

# Trend Analysis of GHG Emissions of BIHAR

GHG Platform India is a civil society initiative providing an independent estimation and analysis of India's Greenhouse Gas (GHG) emissions across key sectors.

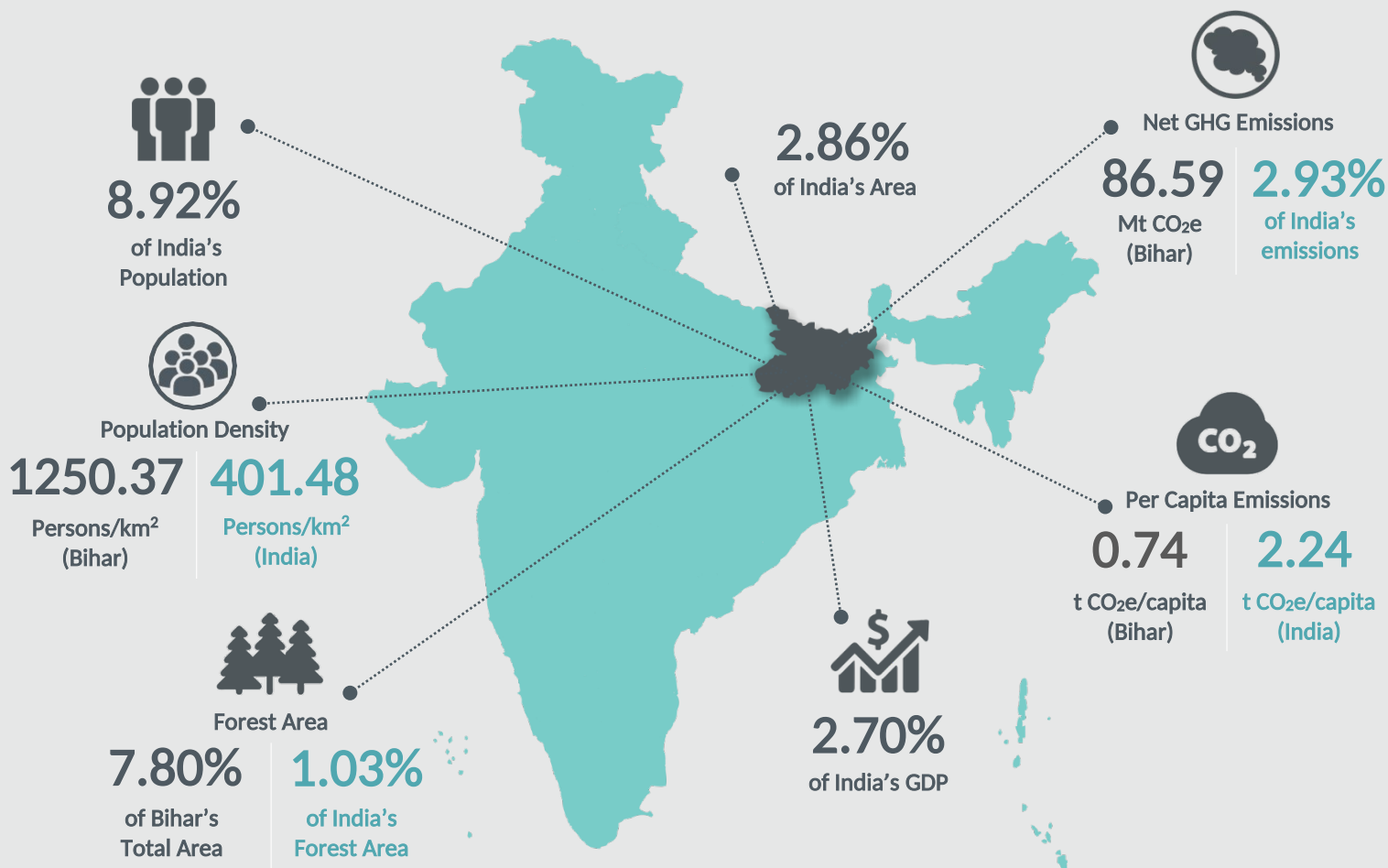
The Platform aims to add value to the various ongoing GHG emissions estimation efforts by addressing existing data gaps and data accessibility issues, broadening the scope of national inventories to include state inventories, and increasing the volume of analytics and policy dialogue on India's GHG emissions sources, profile, and related policies.

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



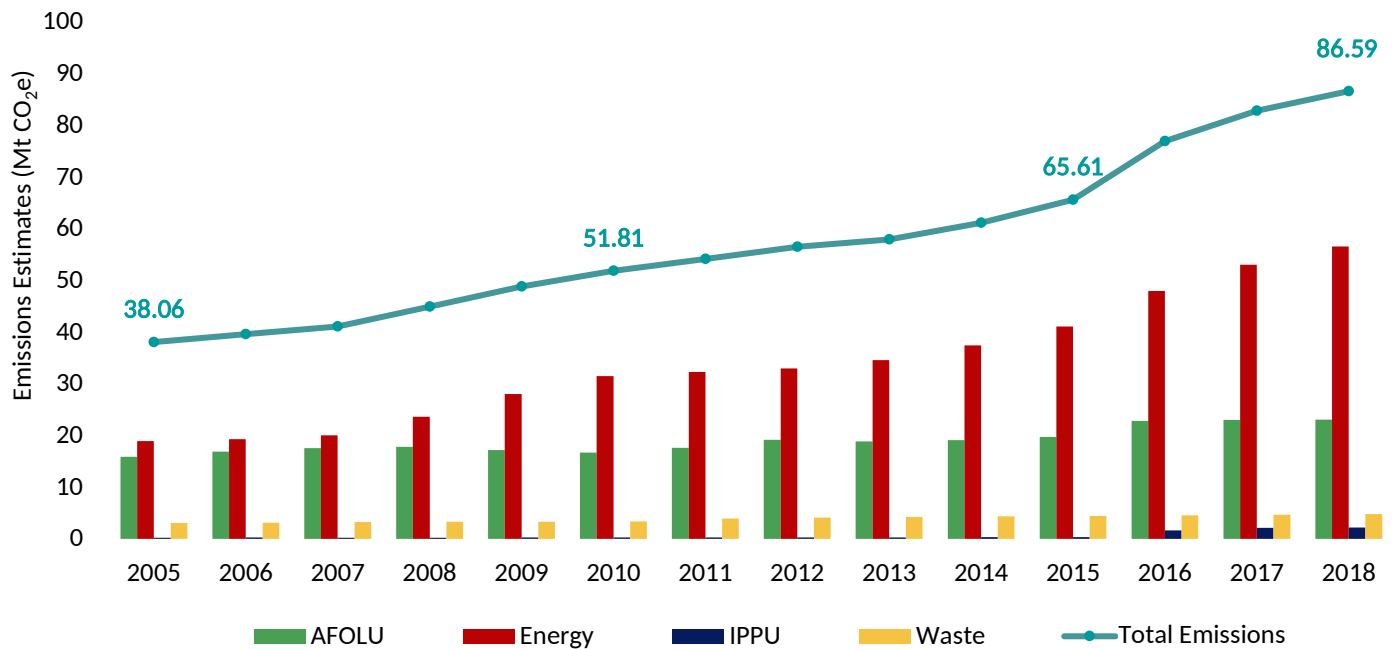
\*Fuel combusted for captive electricity generation (auto-producers) and direct fuel combustion (industrial energy) has been reported under Energy sector.

