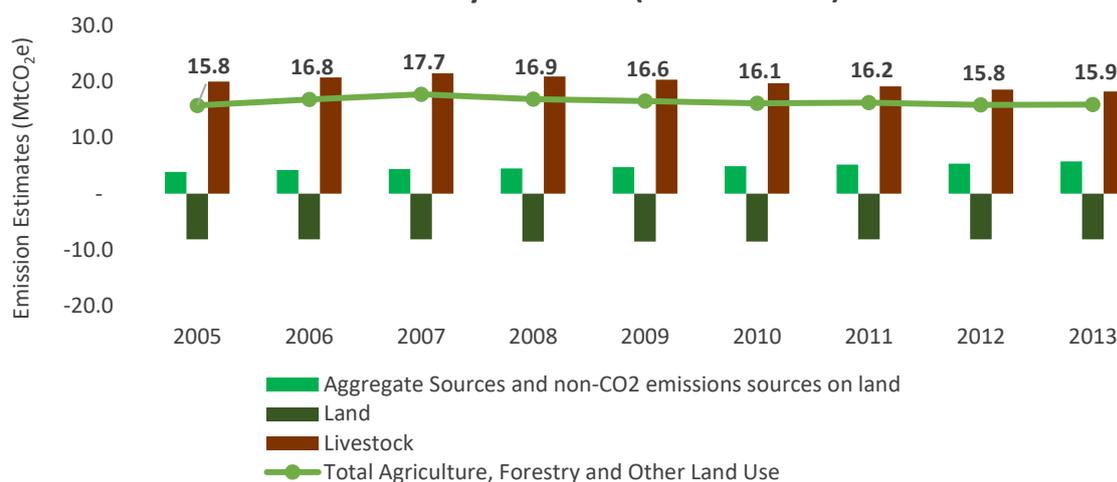




## AFOLU Sector

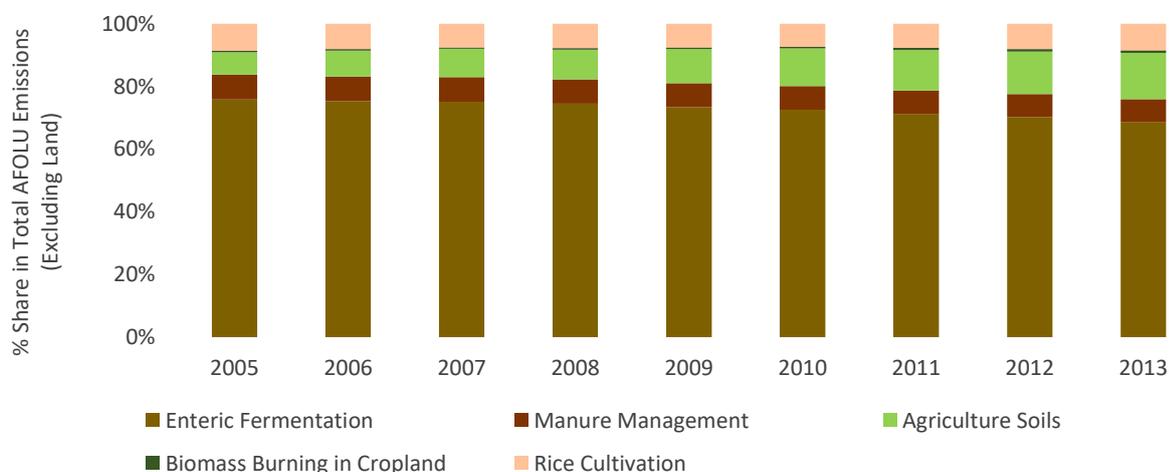
The AFOLU sector represented ~10% of emissions in Madhya Pradesh in 2013. Emissions from the AFOLU sector arise from three main sub-sectors namely Livestock, Land and Aggregate sources and Non-CO<sub>2</sub> Emissions Sources on Land. While Livestock sub-sector and Aggregate sources and Non-CO<sub>2</sub> Emissions Sources on Land were net emitters of GHGs, the Land sub-sector acted as a net sink for the entire reference period as shown in Figure 9 below. The emissions of the AFOLU sector grew at an almost flat CAGR of 0.12% from 15.8 MtCO<sub>2</sub>e in 2005 to 15.9 MtCO<sub>2</sub>e in 2013.

