

Trend Analysis of GHG Emissions of PUNJAB

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

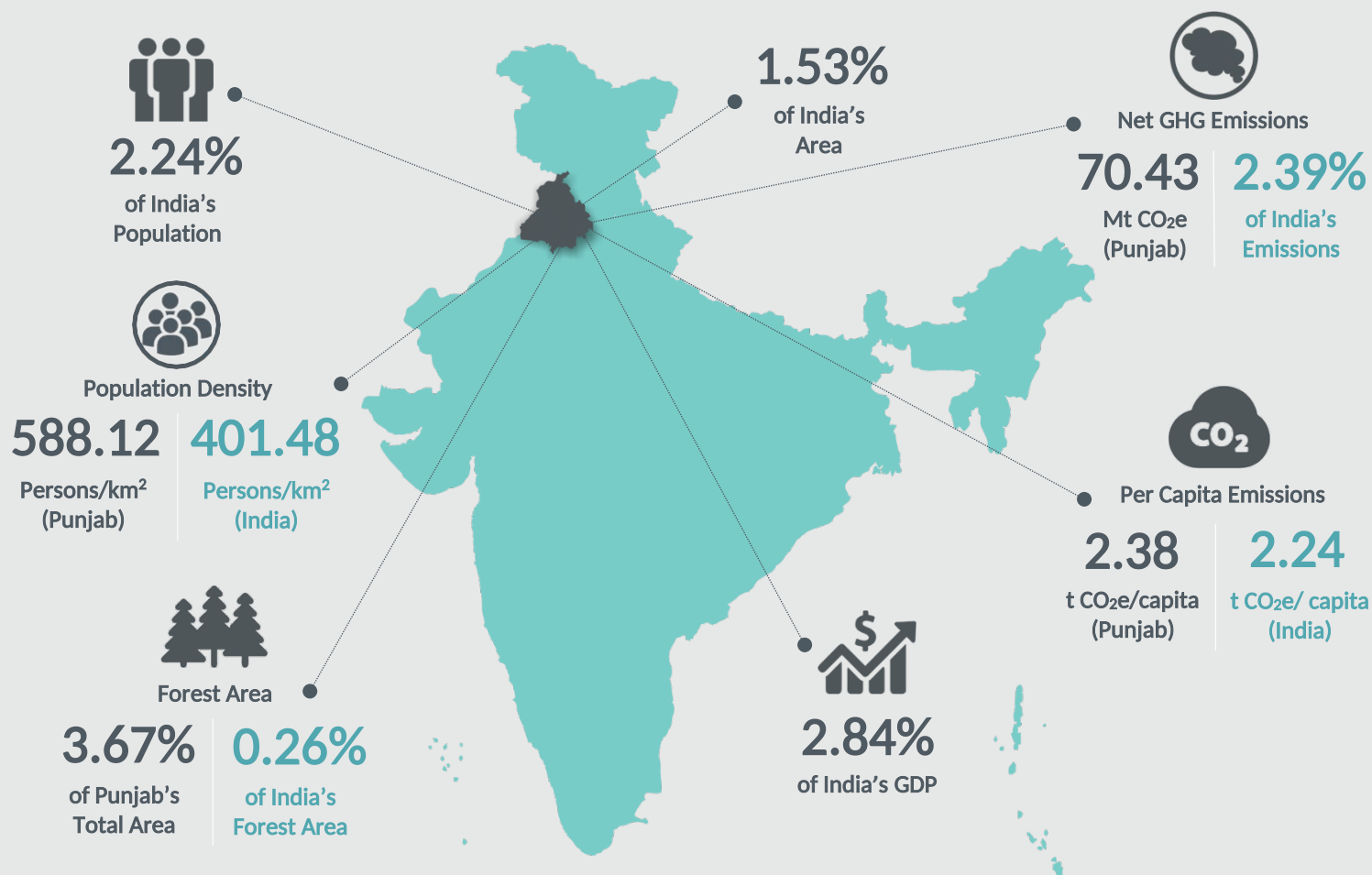
The Platform aims to add value to the various ongoing GHG emissions estimation efforts by addressing existing data gaps and data accessibility issues, broadening the scope of national inventories to include state inventories, and increasing the volume of analytics and policy dialogue on India's GHG emissions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

Punjab at a Glance (2018)



Economy-wide Emissions Estimates

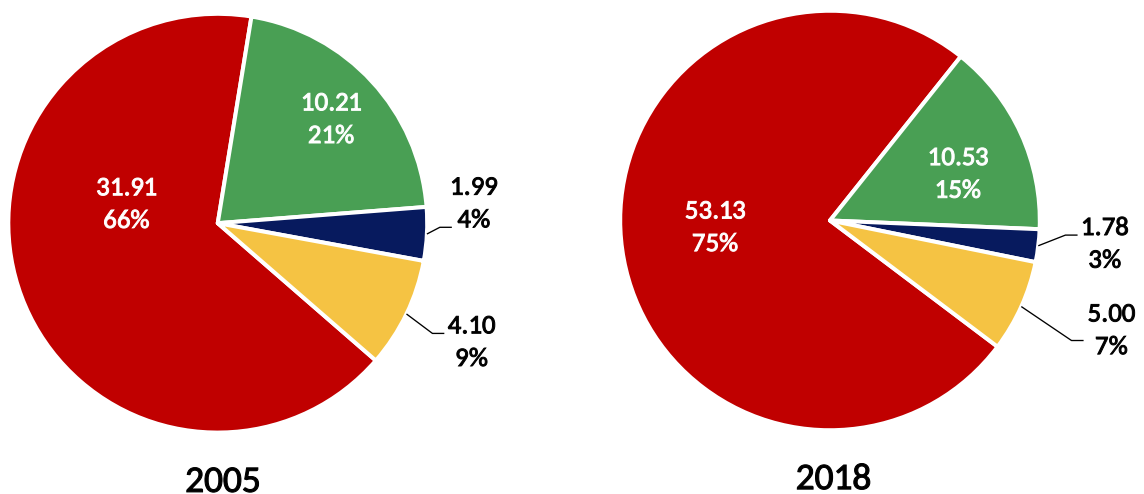
Figure 1: GHG Emissions Estimates of Punjab (2005 to 2018)



