

Trend Analysis of GHG Emissions of KERALA

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

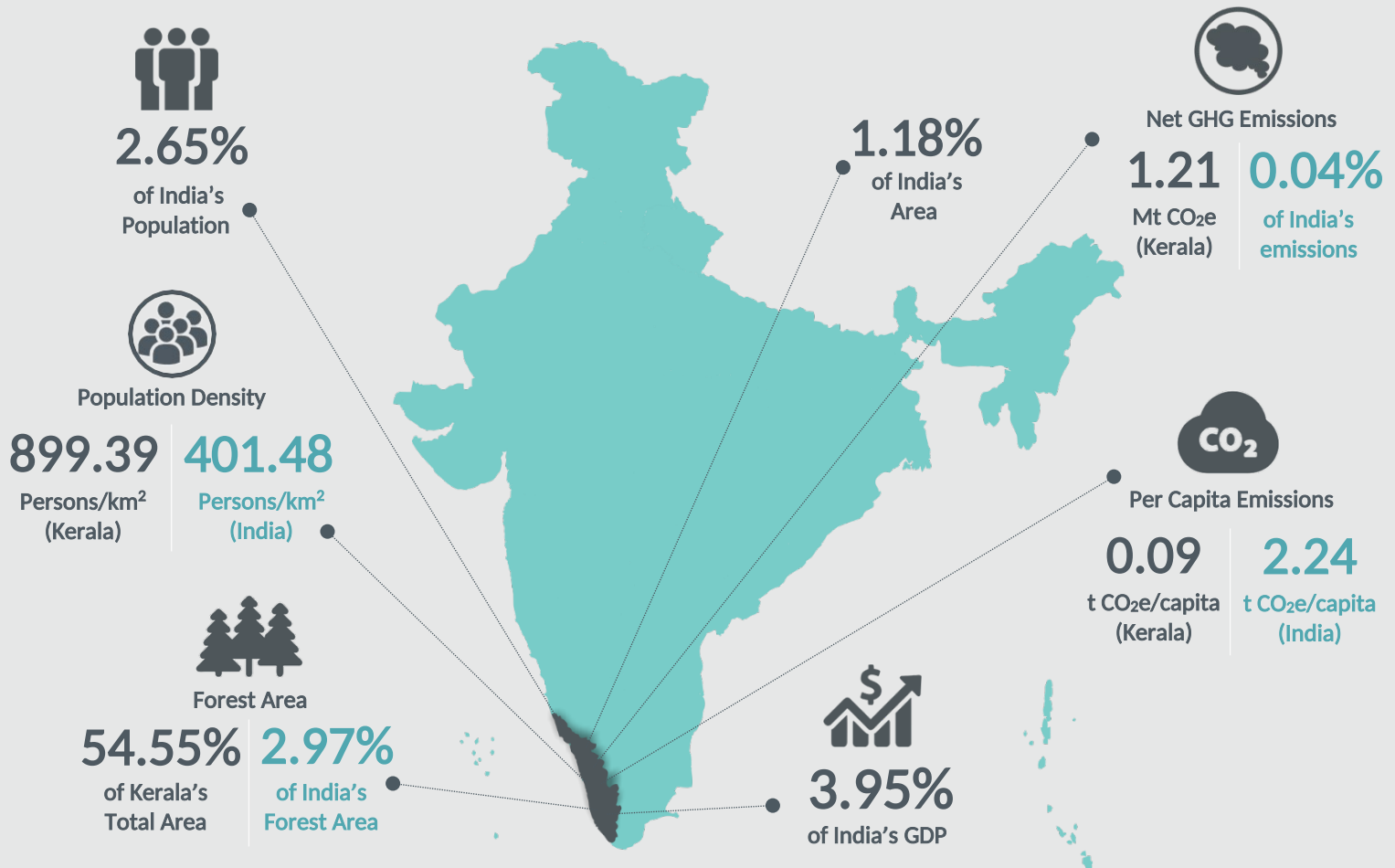
The Platform aims to add value to the various ongoing GHG emissions estimation efforts by addressing existing data gaps and data accessibility issues, broadening the scope of national inventories to include state inventories, and increasing the volume of analytics and policy dialogue on India's GHG emissions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

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



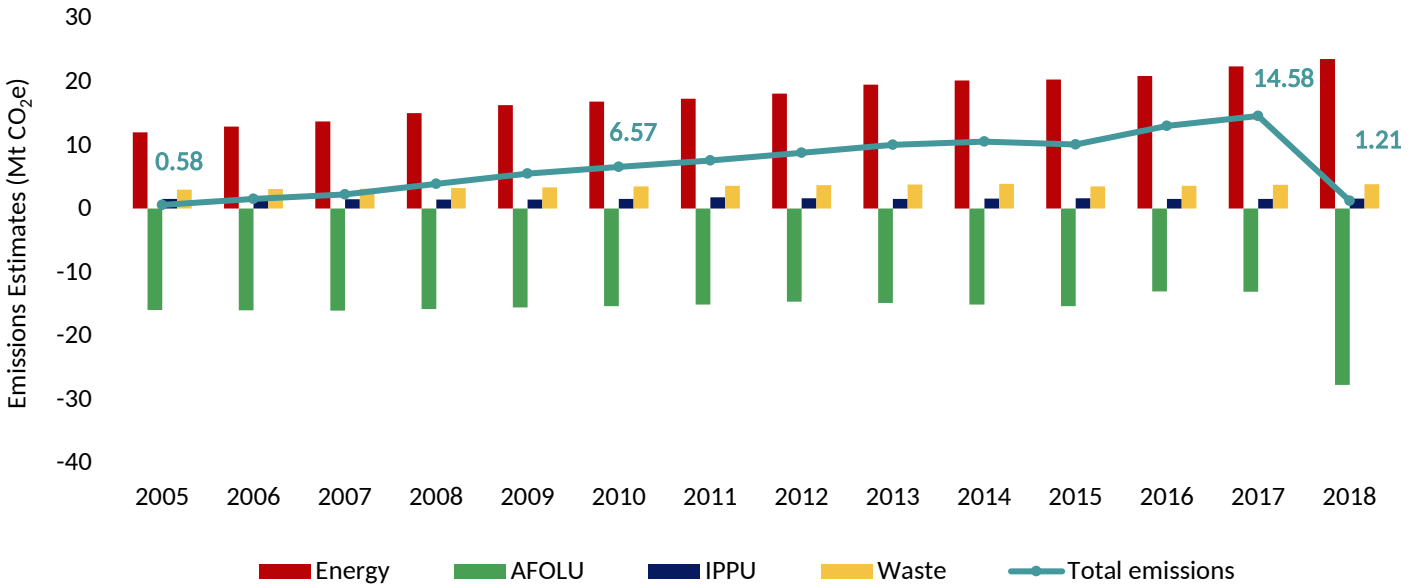
* Fuel combusted for captive electricity generation (auto-producers) and direct fuel combustion (industrial energy) has been reported under Energy sector.

