

# Trend Analysis of GHG Emissions in GUJARAT

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\***



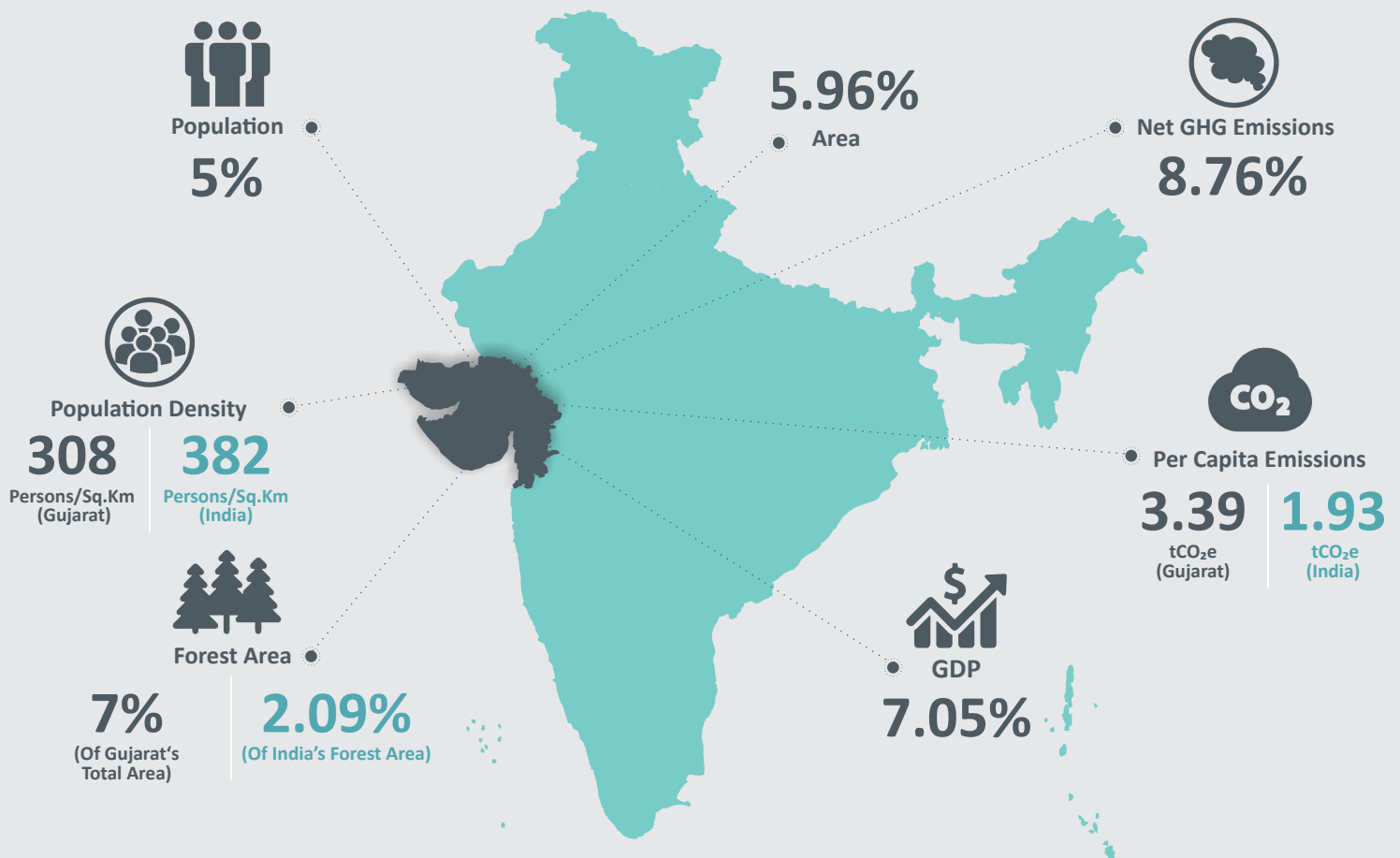
**AFOLU**



**WASTE**

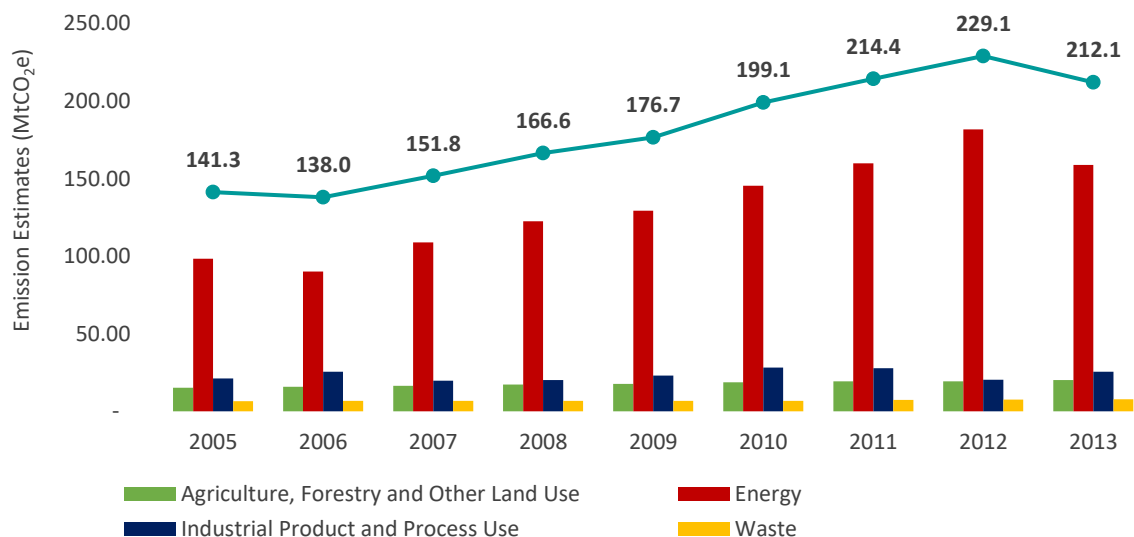
\*Fuel combusted for Captive Electricity Generation (Auto-Producers) has been reported under Energy sector.

## Gujarat at a glance (2013)



# Economy-wide Emission Estimates

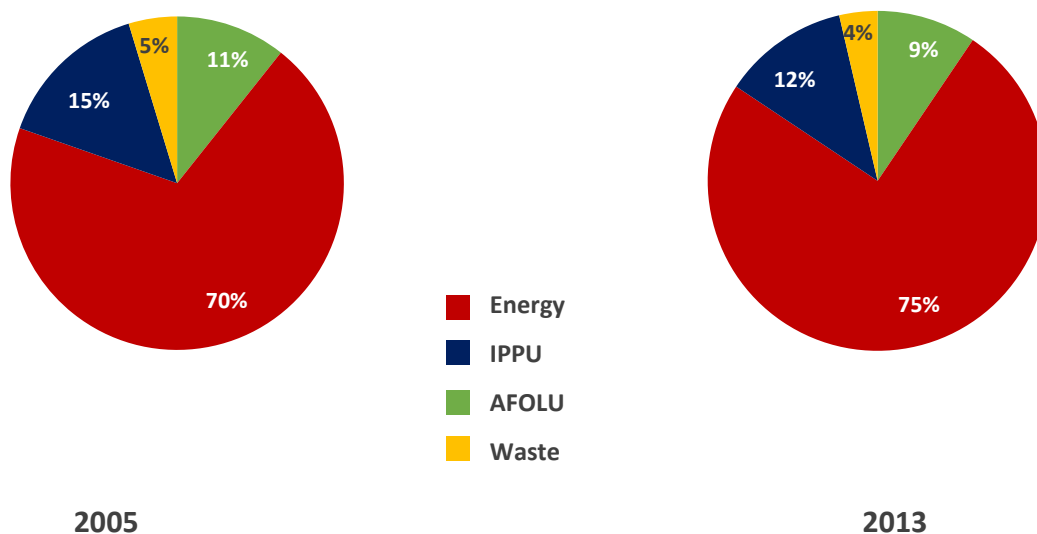
Figure 1: GHG Emission Estimates for Gujarat (2005 to 2013)



Emissions of Gujarat grew from 141.3 MtCO<sub>2</sub>e to 212.1 MtCO<sub>2</sub>e at an estimated CAGR<sup>1</sup> of 5.21% from 2005 to 2013<sup>2</sup>. In 2012, a peak in the overall emissions was observed owing to an increase in the emissions of the Energy sector.