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



Out of the three sub-sectors, maximum emissions were recorded from the Livestock (~76% in 2013) sub-sector (Enteric Fermentation & Manure Management) across all the years. This was perhaps a reflection of the importance of dairy and other associated activities in the animal husbandry sector of Madhya Pradesh. If emissions from the AFOLU sector are considered without the removals from the Land sub-sector, maximum emissions arose from Enteric Fermentation across all the years (~69% in 2013). However, the contribution of Enteric Fermentation in the total AFOLU emissions reduced from ~76% in 2005 to ~69% in 2013 as shown in Figure 10 below.

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





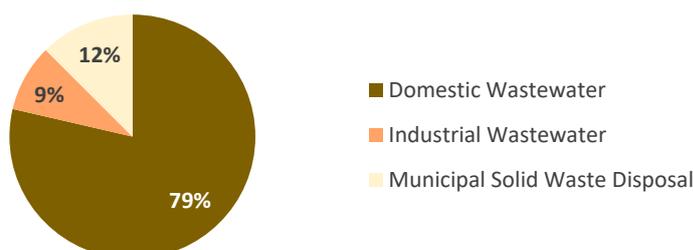
## Waste Sector

The Waste sector contributed to ~2% of total emissions in Madhya Pradesh in 2013. Municipal Solid Waste<sup>3</sup>, Domestic Wastewater and Industrial Wastewater are the key sources of GHG emissions in the Waste sector. GHG emissions from Waste grew at a CAGR of 3.56% from 3.03 MtCO<sub>2</sub>e in 2005 to 4.01 MtCO<sub>2</sub>e in 2013.

**Figure 11: GHG Emission Estimates from Waste Sector in Madhya Pradesh (2005 to 2013)**



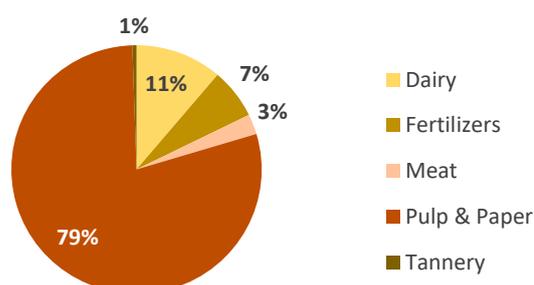
**Figure 12: Category-wise Share of GHG Emissions for Waste Sector (in 2013)**



Domestic Wastewater represented ~79% of the total Waste emissions in 2013. Emissions of the Domestic Wastewater originating from the rural and urban areas of the Madhya Pradesh increased at CAGR of 3.90% from 2.32 MtCO<sub>2</sub>e in 2005 to 3.16 MtCO<sub>2</sub>e in 2013. Almost 64% of Domestic Wastewater emissions arose from rural areas of Madhya Pradesh in 2013. Municipal Solid Waste contributed 12% of Waste sector emissions in 2013. Changing Solid Waste composition has resulted in an increase in the GHG emissions generated from every tonne of Solid Waste disposed over the years in Madhya Pradesh and emissions from this sub-sector grew at a CAGR of 4.43% from 0.35 MtCO<sub>2</sub>e in 2005 to 0.50 MtCO<sub>2</sub>e in 2013.

Industrial Wastewater contributed to almost 9% of emissions in 2013 from Madhya Pradesh's Waste sector. Deep diving into the various Industrial Wastewater categories, it was observed that almost 79% emissions arose from the Pulp and Paper Industries in 2013 followed by Dairy Waste (11%) as shown in Figure 13 below.

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



<sup>3</sup> 'Refers to emission in urban areas. Emissions from 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'



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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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**ICLEI - Local Governments for Sustainability** is a leading global network of over 1,500 cities, towns and regions committed to building a sustainable future.

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

**WRI-India** is a research organization that turns big ideas into action at the nexus of environment, economic opportunity and human well-being.

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