Kerala at a Glance (2018)



Economy-wide Emissions Estimates

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



Emissions of Kerala increased at a rate of 5.73% (compounded annually) from 0.58 Mt CO₂e in 2005 to 1.21 Mt CO₂e in 2018. Kerala’s rapid growth of emissions till 2017 was due to increase in emissions from the Energy sector. However, due to significant enhancement of sinks in 2018, the overall emissions growth for that year was significantly moderated. In 2005, the share of Energy sector in gross economy-wide emissions (excluding AFOLU sector) was ~73%. This was followed by Waste and Industrial Processes and Product Use (IPPU) sectors with shares of ~18% and ~9%, respectively. In 2018, the share of Energy sector emissions increased to ~81% of the gross economy-wide emissions (excluding AFOLU sector). However, the contribution of Waste and IPPU sectors declined to 13% and 6%, respectively, in 2018 (see Figure 2).

Figure 2: Sector-wise Contribution (Mt CO₂e) and Percentage Share in Gross Economy-wide GHG Emissions (excluding AFOLU sector) of Kerala

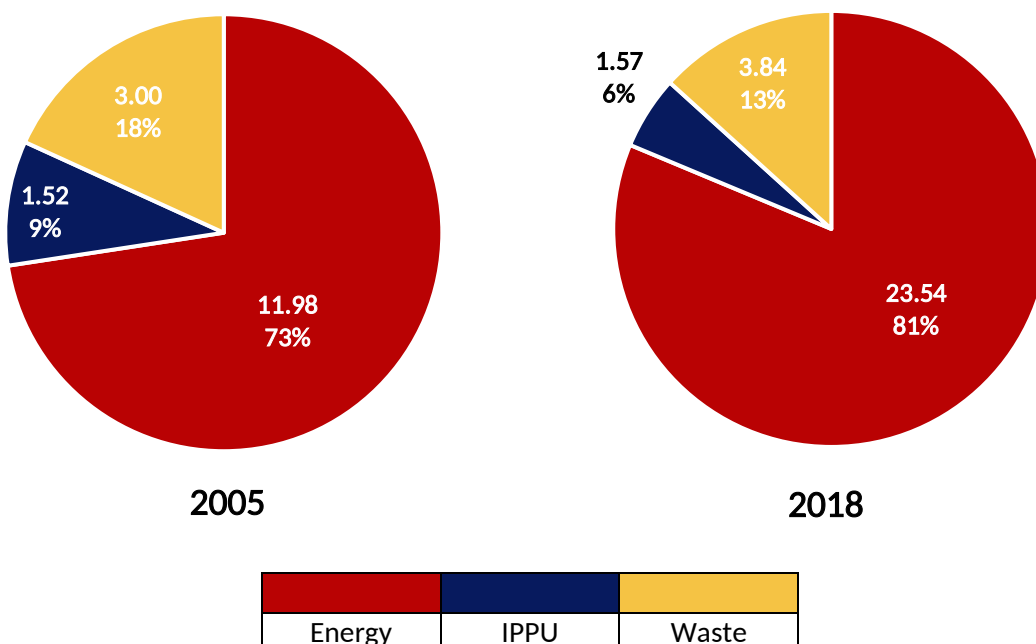
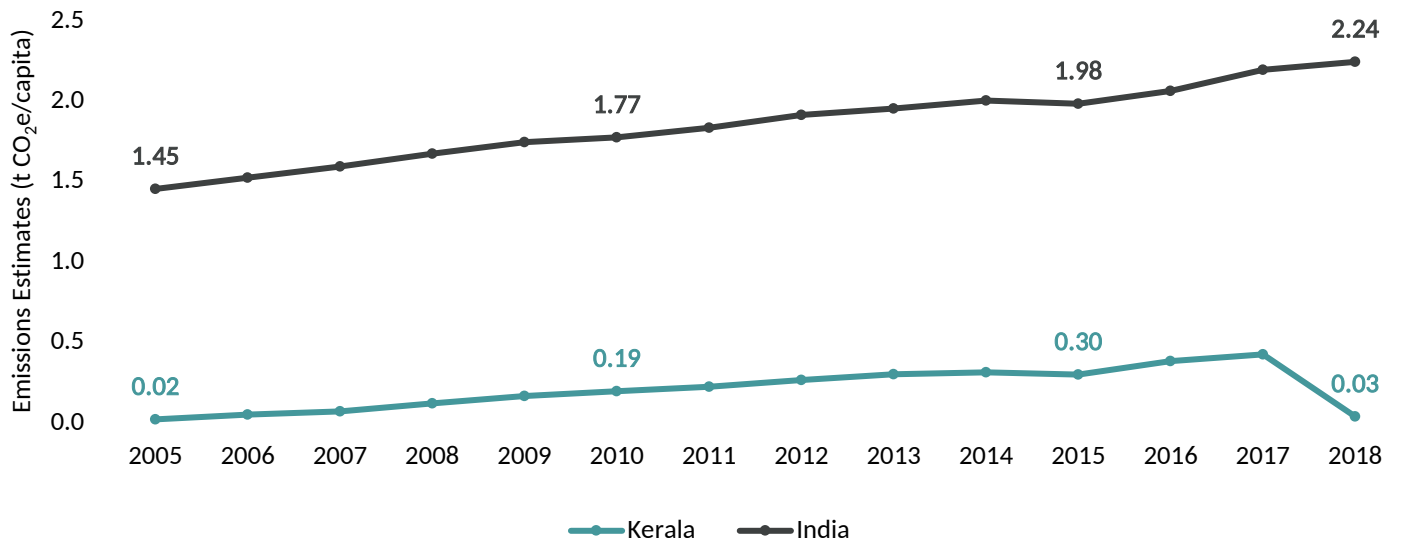


Figure 3: Per Capita Net Emissions of Kerala and India (2005 to 2018)



The per capita emissions of Kerala were significantly lower than the per capita emissions of India. However, they increased at a compounded rate of 5.31% from 0.02 t CO₂e per capita in 2005 to 0.03 t CO₂e per capita in 2018, which was higher than that of India (~3.41%).