Almost 75% of the emissions of Gujarat were from the Energy sector followed by 12% emissions from the IPPU sector. The remaining 13% emissions were attributed to the AFOLU (~9%) and Waste (~4%) sectors in 2013. When compared to 2005 values, the sectoral contribution from the Energy sector had increased, while the proportion of the AFOLU, IPPU and Waste sectors decreased in the total emissions of Gujarat as illustrated in Figure 2 below.

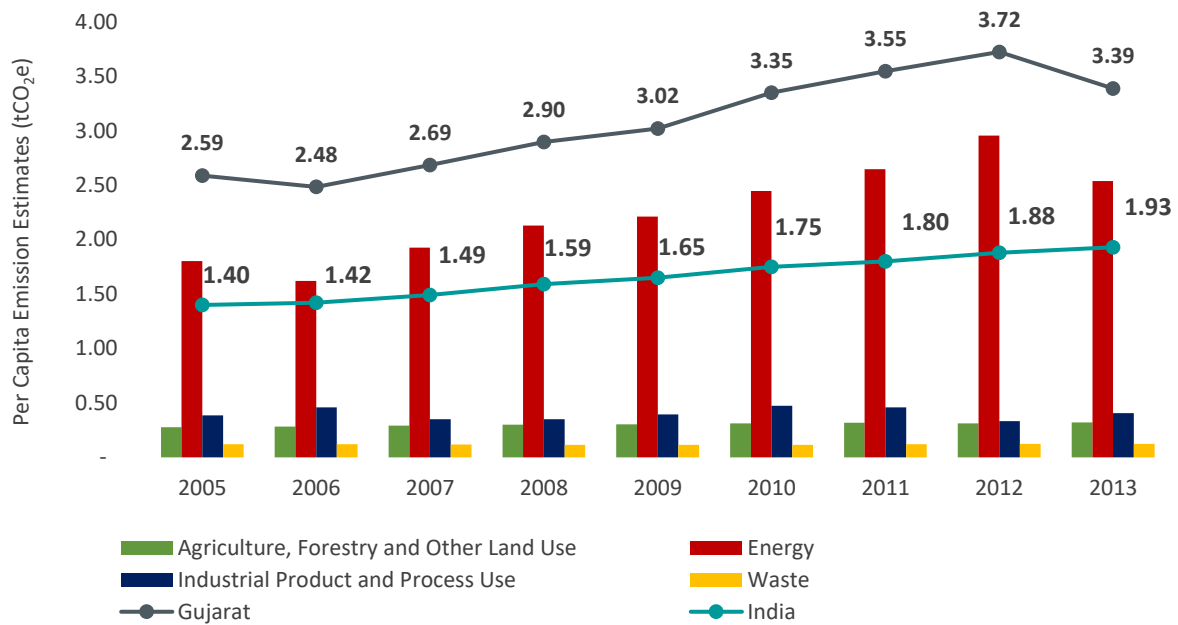
Figure 2: Sector-wise Contribution to Economy-wide GHG Emissions of Gujarat



<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.

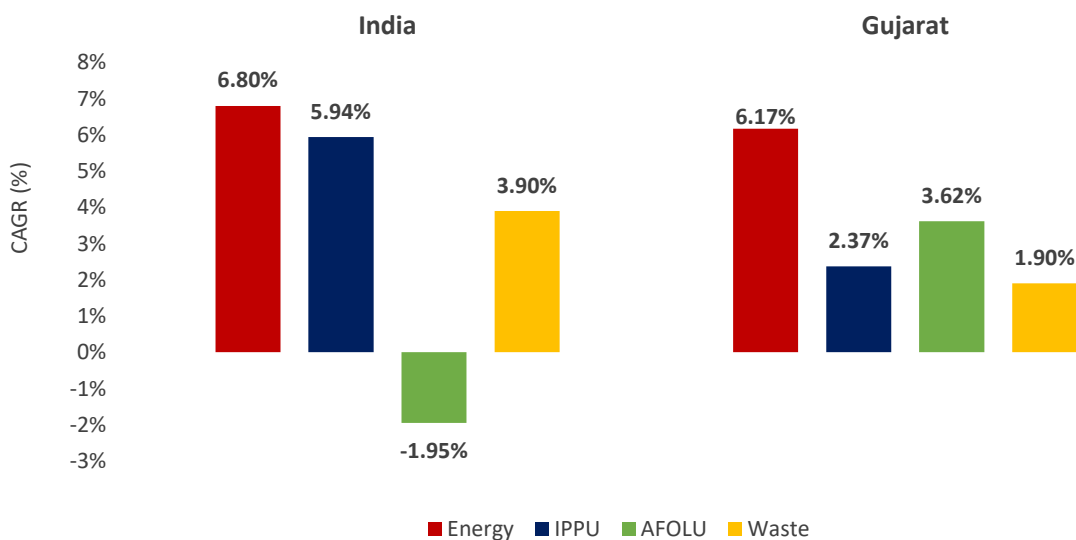
**Figure 3: Per Capita GHG Emissions for Gujarat and India (2005 to 2013)**