## Bihar at a Glance (2018)



# Economy-wide Emissions Estimates

Figure 1: GHG Emissions Estimates of Bihar (2005 to 2018)



Emissions of Bihar increased at a CAGR of 6.53% from 38.06 Mt CO<sub>2</sub>e in 2005 to 86.59 Mt CO<sub>2</sub>e in 2018 as illustrated in Figure 1 above. The share of emissions from Energy sector increased from ~50% in 2005 to ~65% in 2018. Whereas, the contribution of the Agriculture, Forestry and Other Land-Use (AFOLU) sector in economy-wide emissions reduced from ~42% in 2005 to ~27% in 2018. The Industrial Product and Process Use (IPPU) sector emissions contribution increased from ~0.5% in 2005 to ~3% in 2018, while the share of Waste sector emissions reduced from ~8% in 2005 to ~5% in 2018 (see Figure 2).

Figure 2: Sector-wise Contribution (Mt CO<sub>2</sub>e) and Percentage Share in Total Economy-wide GHG Emissions of Bihar

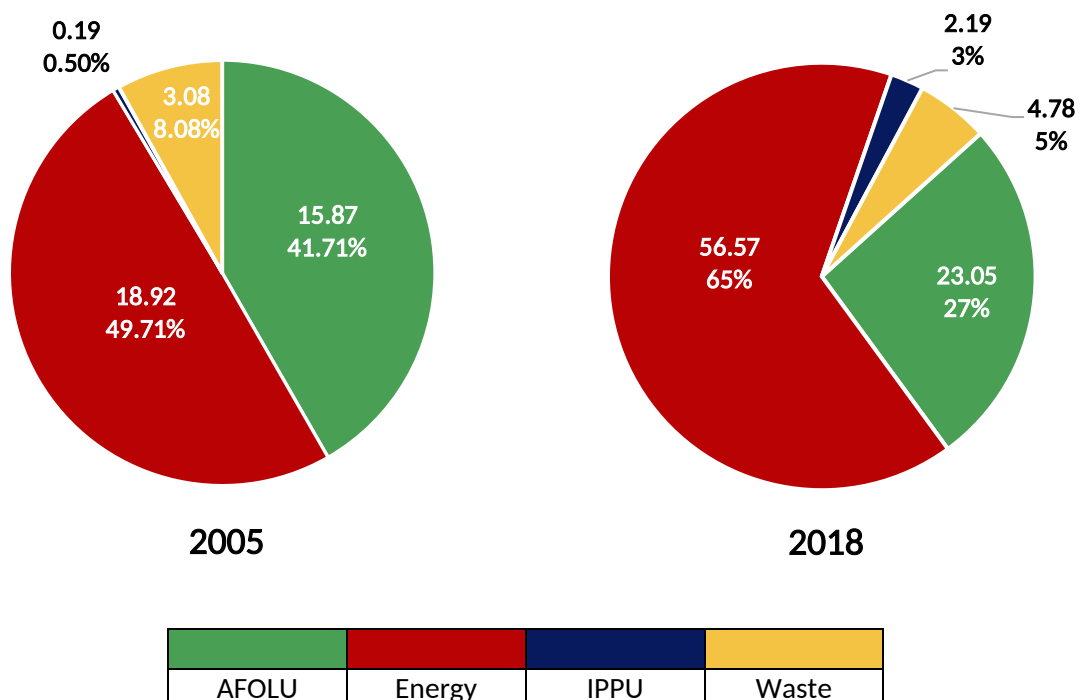


Figure 3: Per Capita GHG Emissions of Bihar and India (2005 to 2018)