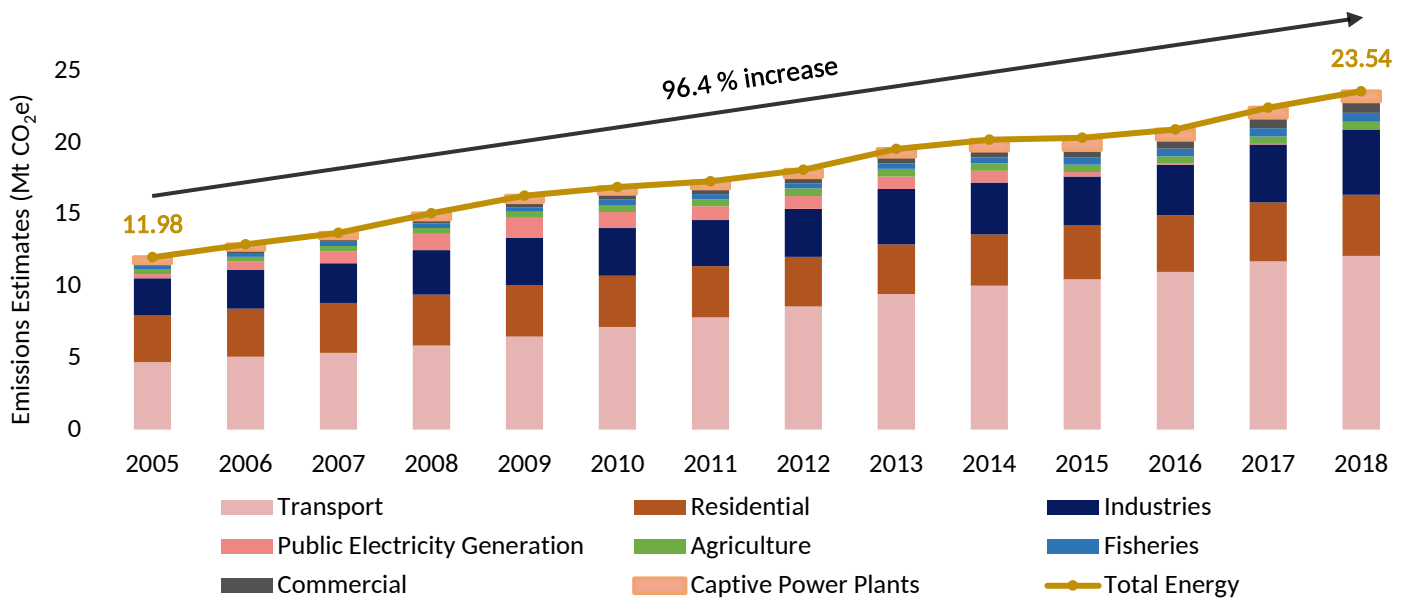
Energy Sector



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

The Energy sector of Kerala accounted for ~81% of the gross economy-wide emissions (excluding AFOLU sector) in 2018. Emissions from the Energy sector increased almost 2 times from 11.98 Mt CO₂e in 2005 to 23.54 Mt CO₂e in 2018 as shown in Figure 4.

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



Within the Energy sector, Transport category was the major contributor of GHG emissions with a share of ~52% of the total Energy emissions in 2018. This was followed by Industrial Energy and Residential categories at 19% and 18%, respectively (see Figure 5).

Within Fuel Combustion sub-sector, emissions from Liquid Petroleum Fuels were a major contributor, with an average share of ~70% across the reference period (see Figure 6). This was followed by emissions from combustion of Gaseous Fuels, with an average share of ~16% between 2005 and 2018. Coal had an average share of ~7%, while Other Fuels contributed ~8% to the Fuel Combustion emissions throughout the reference period.

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

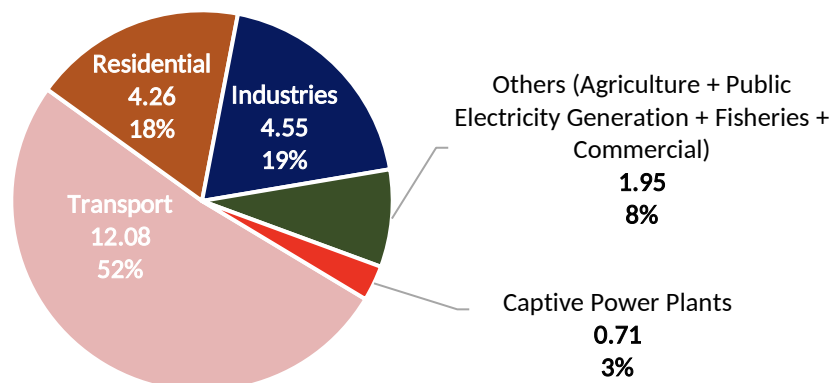
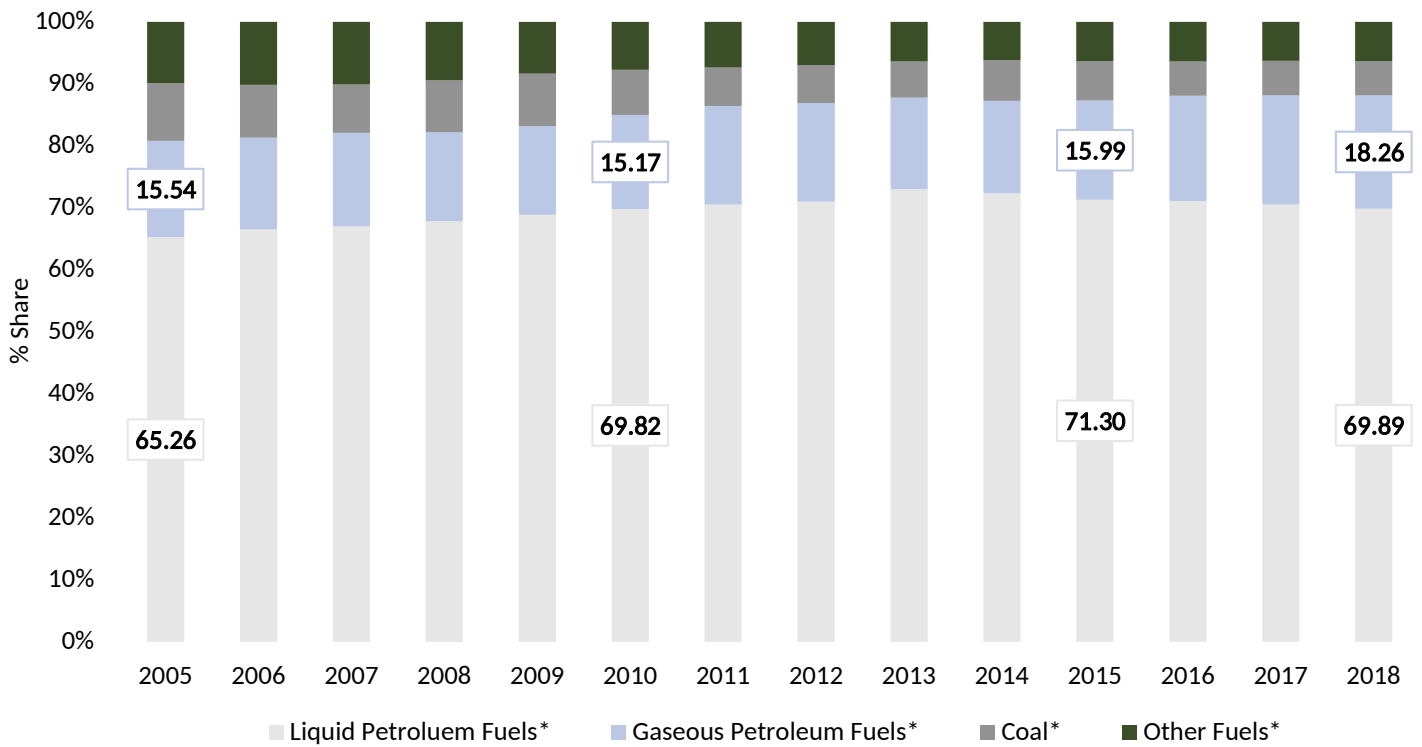