Emissions of Punjab increased at a rate of 2.96% (compounded annually) from 48.22 Mt CO₂e in 2005, to 70.43 Mt CO₂e in 2018 (see Figure 1). The Energy sector was the key driver of total economy-wide emissions in Punjab.

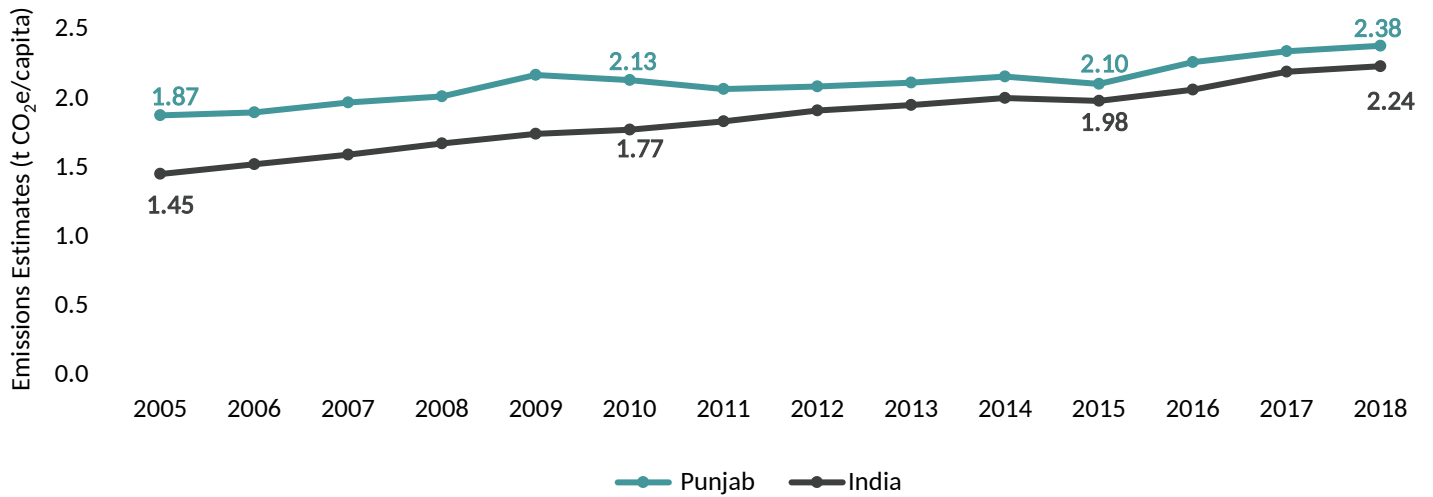
In 2005, the share of Energy sector in the total GHG emissions of Punjab was ~66%. While, Agriculture, Forestry and Other Land Use (AFOLU), Industrial Processes and Product Use (IPPU) and Waste sectors accounted for ~21%, ~4% and ~9%, respectively. As seen in Figure 2, in 2018, the share of Energy sector emissions in the overall emissions of the State increased to ~75%, while that of the AFOLU, IPPU and Waste sectors decreased to ~15%, ~3% and 7%, respectively.

Figure 2: Sector-wise Contribution (Mt CO₂e) and Percentage Share in Total Economy-wide GHG Emissions of Punjab



| | | | |
|-------|--------|------|-------|
| AFOLU | Energy | IPPU | Waste |
|-------|--------|------|-------|

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



The per capita emissions of Punjab were higher than the per capita emissions of India throughout the reference period. In Punjab, the per capita emissions increased at a CAGR of 1.85%, from 1.87 t CO₂e per capita in 2005 to 2.38 t CO₂e per capita in 2018, which was much lower than India's CAGR (~3.41%).