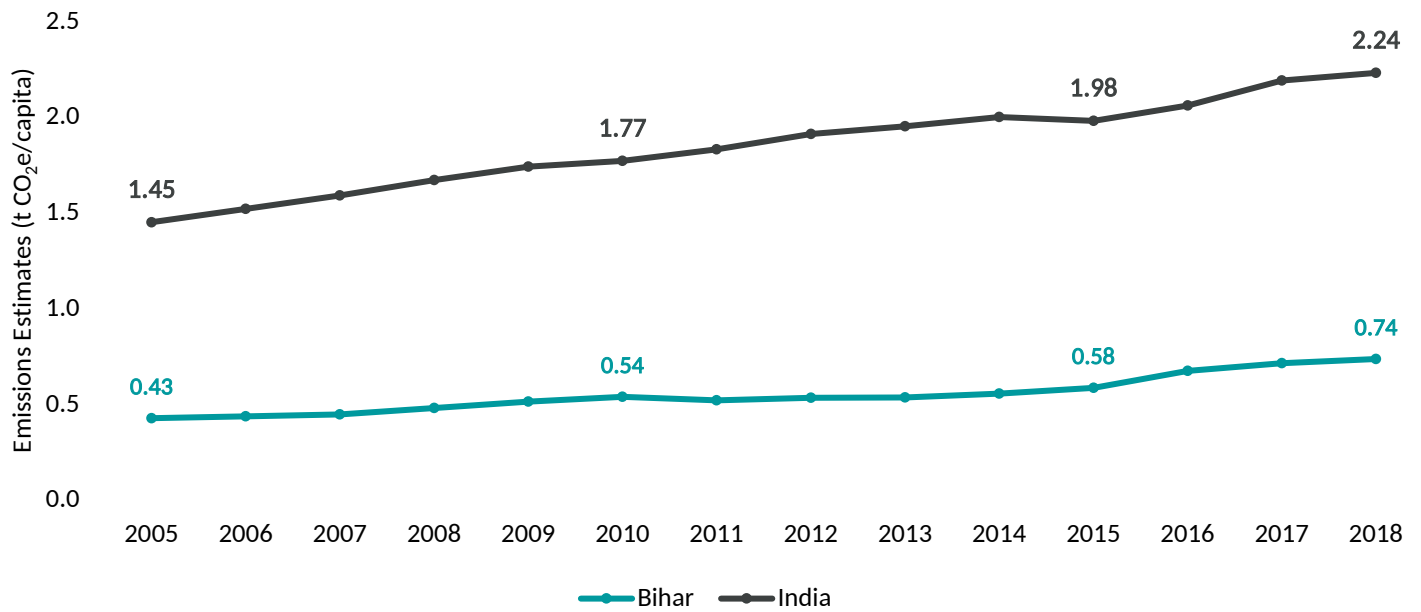


Figure 3 shows that the per capita emissions of Bihar were lower than India's per capita emissions across the reference period. The per capita emissions of Bihar grew at a rate of 4.28% (compounded annually), from 0.43 t CO<sub>2</sub>e/capita in 2005 to 0.74 t CO<sub>2</sub>e/capita in 2018, which was higher than that of India (3.41%).

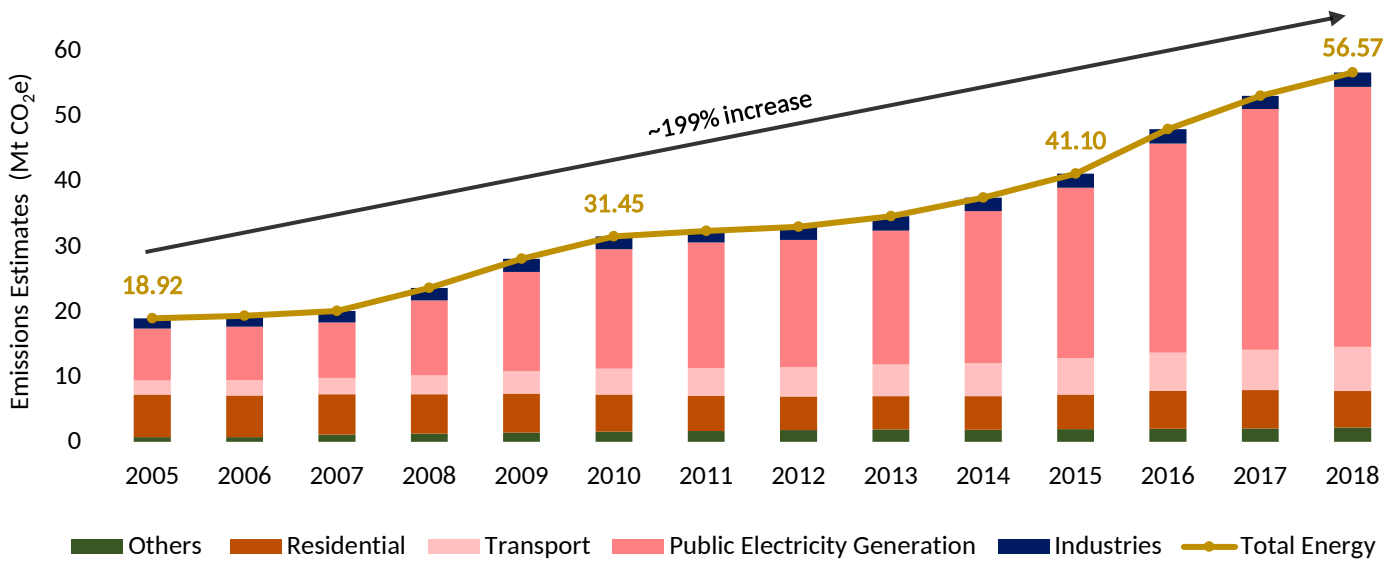
# Energy Sector



The Energy sector emissions comprise of emissions from Fuel Combustion and Fugitive Emissions. Fuel Combustion includes emissions from Public Electricity Generation, Transport, Captive Power Plants, Industries, Agriculture, Commercial, and Residential categories. Fugitive Emissions are due to Fuel Production.

The Energy sector of Bihar accounted for ~65% of its total economy-wide emissions in 2018. Emissions from the energy sector increased at a CAGR of 8.79% between 2005 (18.92 Mt CO<sub>2</sub>e) and 2018 (56.57 Mt CO<sub>2</sub>e) as depicted in Figure 4.

Figure 4: GHG Emissions Estimates of Energy Sector - Bihar (2005 to 2018)



Within the Energy sector, Public Electricity Generation category was the major contributor of GHG emissions with a share of ~70% of the total Energy emissions in 2018. This was followed by Transport and Residential categories with shares of 12% and 10%, respectively (see Figure 5).

Within the Fuel Combustion sub-sector, emissions from Coal were a major contributor with an average share of ~64% throughout the reference period (see Figure 6). This was followed by emissions from combustion of Liquid Petroleum Fuels, with an average share of ~27% between 2005 and 2018. Gaseous Petroleum Fuels had an average share of ~6%, while Other Fuels contributed ~4% to the Fuel Combustion emissions between 2005 and 2018.

Figure 5: Category-wise Emissions (Mt CO<sub>2</sub>e) and Percentage Share in Total Energy Sector Emissions (2018)