Figure 6: Percentage Share of GHG Emissions by Fuel Type due to Fuel Combustion in Energy Sector (2005 to 2018)



***Notes**

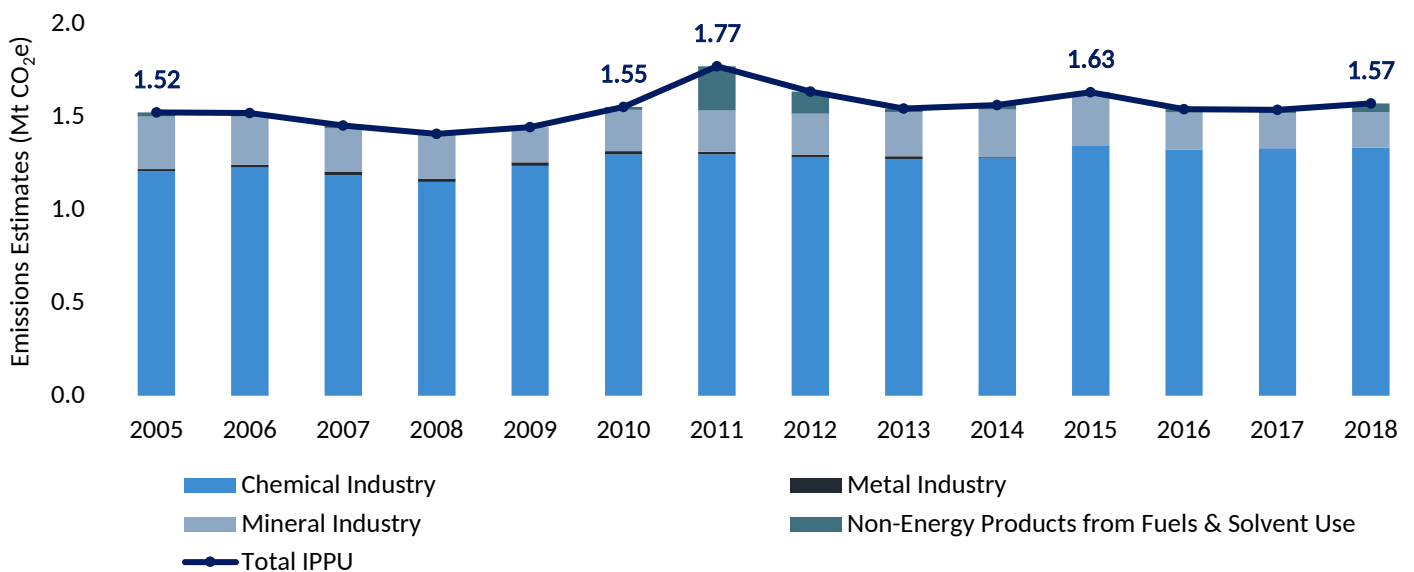
1. Coke is considered in coal because the bifurcation of pet-coke and coke was not available.
2. Gaseous Petroleum Fuels- Natural Gas, LPG and other gaseous fuels
3. Liquid Petroleum Fuels- ATF, Diesel, Kerosene, Motor spirit and other liquid fuels
4. Other Fuels comprise of Firewood and Charcoal



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 Kerala, the IPPU sector represented ~6% of the gross economy-wide emissions (excluding AFOLU) in 2018. Between 2005 and 2018, the overall IPPU emissions increased slightly at a compounded rate of 0.24% from 1.52 Mt CO₂e in 2005 to 1.57 Mt CO₂e in 2018. As seen in Figure 7, a spike in emissions was observed in 2011 due to a 12-fold increase in emissions from Non-Energy Products from Fuels & Solvent Use sub-sector (primarily from Lubricant Use and Paraffin Wax).

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



A detailed trend of the GHG emissions by various IPPU categories in 2018 is depicted in Figure 8. Ammonia Production, a key contributor to the IPPU emissions, accounted for ~67% share, followed by Carbon Black and Cement Production with shares of 13% and 12%, respectively, in 2018 (see Figures 8 and 9).