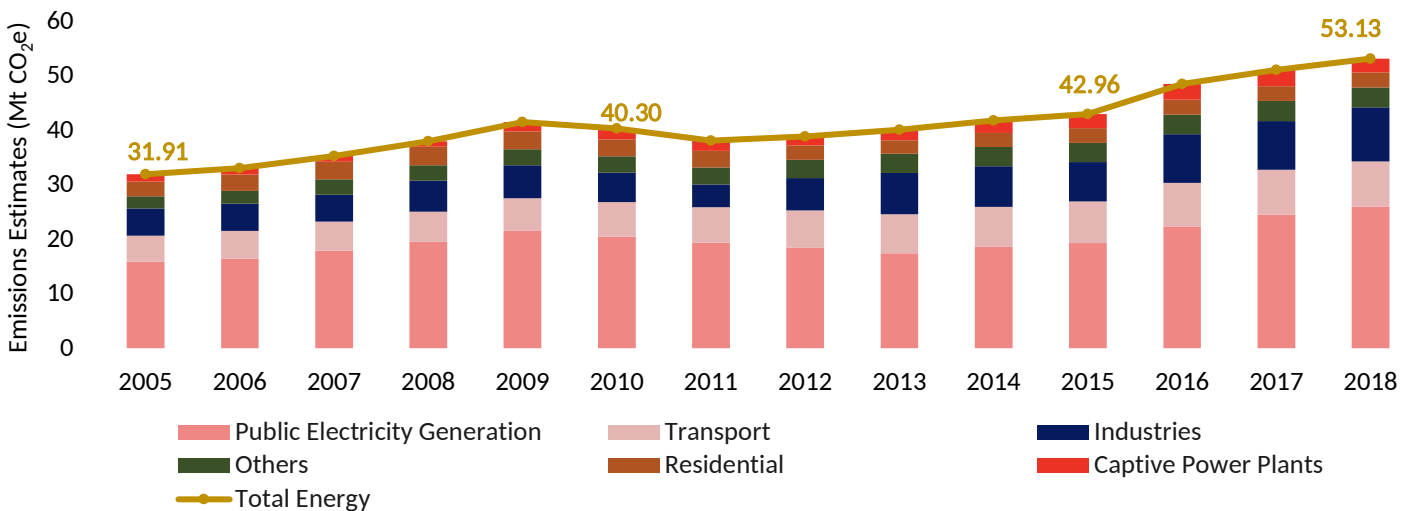


Energy Sector

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 Punjab accounted for ~75% of the total economy-wide emissions of the state in 2018. Emissions from the Energy sector increased at the rate of 4% (compounded annually), from 31.91 Mt CO₂e in 2005, to 53.13 Mt CO₂e in 2018, as shown in Figure 4.

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



Within the Energy sector, Public Electricity Generation category was the leading contributor to GHG emissions with a share of ~49% of the total Energy emissions in 2018. This was followed by Industrial Energy (~19%) and Residential (~15%) categories in 2018 (see Figure 5).

Within the Fuel Combustion sub-sector, emissions from Coal were the major contributor with an average share of ~62% of total Energy emissions during the reference period (see Figure 6). This was followed by emissions from combustion of Liquid Petroleum Fuels, with an average share of ~31% between 2005 and 2018. Gaseous Petroleum Fuels had an average share of ~7%, while Other Fuels contributed ~1% to the Fuel Combustion emissions during the reference period.

Figure 5: Category-wise Emissions (Mt CO₂e) and Percentage Share in Total Energy Sector Emissions (2018)

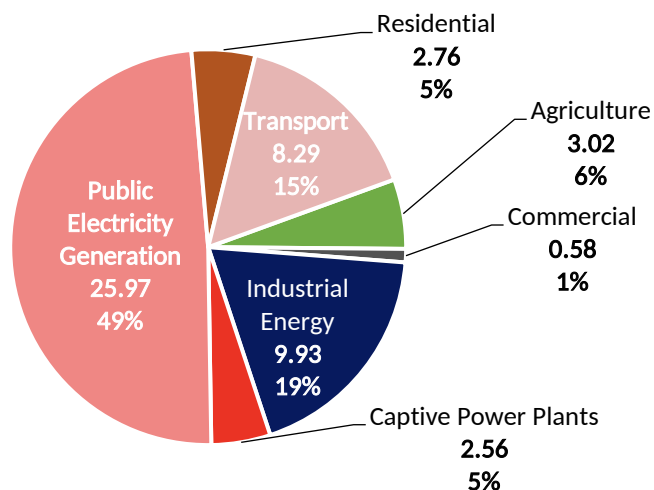
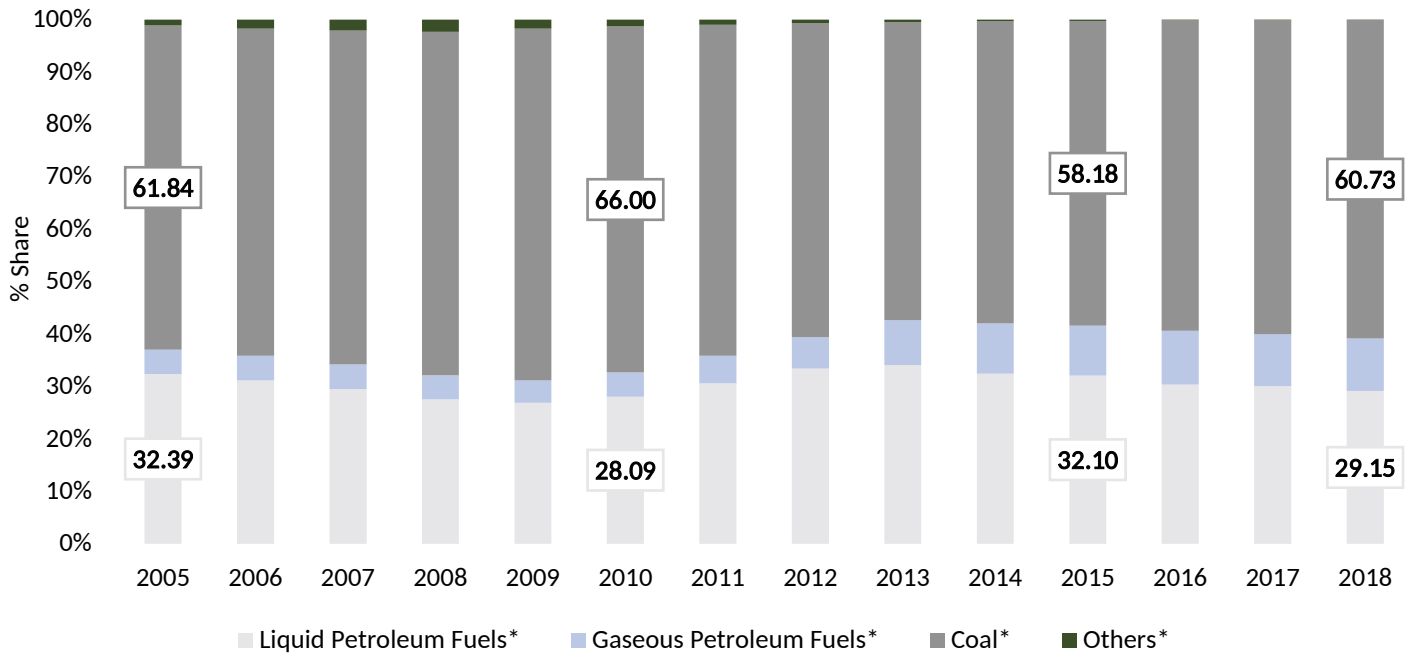