Per capita emissions of Gujarat grew from 2.59 tCO<sub>2</sub>e in 2005 to 3.39 tCO<sub>2</sub>e in 2013 as depicted in Figure 3 above. The highest per capita emissions were observed in 2012 owing to increased Energy emissions. When compared to per capita emissions of India, Gujarat registered substantially higher per capita emissions across all the years. The observed growth rate of the per capita emissions in Gujarat and India was 3.42% and 4.07% respectively from 2005 to 2013.

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

*These growth rates have been compounded annually.*



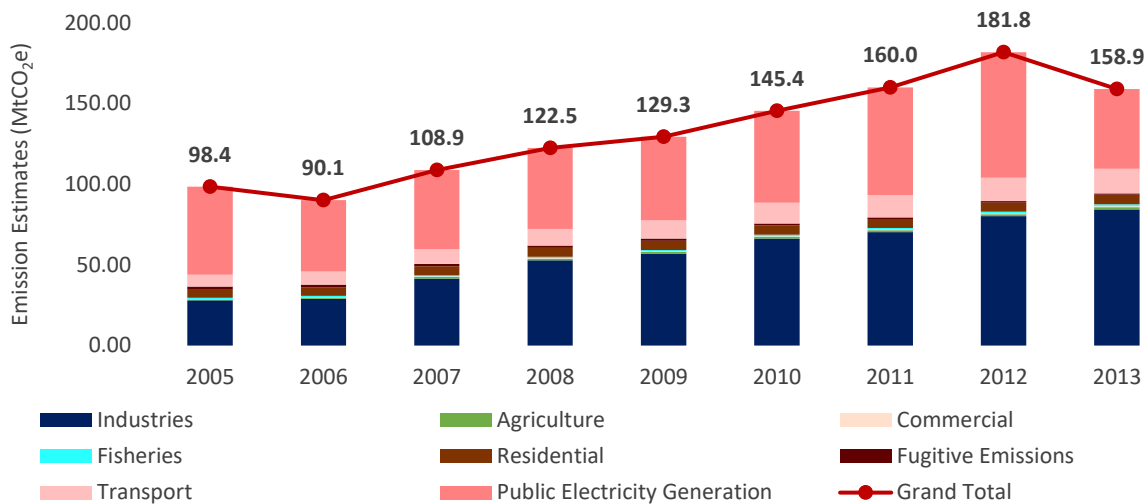
The Energy sector in Gujarat had the highest growth rate of GHG emissions (6.17%) from 2005 to 2013. When compared to India, the sectoral growth rates of the GHG emissions of Gujarat were lower than that of the country for all the sectors except the AFOLU sector. The AFOLU sector of Gujarat had a much higher growth rate of GHG emissions (3.62%) in comparison with India which recorded negative rate of growth of GHG emissions (-1.95%).



## Energy Sector

The Energy sector represented ~75% of the total emissions of Gujarat 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 2013, ~99% of the Energy emissions of Gujarat were from Fuel Combustion. Emissions from this sector grew at a CAGR of 6.17% from 98.4 MtCO<sub>2</sub>e in 2005 to 158.9 MtCO<sub>2</sub>e in 2013. A sudden dip in 2006 and a following rise in 2012 were recorded in the total Energy emissions due to variations in Public Electricity Generation category as shown in Figure 5.