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

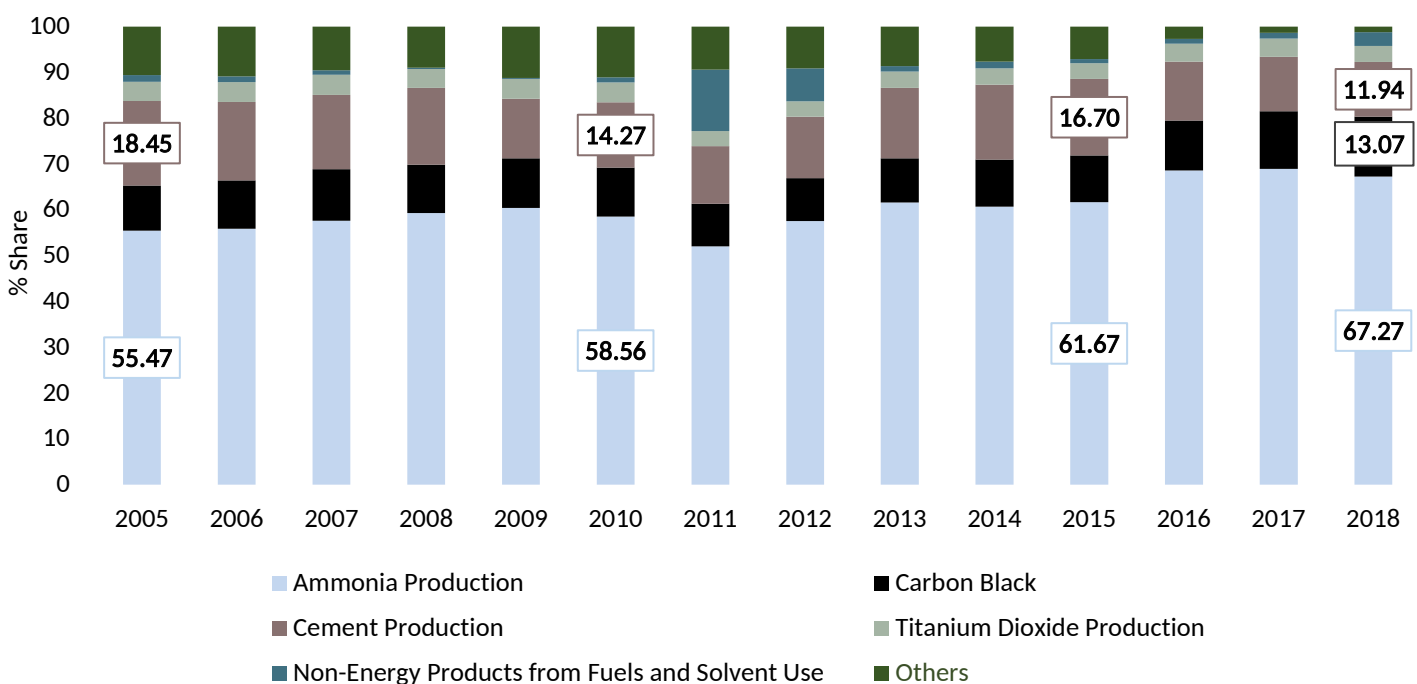
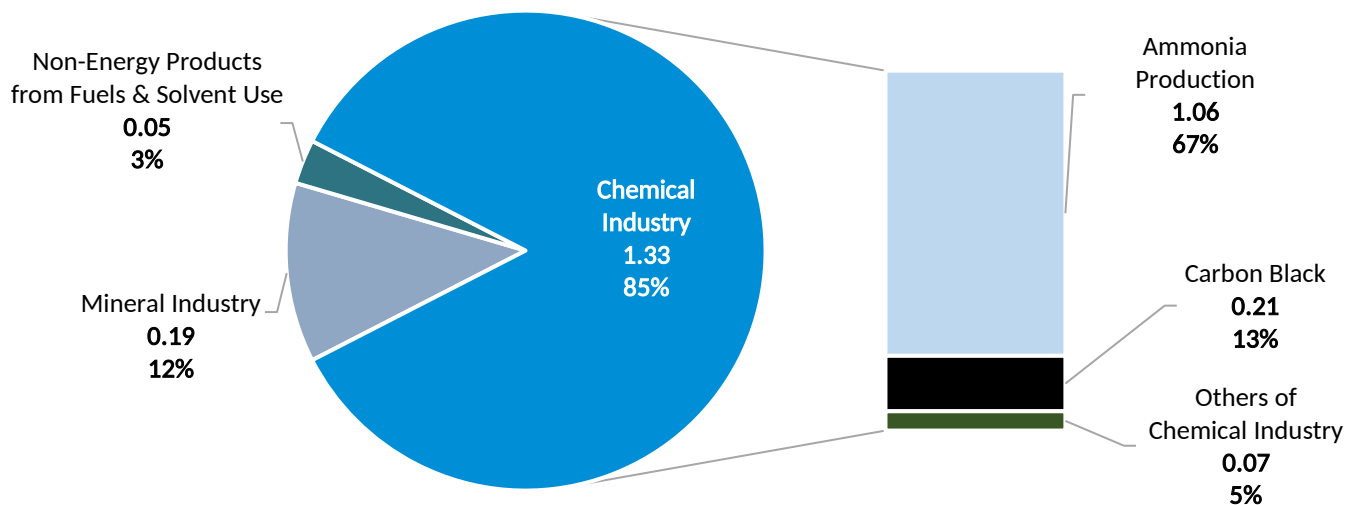