Figure 6: Percentage Share of GHG Emissions by Fuel Type due to Fuel Combustion in Energy Sector (2005 to 2018)



***Notes:**

1. Coke is included in Coal because the bifurcation of pet-coke and coke was not available
2. Gaseous Petroleum 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

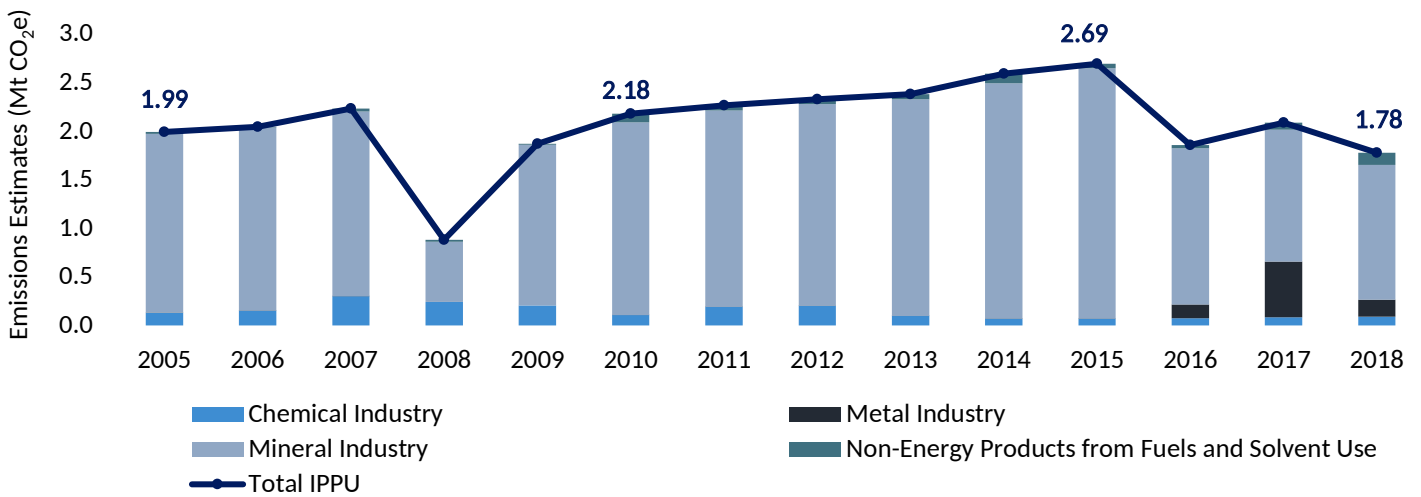


IPPU Sector

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 2018, the IPPU sector represented ~3% of Punjab's total economy-wide emissions. Between 2005 and 2018, the overall IPPU emissions decreased at a compounded rate of 0.87% from 1.99 Mt CO₂e in 2005, to 1.78 Mt CO₂e in 2018.

Mineral Industry sub-sector was the major contributor to the overall IPPU emissions, and its emissions decreased at a CAGR of 2.12% from 1.84 Mt CO₂e 2005 to 1.39 Mt CO₂e in 2018 (see Figure 7). While emissions from the Metal Industry and Non-Energy Products sub-sectors increased at CAGRs of 37.72% and 15.14%, respectively, during the reference period. Emissions from the Chemical Industry decreased at a rate of 2.96% (compounded annually). Dips in emissions were observed in 2008 and 2016, largely driven by decrease in emissions from Mineral Industry sub-sector (primarily due to Cement Production).

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



Cement Production was the key driver of GHG emissions in the sector with an average share of ~86% across the reference period. However, its share in the total IPPU emissions reduced from ~92% in 2005 to ~78% in 2018. Significant emissions were also registered from Iron and Steel Production (~10%), Lubricant Use (~6%) and Carbon Black (~5%) in 2018 in the IPPU sector (see Figures 8 and 9).