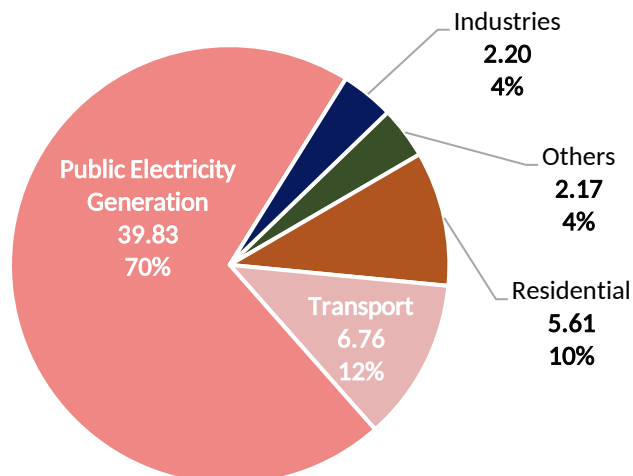
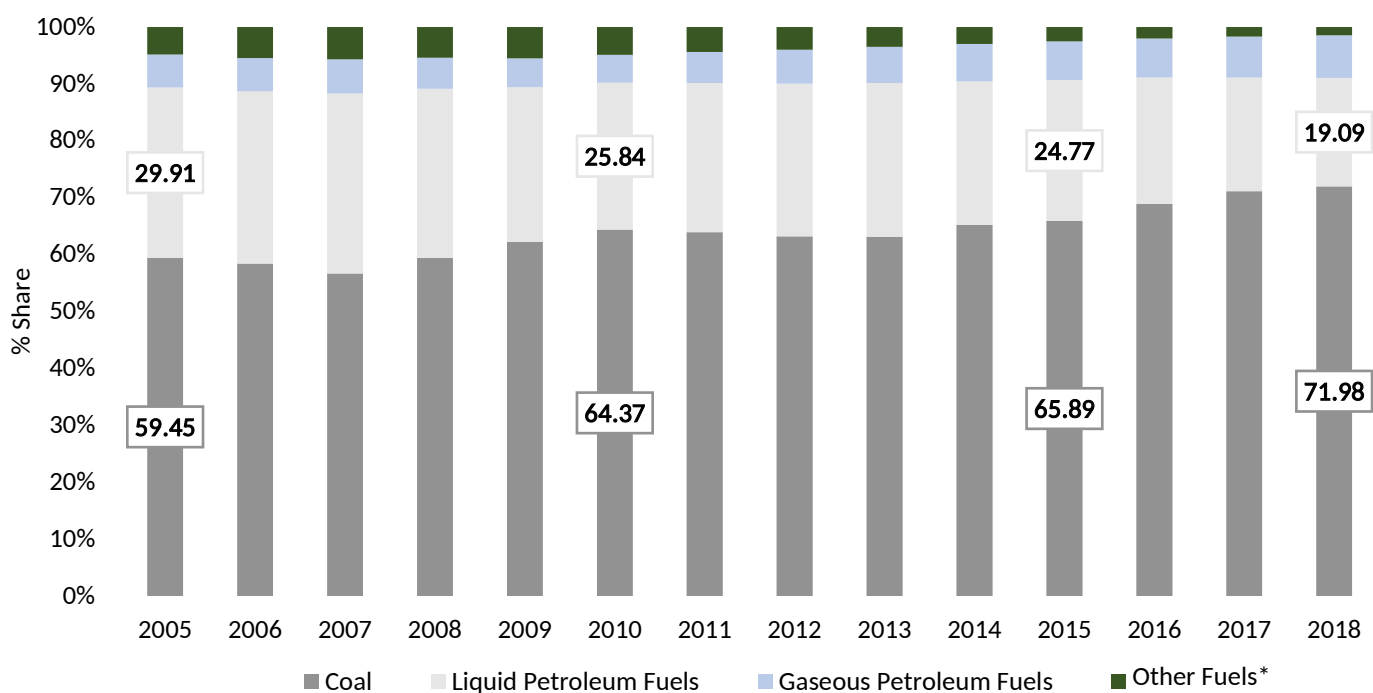


Figure 6: Percentage Share of GHG Emissions by Fuel Type due to Fuel Combustion in Energy Sector (2005 to 2018)



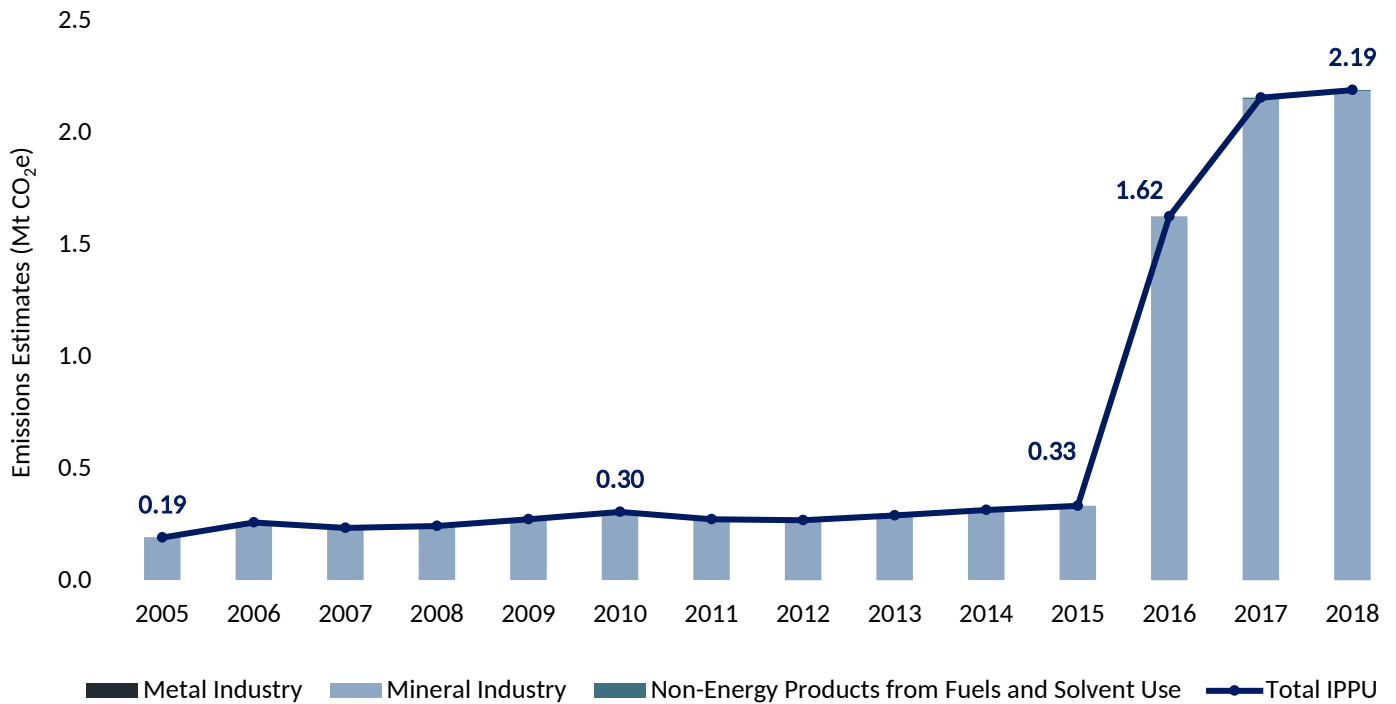
*\*Notes:*

1. Coke is included in Coal because the bifurcation of pet-coke and coke was not available
2. Gaseous Fuels - natural gas, LPG and other gaseous fuels
3. Liquid Petroleum Fuels - ATF, diesel, kerosene, motor spirit and other liquid fuels
4. Other Fuels comprises of firewood and charcoal