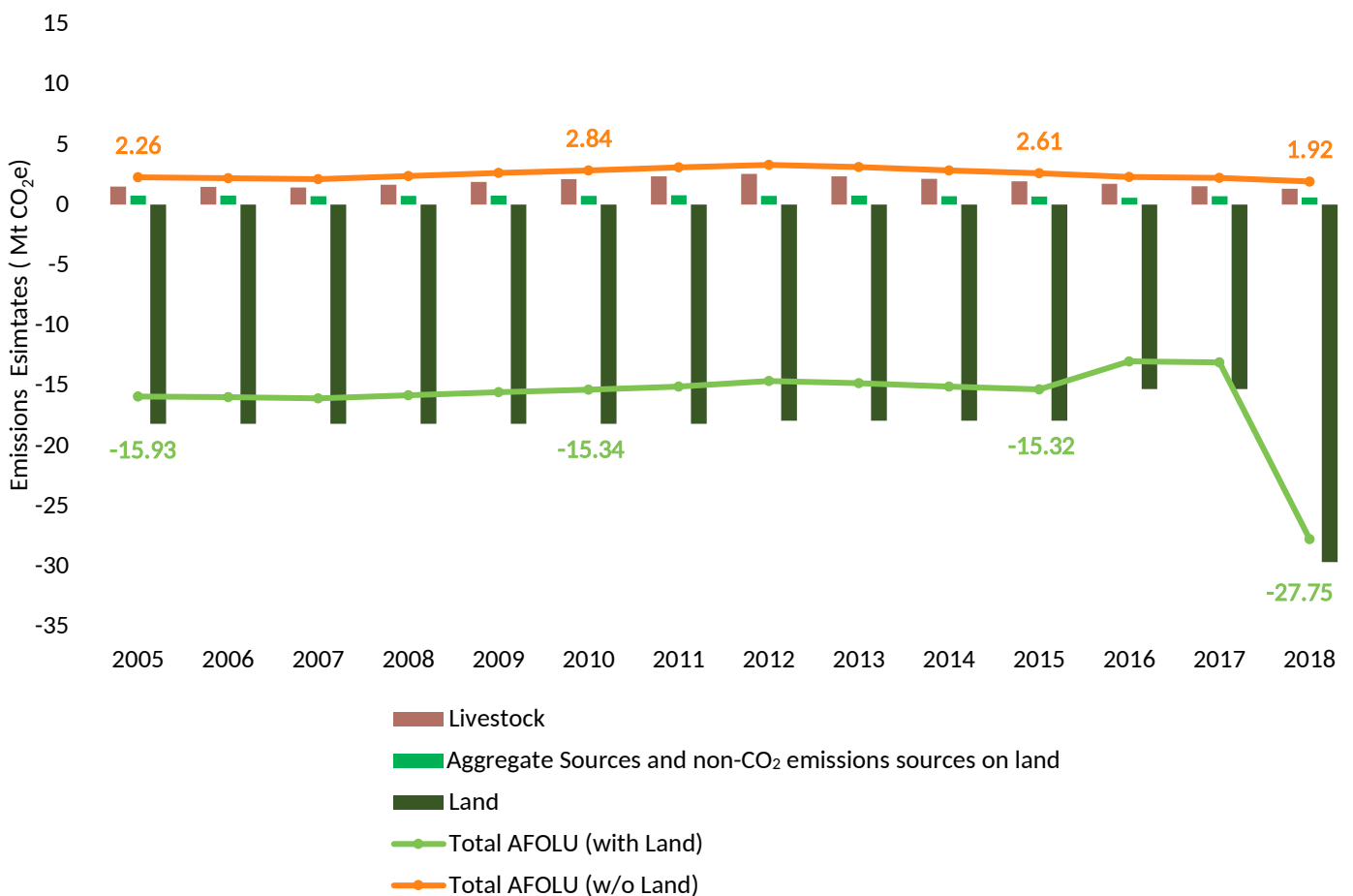
Figure 9: Sub-Sector Emissions (Mt CO₂e) and Percentage Share in Total IPPU Emissions (2018)





Emissions from the Agriculture, Forestry and Other Land Use (AFOLU) sector arise from three main sub-sectors: Livestock, Land and Aggregate Sources and Non-CO₂ Emissions Sources on Land*. In Kerala, while the Livestock and Aggregate Sources and Non-CO₂ Emissions Sources on Land sub-sectors were net GHG emitters, the Land sub-sector was a sink across all the reference years. The AFOLU sector, overall, remained a net sink of emissions across all the reference years. This was because removals from Forest Land increased significantly. This in turn was due to a significant increase in forest area by 36% from 15,59,500 ha (FSI, 2005)** to 21,24,349 ha (FSI, 2021)**. Additionally, emissions from the highest contributing sub-sector, i.e., Livestock declined over the reference period (see Figure 10). The average annual emissions from Livestock and Aggregate sources were 2.56 Mt CO₂e that were neutralized by CO₂ removals from the Land sub-sector which was, on an average, annually removing 15.96 Mt CO₂e during the reference period.

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



The Livestock sub-sector had the maximum share of ~69% of positive AFOLU emissions (excluding Land sub-sector) in Kerala during the reference period. Within the Livestock sub-sector, Enteric Fermentation was the major contributor of positive AFOLU emissions across the reference period with an average share of ~66%. The emissions from this category declined at a rate of 1.12% (compounded annually) from 1.37 Mt CO₂e in 2005 to 1.18 Mt CO₂e in 2018.

Within the Aggregate Sources sub-sector, the categories of Rice Cultivation and Agricultural Soils were the highest contributors to positive AFOLU emissions with average shares of ~15% and ~13%, respectively, during the reference period. While emissions from Rice Cultivation decreased at CAGR of 2.70%, emissions from Agriculture Soils showed nominal growth at CAGR of 0.01% between 2005 and 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 2005 reports data for 2004 and FSI Report 2021 reports data for 2019.