Figure 8: Percentage Share of GHG Emissions from IPPU Categories (2005 to 2018)

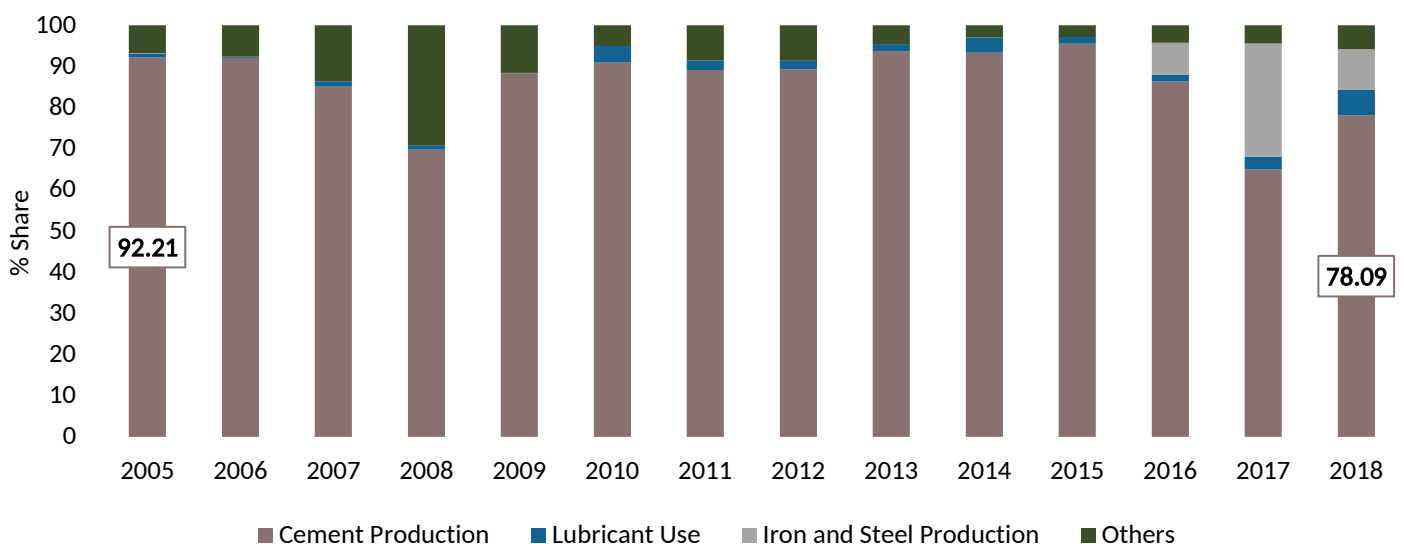
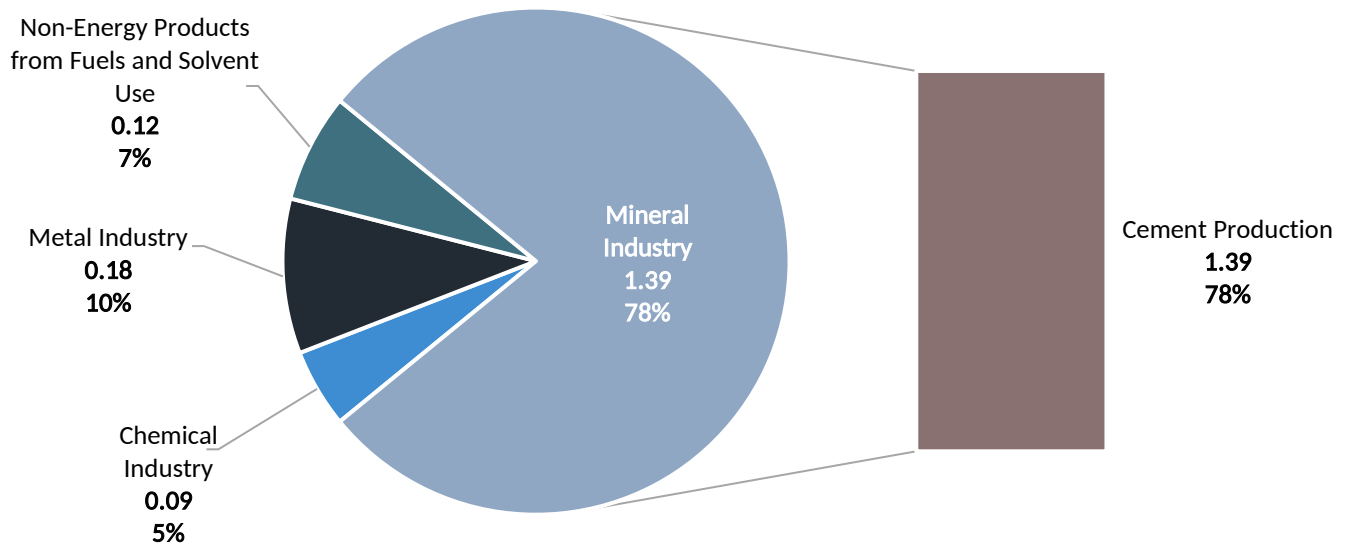


Figure 9: Sub-sector Emissions (Mt CO₂e) and Percentage Share in Total IPPU Emissions (2018)