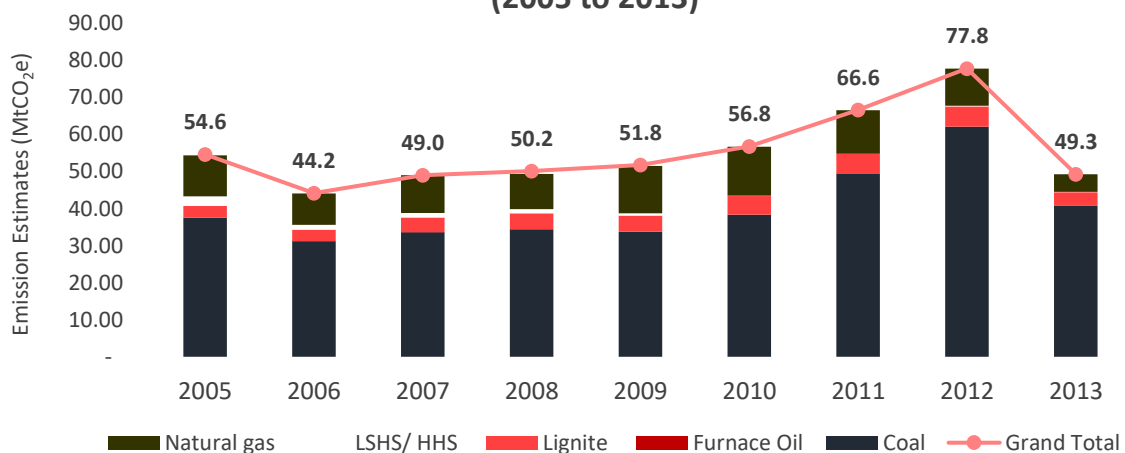
**Figure 5: GHG Emission Estimates for Energy in Gujarat (2005 to 2013)**



In 2013, emissions from the Fuels Combusted in the Industries (~53%) contributed the maximum emissions in Gujarat's Energy emissions portfolio followed by Public Electricity Generation (~31%). Notably, till 2007, Public Electricity Generation represented the maximum emissions in the Energy sector which declined from ~45% in 2007 to ~31% in 2013, thus, paving the way for the Industries category to become the major contributor of GHG emissions from 2008 onwards.

Under the Public Electricity Generation category, maximum emissions were observed from the burning of Coal and significant emissions were also recorded from Natural Gas, Lignite and other fuels. The year 2012 witnessed the maximum emissions from the Public Electricity Generation category owing to increased emissions from Fuel Combustion in Coal-fired Power Plants of Gujarat as illustrated in Figure 6 below. On an average, Coal contributed to nearly 72% of the emissions from this category followed by Natural Gas (~19%) and Lignite (~8%) during the reference period.