Emissions from the Industrial Processes and Product Use (IPPU) sector are largely driven by Chemical, Metal, Mineral Industries and Non-Energy Products from Fuels and Solvent Use. In Bihar, the IPPU sector represented ~3% of the total economy-wide emissions in 2018. The overall IPPU emissions increased at a CAGR of 20.70% from 0.19 Mt CO<sub>2</sub>e in 2005 to 2.19 Mt CO<sub>2</sub>e in 2018. Notably, a significant jump was observed in IPPU emissions in 2016 owing to higher emissions from the Mineral Industry sub-sector (primarily from Cement Production) as illustrated in Figure 7.

Figure 7: GHG Emissions Estimates of IPPU Sector - Bihar (2005-2018)



Cement Production was the key driver of GHG emissions in the IPPU sector with an average share of 99% throughout the reference period. However, the share of emissions from this category reduced slightly between 2012 to 2015 due to the rise in share of emissions from the category of Other Uses of Soda Ash.

Figure 8: Sub-sector Emissions (Mt CO<sub>2</sub>e) and Percentage Contribution in Total IPPU Emissions (2018)

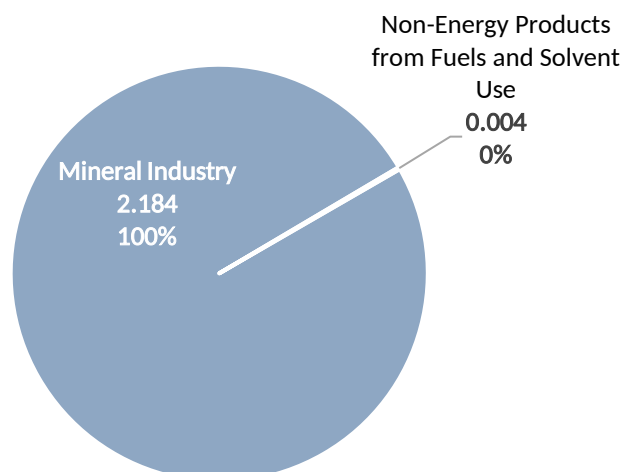
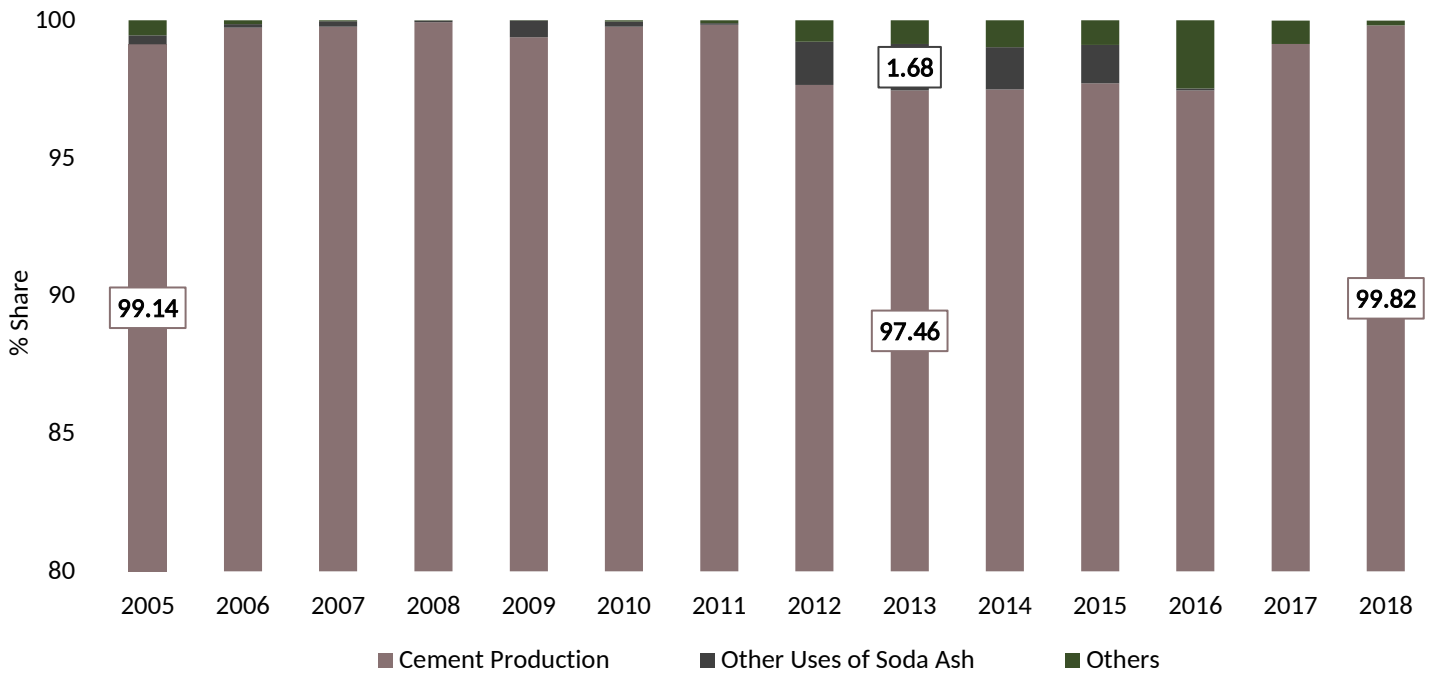


Figure 9: Percentage Share of GHG Emissions from IPPU Categories (2005 to 2018)