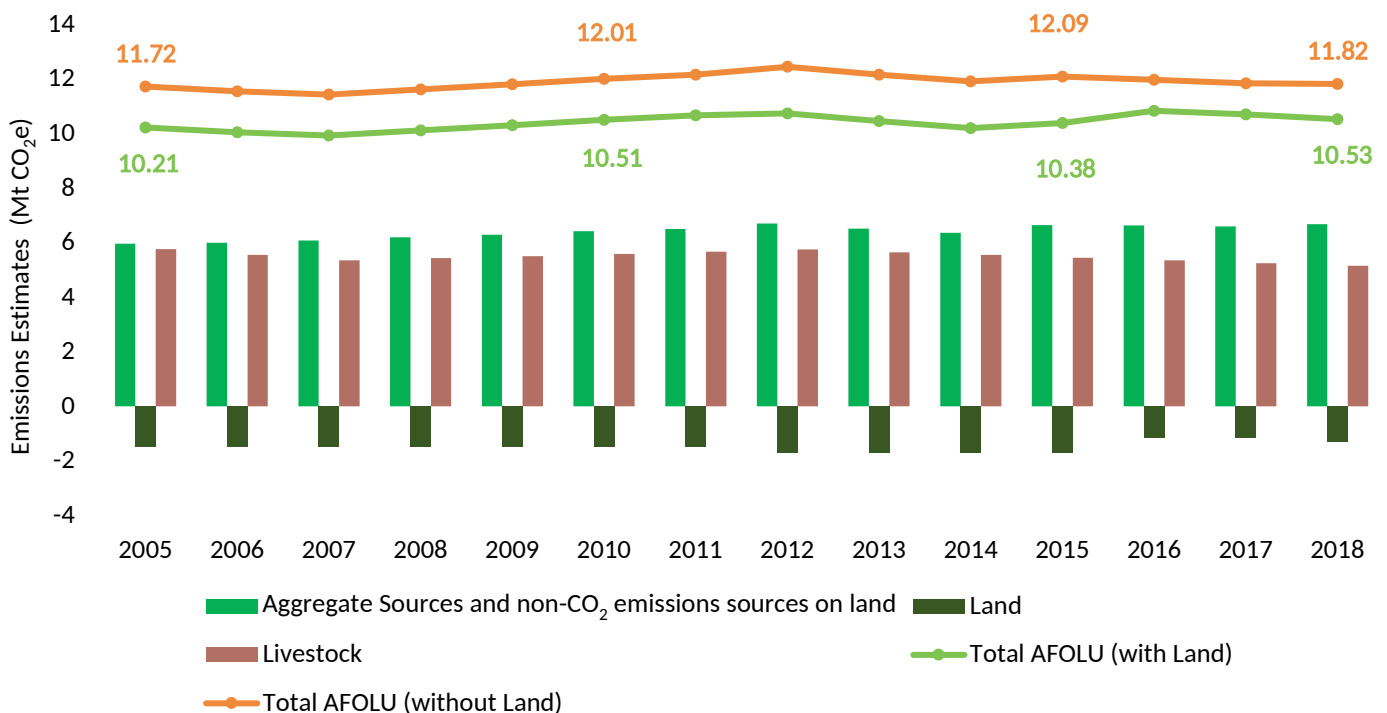




Emissions from the Agriculture, Forestry and Other Land Use (AFOLU) sector arise from three main sub-sectors, namely Livestock, Land and Aggregate Sources and Non-CO₂ Emissions Sources on Land*. AFOLU sector represented ~15% of Punjab's total economy-wide emissions in 2018. The emissions of AFOLU sector in Punjab increased at a CAGR of 0.23% from 10.21 Mt CO₂e in 2005 to 10.53 Mt CO₂e in 2018.

As seen in Figure 10, the Livestock and Aggregate Sources and Non-CO₂ Emissions Sources on Land sub-sectors were net GHG emitters, while the Land sub-sector was a sink throughout the reference period. The sink from the Land sub-sector decreased from ~1.7 Mt CO₂e in 2015 to ~1.14 Mt CO₂e in 2016, largely due to Land Use and Land-Use Change practices and reduction in forest area as reported by FSI (2019)**. In 2018, the removals from Land sub-sector increased marginally to 1.29 Mt CO₂e. The average annual removals from the Land Sub-Sector in Punjab during the reference period were 1.49 Mt CO₂e, around 12.5% of the average annual gross AFOLU emissions (excluding Land sub-sector).

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



The Livestock sub-sector had the maximum share of ~44% of gross AFOLU emissions (excluding Land sub-sector) in Punjab in 2018. Within the Livestock sub-sector, Enteric Fermentation was the major contributor to gross AFOLU emissions with an average share of ~42% across the reference period. However, the contribution of emissions from this category declined at a rate of 0.86% (compounded annually) from 5.2 Mt CO₂e in 2005 to 4.6 Mt CO₂e in 2018.

From the Aggregate Sources sub-sector, Agriculture Soils, Biomass Burning in Cropland and Rice Cultivation categories were major contributors to gross AFOLU emissions. The share of emissions from Agriculture Soils in gross AFOLU emissions increased from ~33% in 2005 to ~35% in 2018 and the share of emissions from Rice Cultivation increased from ~8% in 2005 to ~10% in 2018. Similarly, the share of emissions from Biomass Burning in Cropland increased from ~9% in 2005 to ~12% in 2018 (see Figures 11 and 12).

* The sub-sector called 'Aggregate Sources and Non-CO₂ Emissions Sources on Land' includes emissions from Rice Cultivation, Agriculture Soils, and Biomass Burning in Cropland and Forestland.

** FSI Report 2019, reports data for 2017.

Figure 11: Category-wise Emissions (Mt CO₂e) and Percentage Share in Gross AFOLU Emissions (excluding Land sub-sector) (2018)