**Figure 6: GHG Emission Estimates for Public Electricity Generation (2005 to 2013)**

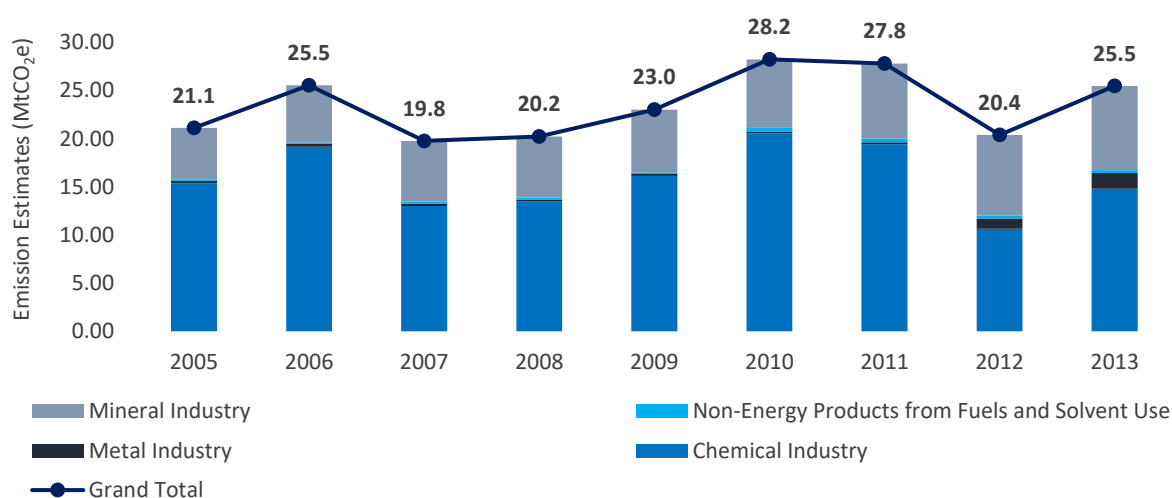




## IPPU Sector

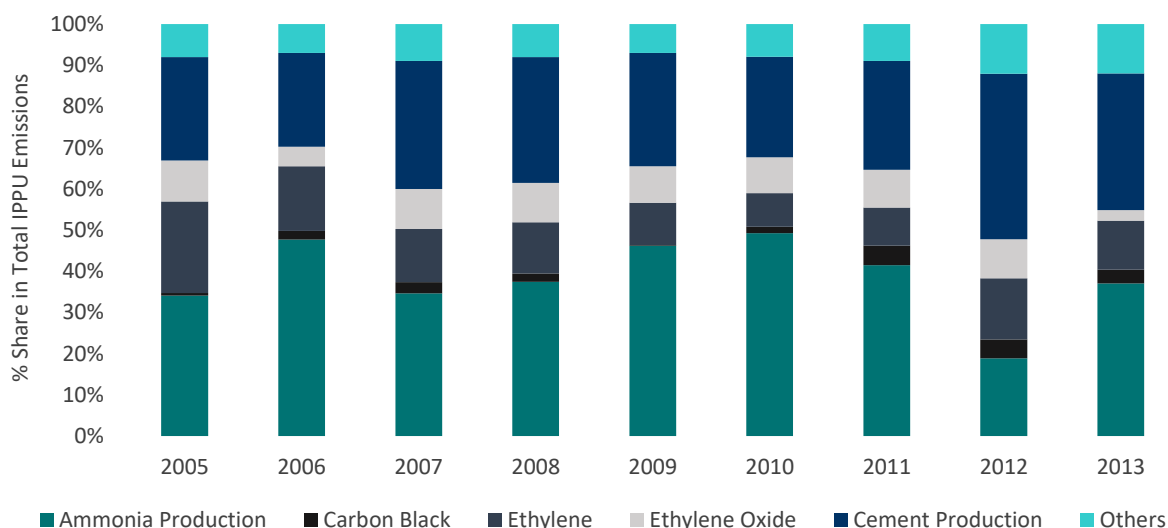
The IPPU sector represented ~12% of the total emissions of Gujarat in 2013. Emissions from the IPPU sector are largely driven by Chemical Metal, Mineral Industries and Non-Energy Products from Fuels and Solvent Use. Between 2005 and 2013, overall IPPU emissions in Gujarat grew at a CAGR of ~2.37% from 21.1 MtCO<sub>2</sub>e in 2005 to 25.5 MtCO<sub>2</sub>e in 2013. However, an interim dip was observed in the year 2007 due to relatively lower GHG emissions from the Chemical Industry owing to a decrease in GHG emissions from the Production of Ammonia. A similar scenario was also observed in the year 2012 as illustrated in Figure 7 below.

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



Yearly variations in IPPU emissions from Gujarat were a result of varying Ammonia Production reported by the factories in ASI database during the period (Figure 8). In 2013, shares of Ammonia and Cement Production contributed nearly ~37% and ~33% respectively to the overall IPPU emissions. Emissions due to the Production of Ammonia grew at a CAGR of 3.47% from 7.2 MtCO<sub>2</sub>e in 2005 to 9.5MtCO<sub>2</sub>e in 2013. Whereas, emissions from Cement Production grew at a relatively higher CAGR of 6.04% from 5.3 MtCO<sub>2</sub>e in 2005 to 8.5MtCO<sub>2</sub>e in 2013.