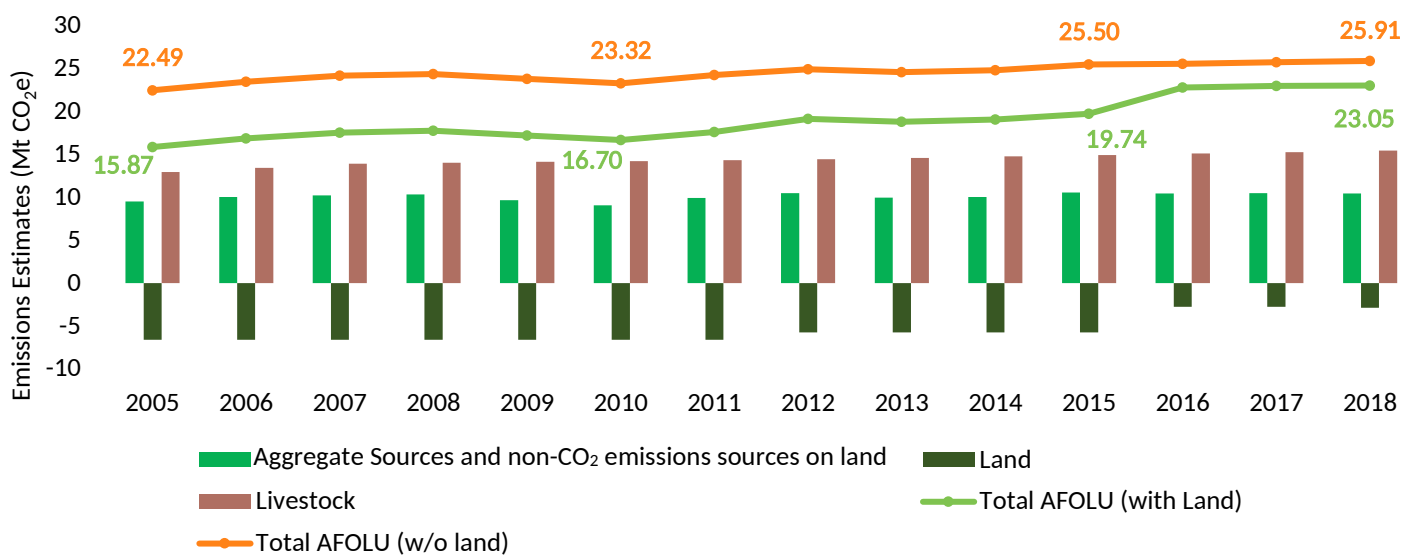


# AFOLU Sector

Emissions from the Agriculture, Forestry and Other Land Use (AFOLU) sector arise from three main sub-sectors, namely Livestock, Land and Aggregate Sources and Non-CO<sub>2</sub> Emissions Sources on Land\*. In Bihar, AFOLU sector represented ~27% of the total economy-wide emissions in 2018. Net emissions of AFOLU sector increased at a CAGR of ~2.91% from 15.87 Mt CO<sub>2</sub>e in 2005 to 23.05 Mt CO<sub>2</sub>e in 2018.

While the Livestock and Aggregate Sources and Non-CO<sub>2</sub> Emissions Sources on Land sub-sectors were net GHG emitters, the Land sub-sector was a sink throughout the reference period (see Figure 10). In the Land sub-sector, a reduction in the sink was seen after 2015 as a result of a relatively smaller increase in Bihar's forest area in the years 2015, 2017 and 2019. The average annual removals from the Land sub-sector in Bihar during the reference period were 5.56 Mt CO<sub>2</sub>e, around 22.67% of the average annual gross AFOLU emissions (excluding Land sub-sector).

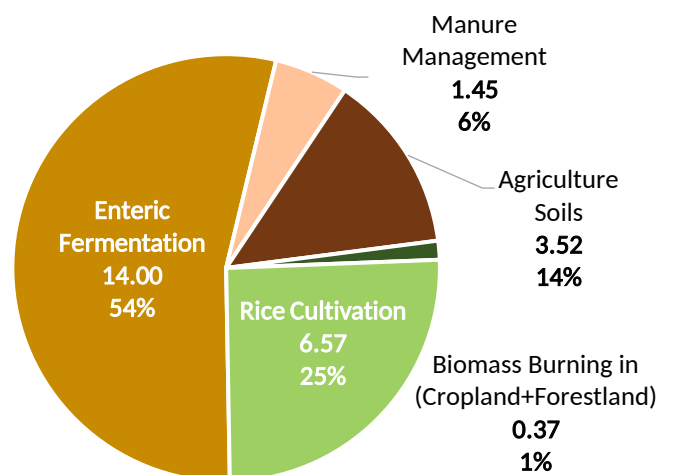
**Figure 10: GHG Emissions Estimates of AFOLU Sector - Bihar (2005 to 2018)**



The Livestock sub-sector had the maximum share of ~60% of gross AFOLU emissions (excluding Land sub-sector) of Bihar in 2018. The contribution of emissions from this sub-sector increased at a rate of 1.37% (compounded annually) from 12.96 Mt CO<sub>2</sub>e in 2005 to 15.46 Mt CO<sub>2</sub>e in 2018. Within the Livestock sub-sector, Enteric Fermentation was the major contributor to gross AFOLU emissions across the reference period, with an average share of ~54%.

From the Aggregate Sources sub-sector, the categories of Rice Cultivation and Agriculture Soils were the top GHG contributors to gross AFOLU emissions, with average shares of ~27% and ~12%, respectively, across the reference period. While emissions from Rice Cultivation decreased at a CAGR of 1.18%, emissions from Agriculture Soils increased at a CAGR of 1.25% (see Figures 11 and 12).