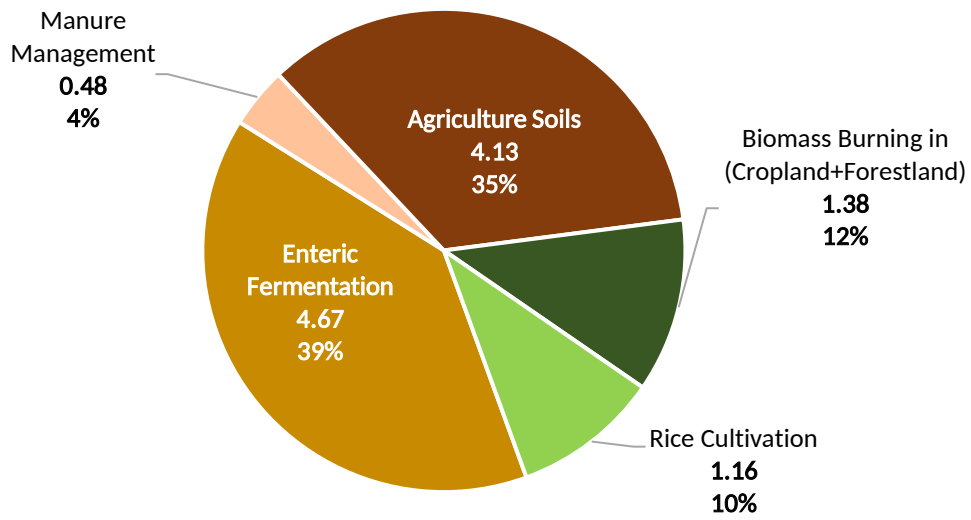


Figure 12: Category-wise Share of Gross AFOLU Emissions (excluding Land sub-sector) (2005 to 2018)





Waste Sector

Solid Waste Disposal, Domestic Wastewater and Industrial Wastewater are the key sources of GHG emissions in the Waste sector. In 2018, Waste sector contributed to almost 7% of Punjab’s overall emissions. Waste sector emissions in the state increased at a CAGR of 1.53% during the reference period, from 4.10 Mt CO₂e in 2005, to 5 Mt CO₂e in 2018, as illustrated in Figure 13 below. A dip in the overall Waste emissions can be observed in 2015, largely due to decrease in emissions from Industrial Wastewater sub-sector.

Figure 13: GHG Emissions Estimates of Waste Sector - Punjab (2005 to 2018)

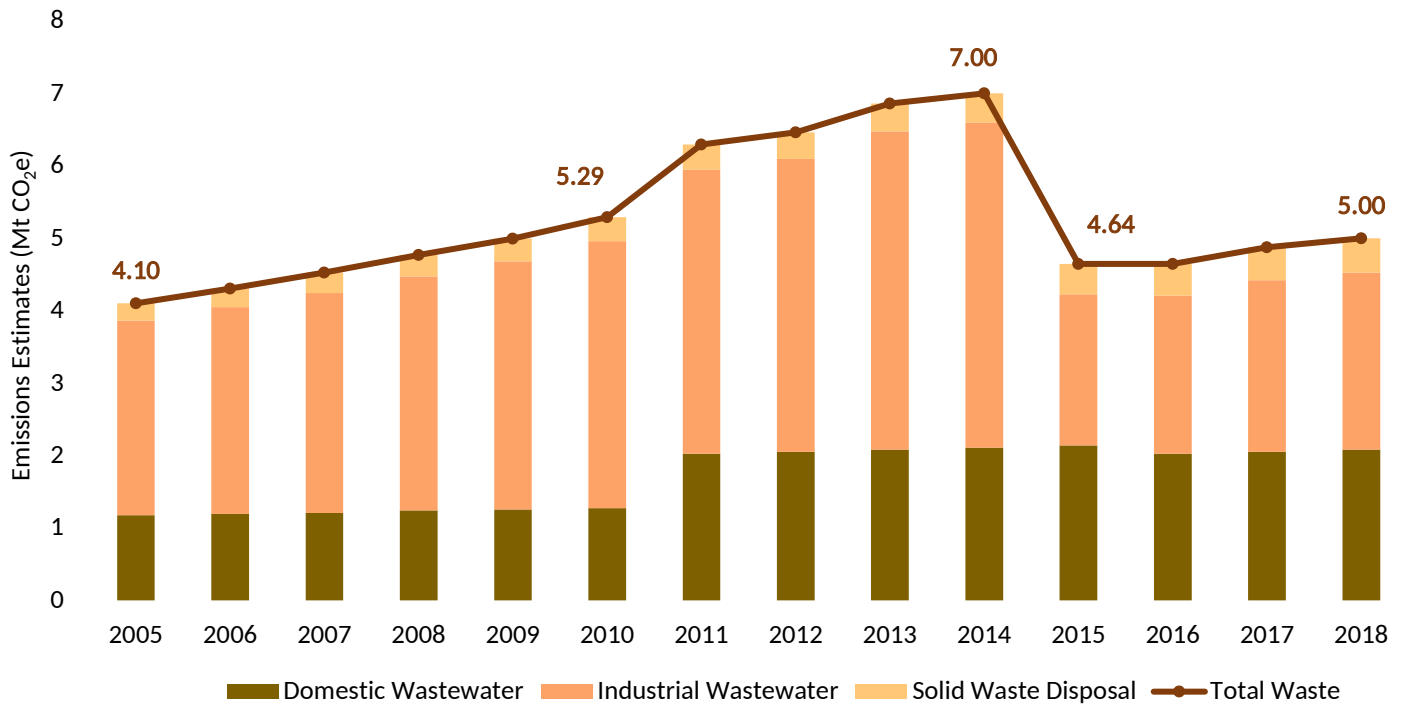
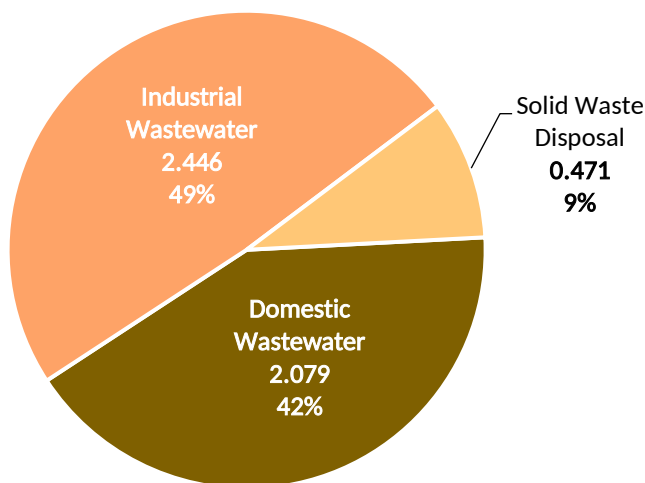