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

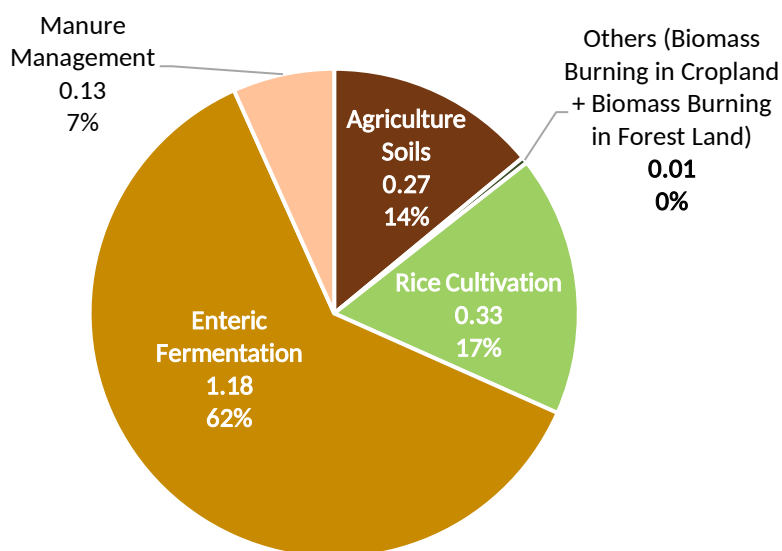
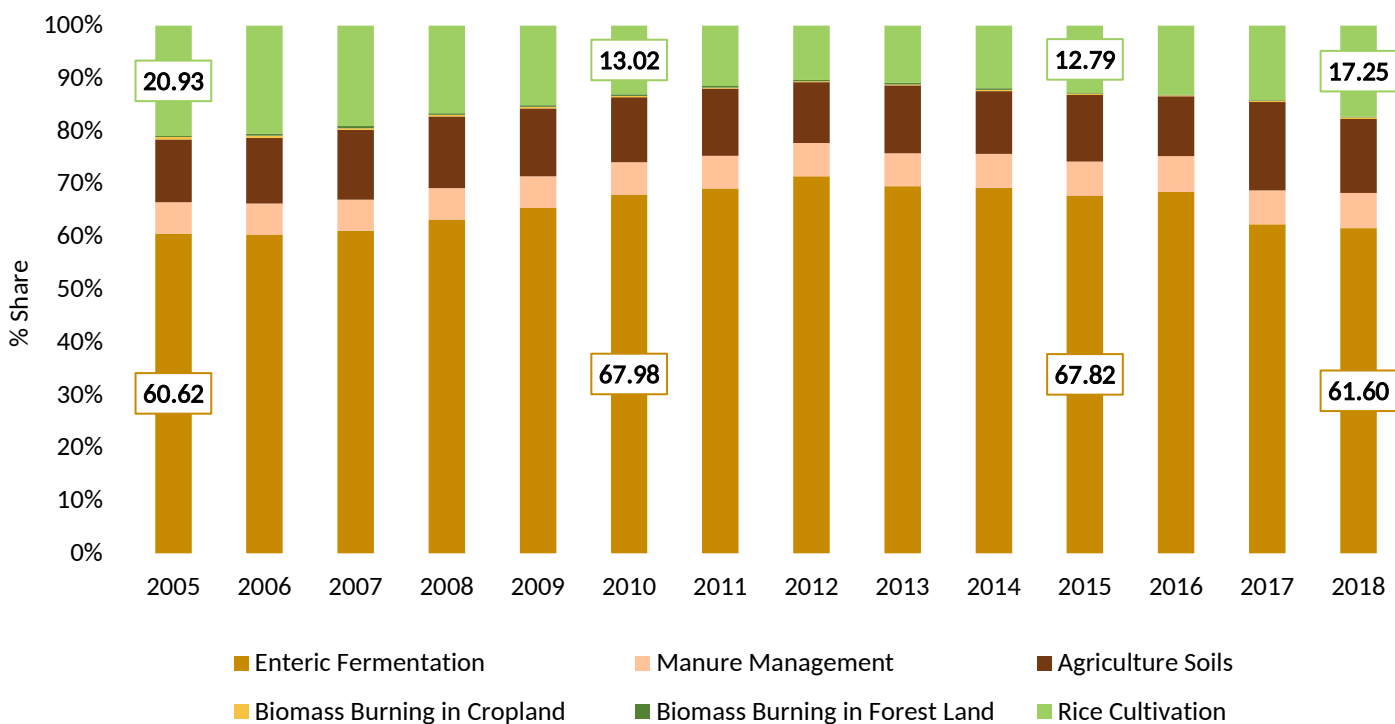


Figure 12: Category-wise Share of Positive AFOLU Emissions (excluding Land sub-sector) (2005 to 2018)





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 13% of gross economy-wide emissions (excluding AFOLU sector) of Kerala in 2018. GHG emissions from the Waste sector of Kerala grew at a CAGR of 1.92% from 3.0 Mt CO₂e in 2005 to 3.84 Mt CO₂e in 2018. There was a dip in emissions in 2015 which can be attributed to decline in emissions from Industrial Wastewater sub-sector reported in that year (see Figure 13).

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

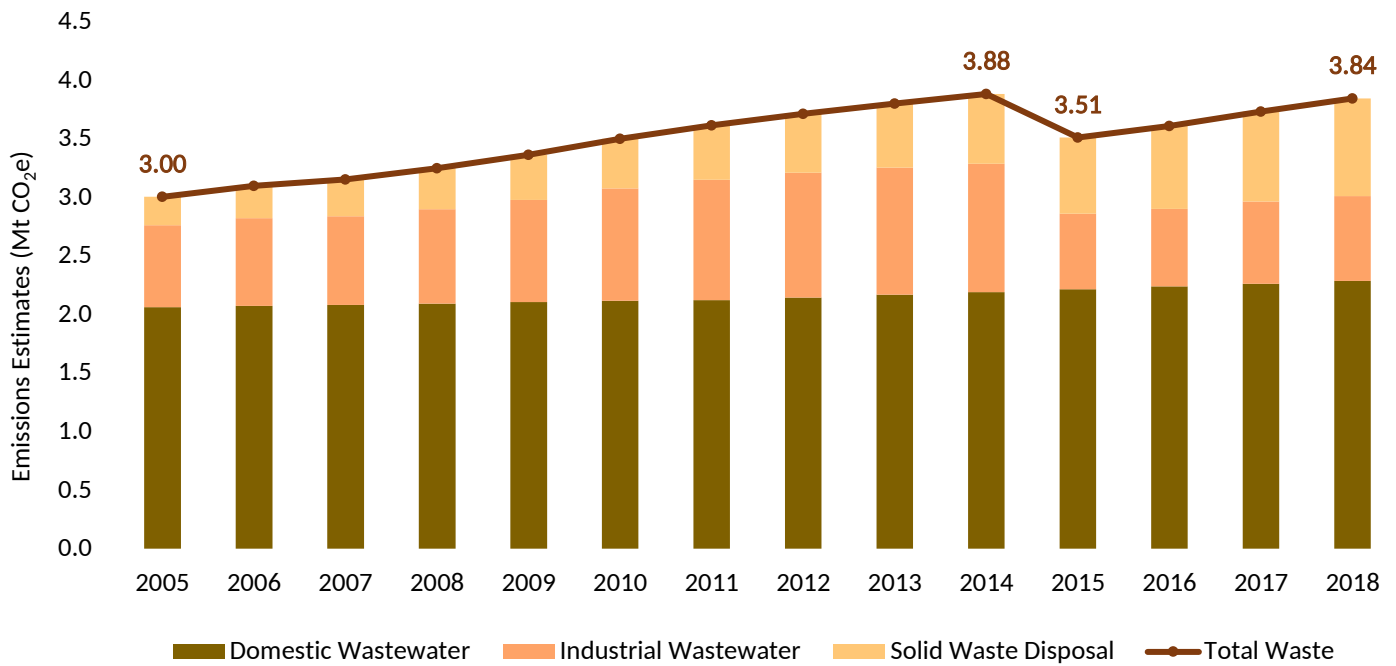
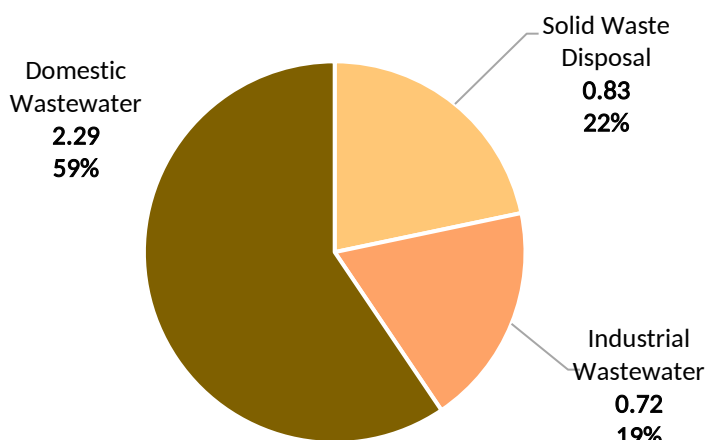