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

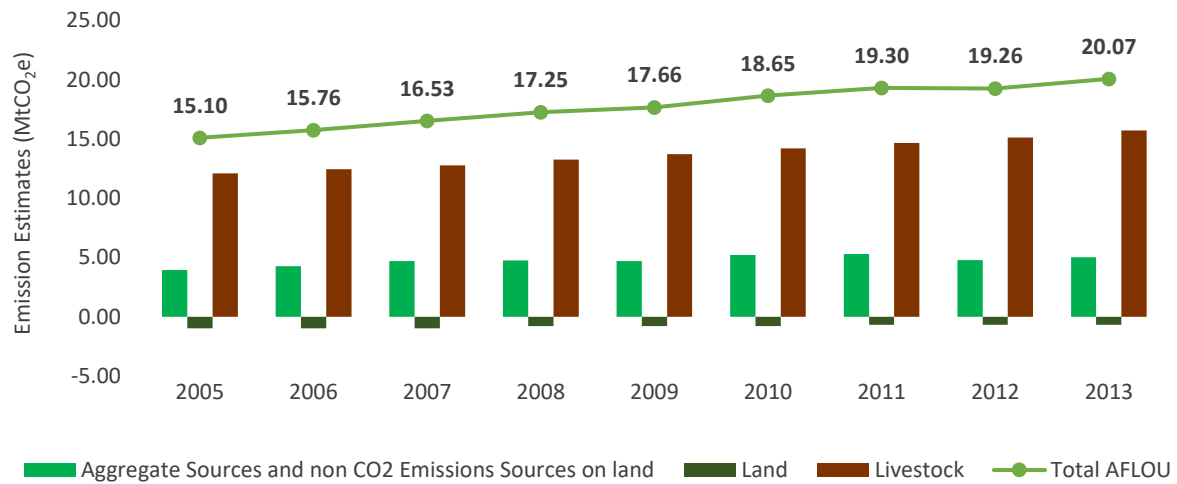




## AFOLU Sector

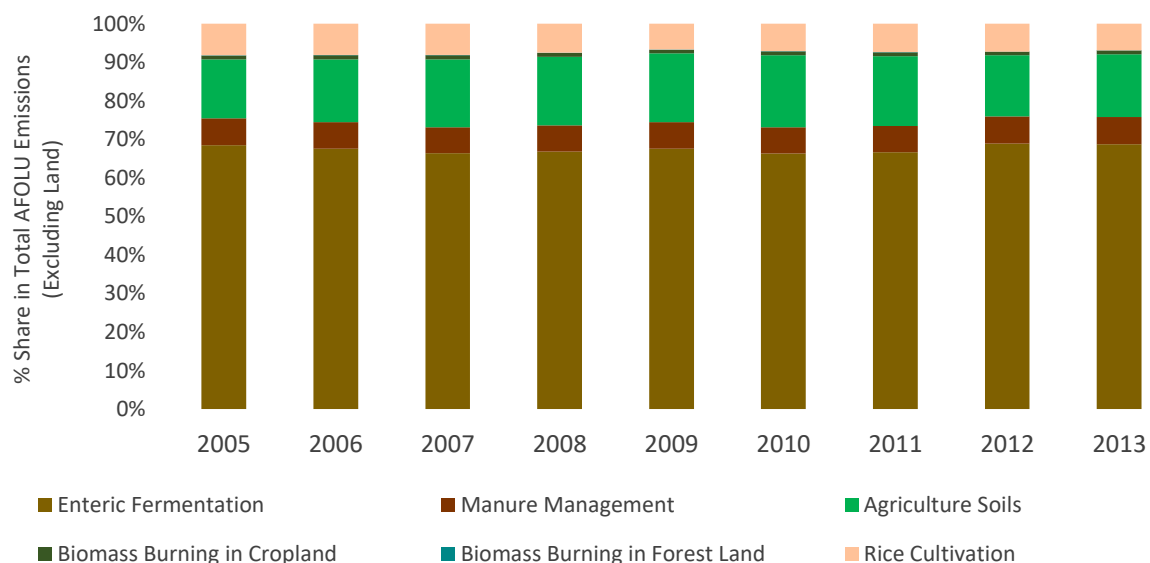
The AFOLU sector represented ~9% of the total emissions of Gujarat in 2013. Emissions from the AFOLU sector arise from three main sub-sectors namely Livestock, Land and Aggregate Sources and Non-CO<sub>2</sub> Emissions Sources on Land. Emissions of the AFOLU sector grew at a CAGR of 3.62% from 15.10 MtCO<sub>2</sub>e in 2005 to 20.07 MtCO<sub>2</sub>e in 2013. Notably, removals from the Land sub-sector were low in 2005 and had further decreased at a compounded rate of 4.43% from 0.96 MtCO<sub>2</sub>e in 2005 to 0.67 MtCO<sub>2</sub>e in 2013.

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



On further investigation of the AFOLU sub-sectors, it was found that the Livestock sub-sector was the major emitter of GHGs with a contribution of 76% (excluding Removals from Land) in 2013. Further, Enteric Fermentation from Livestock sub-sector was found to be the major contributor across all the years as depicted in Figure 10 below. This is perhaps a reflection of the importance of animal husbandry activities in the state of Gujarat. Emissions due to the Agricultural soils almost remained constant across all the years with an average share of ~17% throughout the reference period.