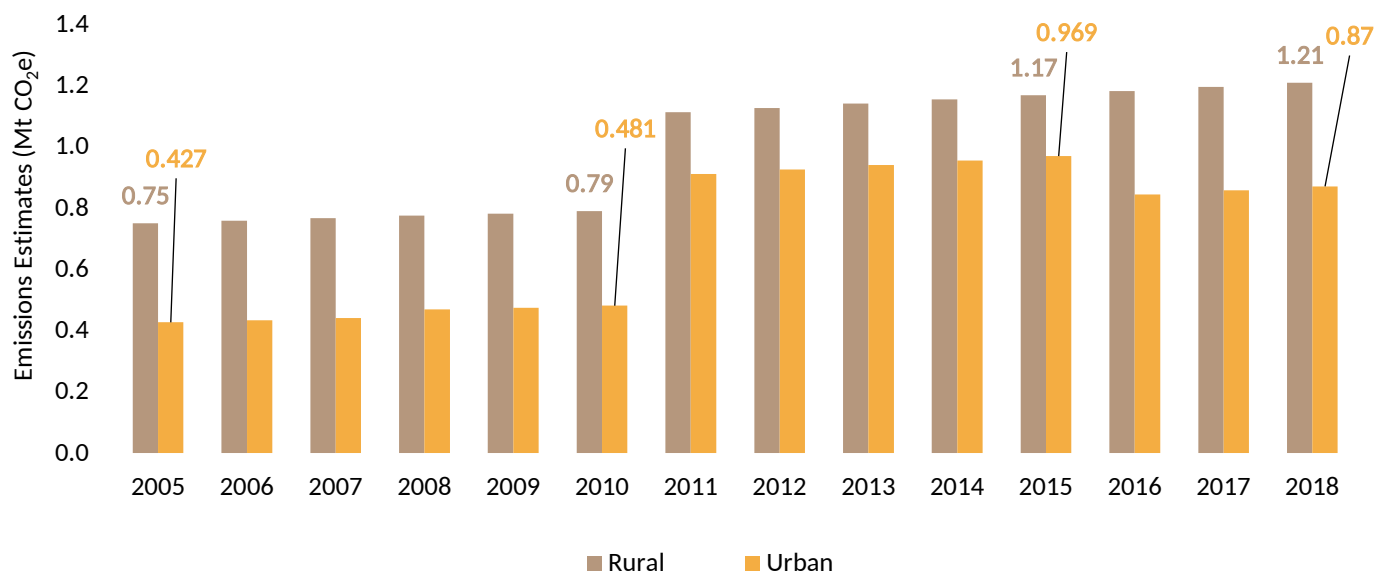
Figure 14: Sub-sector Emissions (Mt CO₂e) and Percentage Share in Total Waste Sector Emissions (2018)



Discharge of untreated wastewater and use of septic tanks are the key drivers of emissions due to Domestic Wastewater sub-sector. In 2018, Domestic Wastewater had a share of 42% in the total Waste sector emissions of Punjab. Approximately 9% of the Waste sector emissions were from Solid Waste Disposal, which increased at an estimated CAGR of 5.39% from 0.23 Mt CO₂e in 2005 to 0.47 Mt CO₂e in 2018. Industrial Wastewater accounted for nearly 49% of Waste sector emissions, which declined at a CAGR of 0.71%, from 2.68 Mt CO₂e in 2005 to 2.44 Mt CO₂e in 2018 (see Figure 14).

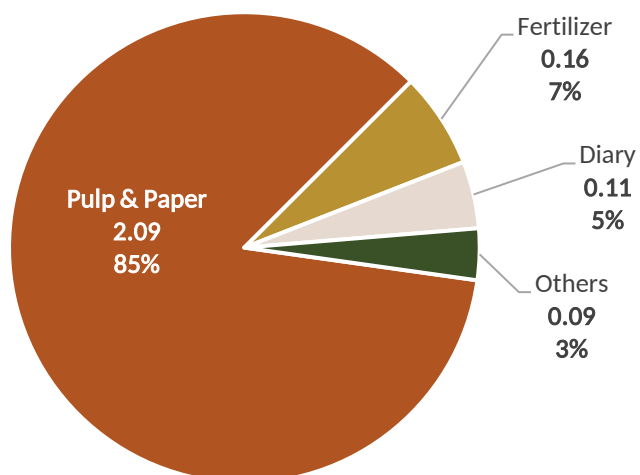
Emissions due to Domestic Wastewater from both rural and urban areas increased at a CAGR of 4.47% from 1.17 Mt CO₂e in 2005 to 2.07 Mt CO₂e in 2018. Almost 58% of Domestic Wastewater emissions (2018) emanated from rural areas of Punjab, as shown in Figure 15.

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



In 2018, Pulp and Paper Industry was the leading contributor to Industrial Wastewater emissions, with a share of ~85%. This was followed by Fertilizer Industry (~7%), Dairy (~5%) and Others (~3%), as illustrated in Figure 16.

Figure 16: Category-wise Emissions (Mt CO₂e) 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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