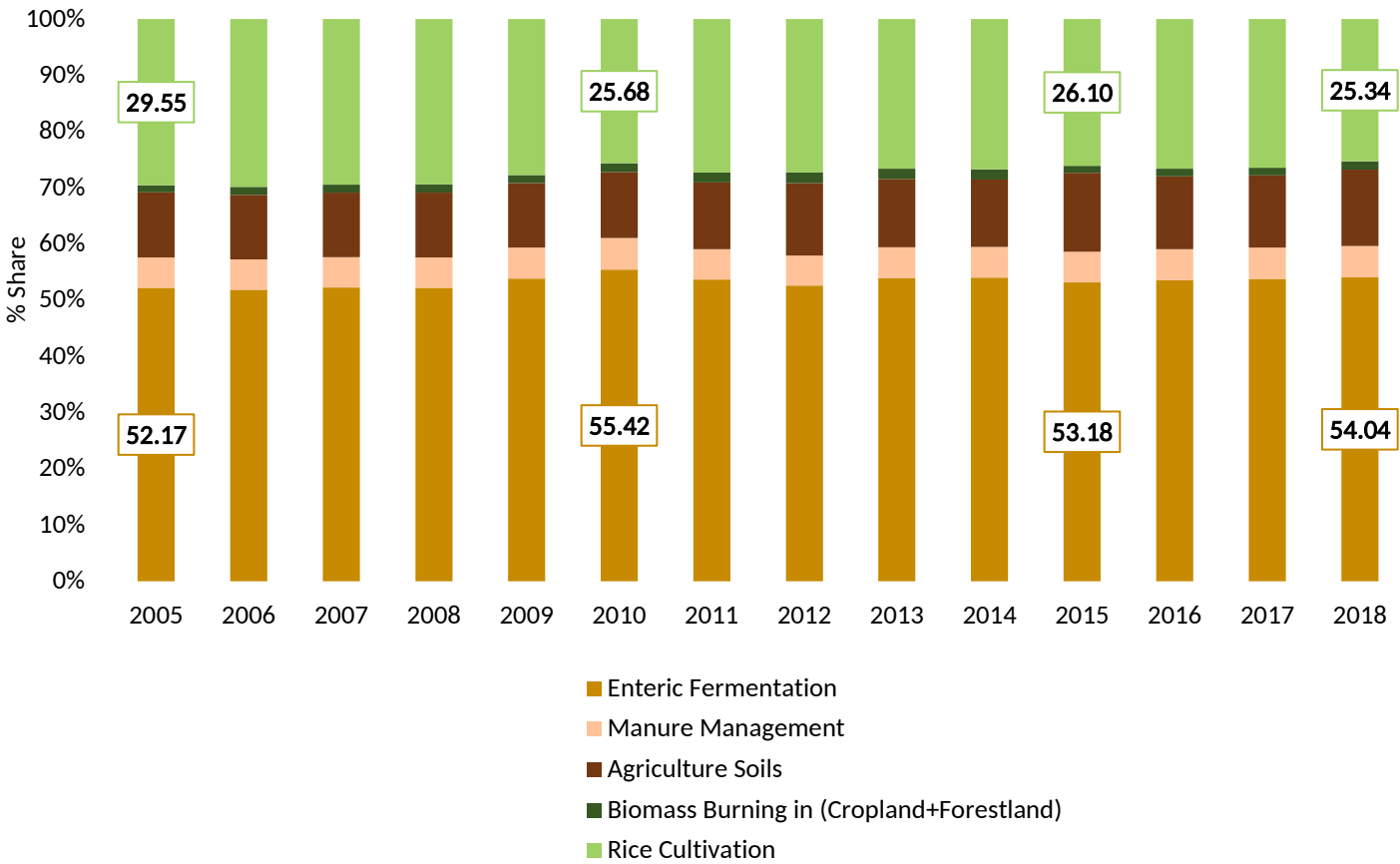
**Figure 11: Category-wise Emissions (Mt CO<sub>2</sub>e) and Percentage Share in Gross AFOLU Emissions (excluding Land sub-sector) (2018)**



\* The sub-sector called 'Aggregate Sources and Non-CO<sub>2</sub> Emissions Sources on Land' includes emissions from Rice Cultivation, Agriculture Soils, and Biomass Burning in Cropland and Forestland.



Figure 12: Category-wise Share of Gross AFOLU Emissions (excluding Land sub-sector) (2005 to 2018)





## Waste Sector

Solid Waste Disposal, Domestic Wastewater and Industrial Wastewater are the key sources of GHG emissions in the Waste sector. The Waste sector contributed to almost ~5% of total economy-wide emissions of Bihar in 2018. GHG emissions from the Waste sector increased at an estimated CAGR of 3.45% from 3.08 Mt CO<sub>2</sub>e in 2005 to 4.78 Mt CO<sub>2</sub>e in 2018 (see Figure 13).

Figure 13: GHG Emissions Estimates of Waste Sector – Bihar (2005 to 2018)

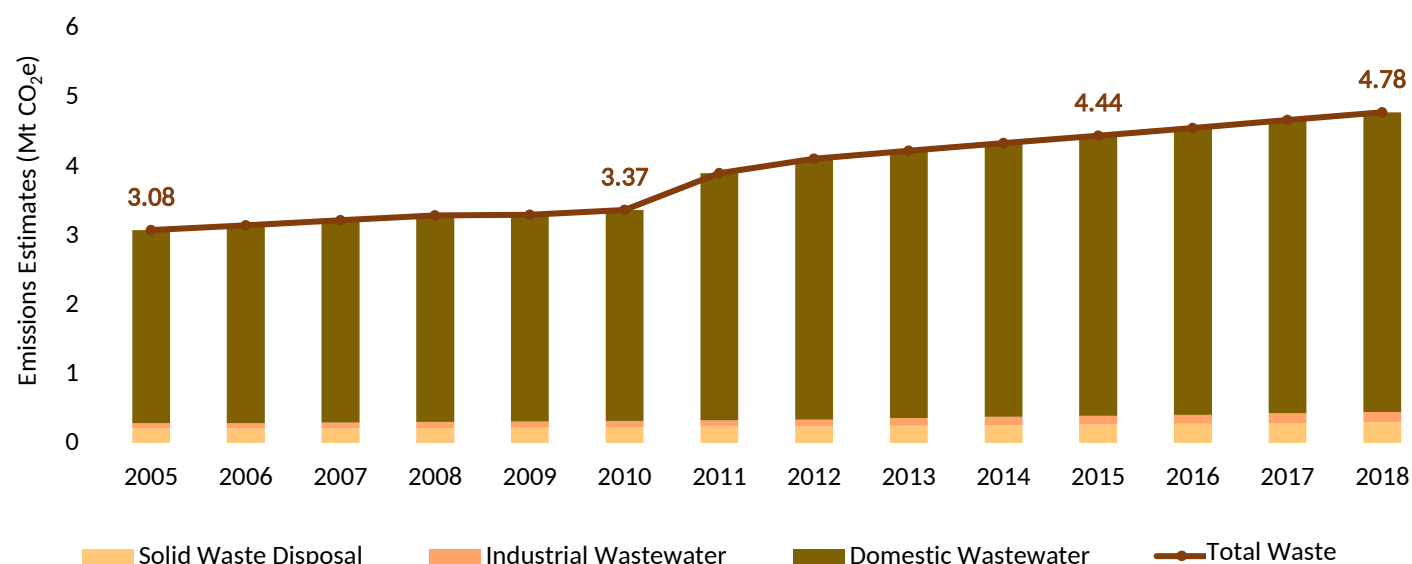
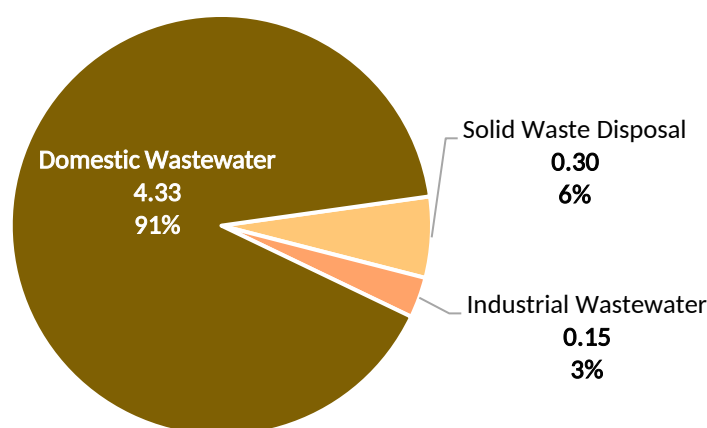