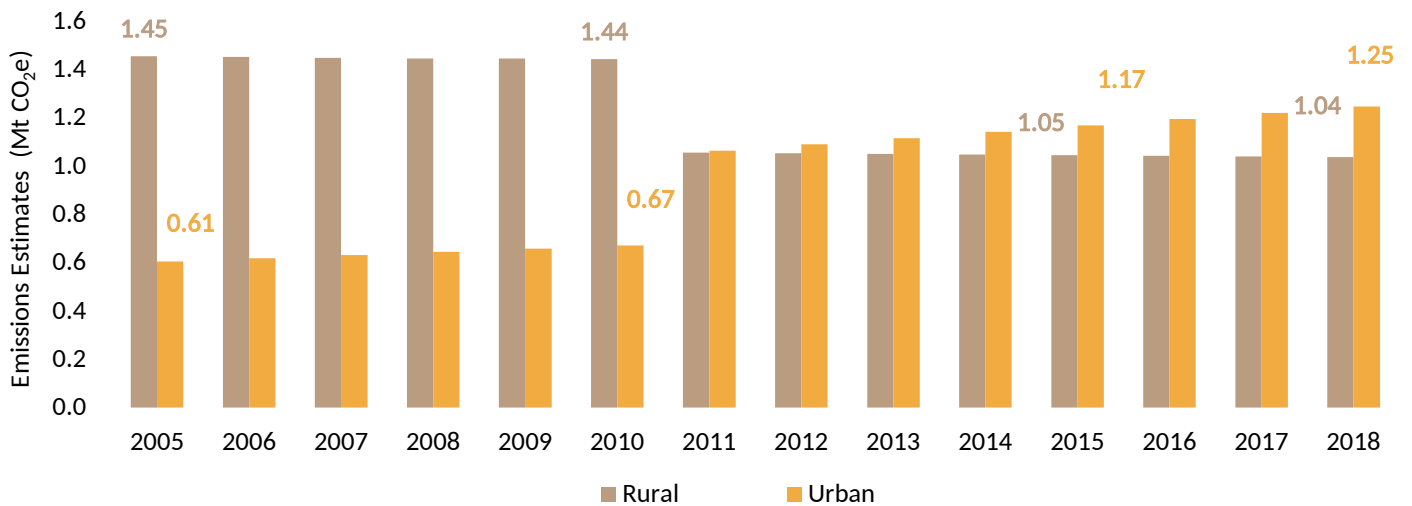
Figure 14: Sub-sector Emissions (Mt CO₂e) and Percentage Share in Total Waste Sector emissions (2018)



Discharge of untreated wastewater and use of septic tanks are the key drivers of emissions due to Domestic Wastewater sub-sector. Domestic Wastewater had a share of 59% in the total Waste sector emissions of Kerala in 2018. Approximately, 22% of the Waste sector emissions were from Solid Waste Disposal, which grew at an estimated CAGR of 10% from 0.24 Mt CO₂e in 2005 to 0.83 Mt CO₂e in 2018. Industrial Wastewater accounted for nearly 19% of the Waste sector emissions in 2018 and grew at a CAGR of 0.25% (0.70 Mt CO₂e in 2005 to 0.72 Mt CO₂e in 2018) (see Figure 14).

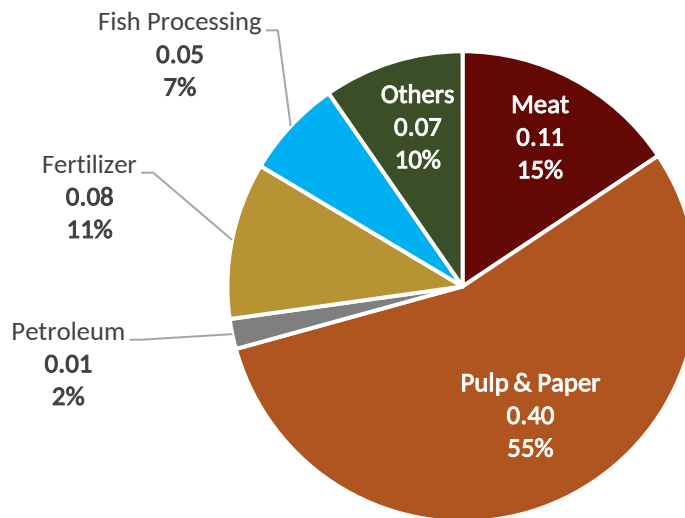
Emissions from Domestic Wastewater of both rural and urban areas grew at a CAGR of 0.8% from 2.06 Mt CO₂e in 2005 to 2.29 Mt CO₂e in 2018. Almost 55% of Domestic wastewater emissions were from the urban areas of Kerala in 2018 as shown in Figure 15.

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



The Pulp and Paper Industry was the major contributor to Industrial Wastewater emissions with a share of ~55% in 2018. This was followed by Meat (~15%) and Fertilizers Industries (~11%) as illustrated in Figure 16.

Figure 16: Category-wise Emissions (Mt CO₂e) and Percentage Share in Total Industrial Wastewater Emissions (2005 to 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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