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

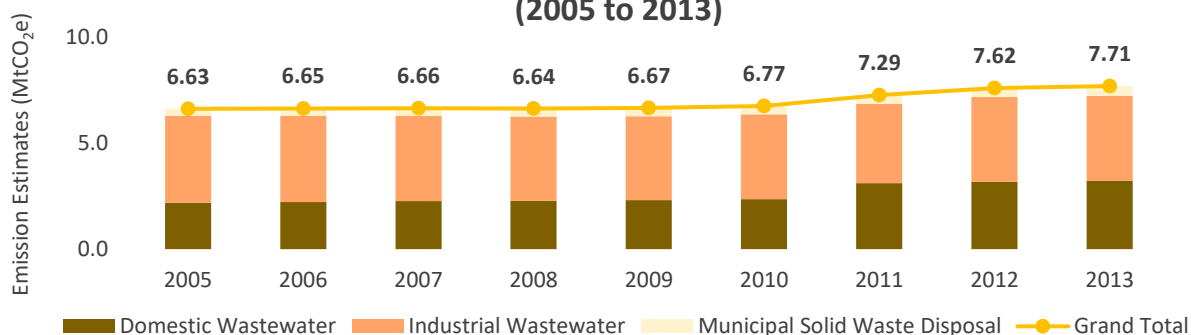




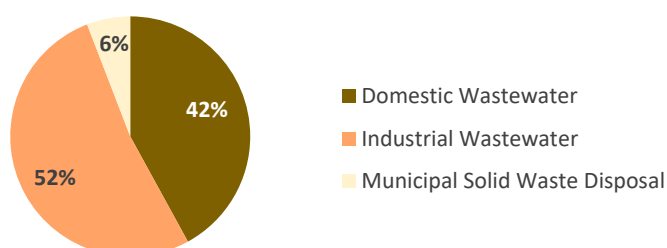
## Waste Sector

The Waste sector contributed to nearly 4% of the total emissions of Gujarat 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 the Waste sector grew at a CAGR of 1.90% from 6.63 MtCO<sub>2</sub>e in 2005 to 7.71 MtCO<sub>2</sub>e in 2013 as depicted in Figure 11 below. A spike in emissions in 2011 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: GHG Emission Estimates for Waste Sector in Gujarat (2005 to 2013)**



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

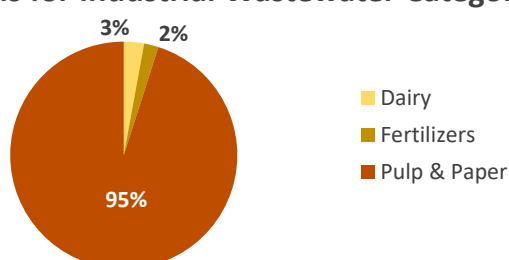


Domestic Wastewater comprised ~42% of the Waste sector emissions in Gujarat. Emissions from this sub-sector grew at a CAGR of 4.99% from 2.19 MtCO<sub>2</sub>e in 2005 to 3.24 MtCO<sub>2</sub>e in 2013. Approximately 51% of Domestic Wastewater emissions emanated from the rural areas in 2013. Discharge of untreated wastewater and use of septic tanks are key drivers of emissions in this sub-sector.

Municipal Solid Waste contributed ~6% of emissions in 2013. Emissions from this category grew at a rate of 3.83% (compounded annually) from 0.33 MtCO<sub>2</sub>e in 2005 to 0.45 MtCO<sub>2</sub>e in 2013.

Emissions from Industrial Wastewater sub-sector had a major share of ~52% in the Waste sector emissions in 2013, which declined at a negligible 0.26% (compounded annually) from 4.10 MtCO<sub>2</sub>e in 2005 to 4.02 MtCO<sub>2</sub>e in 2013. Deep diving into various Industrial Wastewater categories, it was observed that Pulp and Paper Industries contributed to ~95% of the total emissions of this sub-sector. Whereas, other Industries had a combined share of ~5% comprising of emissions from Dairy (~3%) and Fertilizer Waste (2%) respectively as shown in Figure 13 below.

**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



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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.

**Center for Study of Science, Technology and Policy (CSTEP)** is a not for profit research organisation incorporated in 2005 u/s 25 of The Companies Act, 1956.

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

**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.

**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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