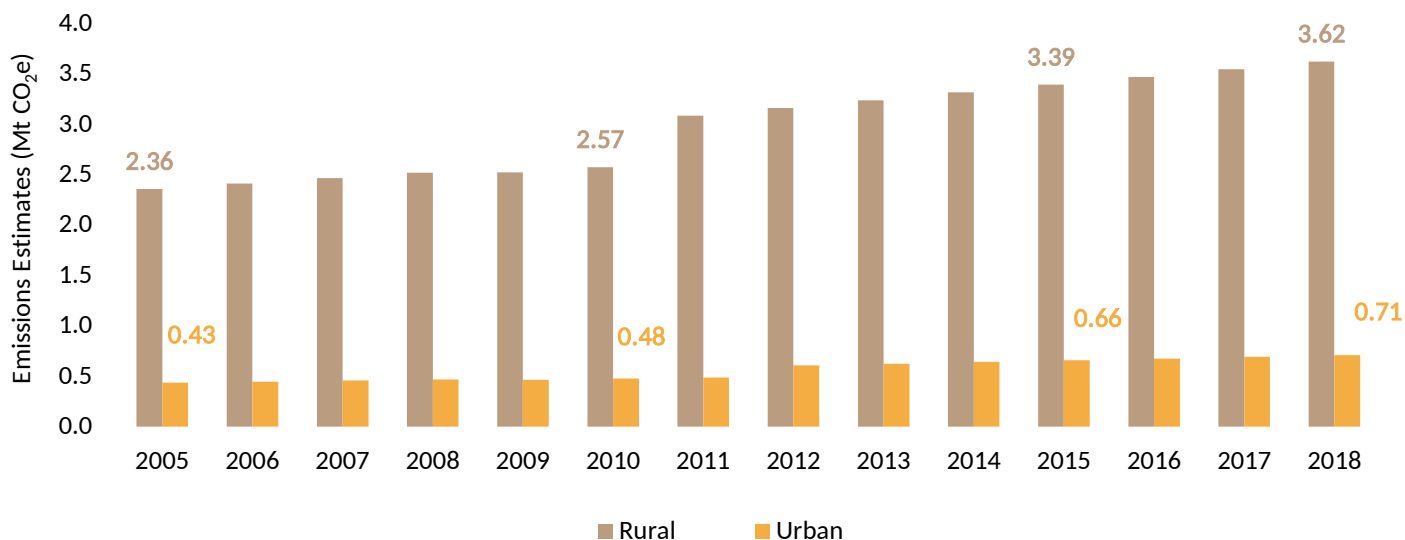
Figure 14: Sub-sector Emissions (Mt CO<sub>2</sub>e) and Percentage Share in Total Waste Sector Emissions (2018)



Discharge of untreated wastewater and use of septic tanks are the key drivers of emissions due to Domestic Wastewater sub-sector. Domestic Wastewater had a share of ~91% in the total Waste sector emissions of Bihar in 2018. Approximately 6% of the Waste sector emissions were from Solid Waste Disposal, which grew at an estimated CAGR of 2.74% from 0.21 Mt CO<sub>2</sub>e in 2005 to 0.30 Mt CO<sub>2</sub>e in 2018. Industrial Wastewater accounted for nearly 3% of Waste sector emissions in 2018 and increased at a CAGR of 5.45% from 0.07 Mt CO<sub>2</sub>e in 2005 to 0.15 Mt CO<sub>2</sub>e in 2018 (see Figures 14).

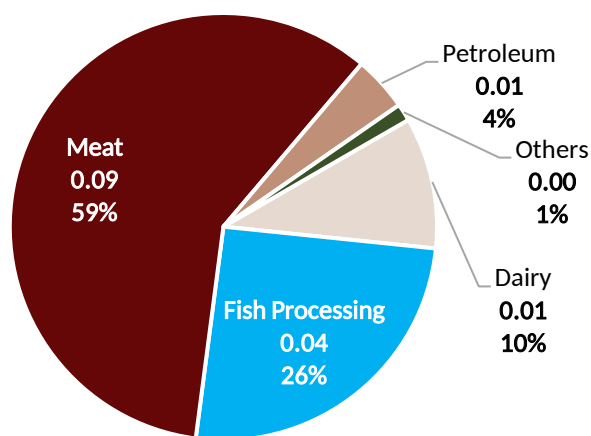
Emissions from Domestic Wastewater from both rural and urban areas grew at a CAGR of 3.44% from 2.79 Mt CO<sub>2</sub>e in 2005 to 4.33 Mt CO<sub>2</sub>e in 2018. Almost 84% of Domestic Wastewater emissions were from the rural areas of Bihar in 2018 as shown in Figure 15.

Figure 15: Area-wise GHG Emissions Estimates of Domestic Wastewater (2005 to 2018)



In 2018, Meat Industry was the leading GHG emitter under Industrial Wastewater emissions, with a share of ~59%. This was followed by Fish Processing (25.44%), Dairy (9.97%) and Petroleum industry (~4%) as shown in Figure 16.

Figure 16: Category-wise Emissions (Mt CO<sub>2</sub>e) and Percentage Share in Industrial Wastewater Emissions (2018)





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:



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.

**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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