Transitions Research

Kolhapur, Maharashtra: Greenhouse Gas Emissions Inventory Report

About Us

Transitions Research is a social science collective driving radical transitions at the intersection of technology, society, and sustainability. We aim to ensure these transitions are just, inclusive, and empower people while protecting the planet. Our work focuses on discovering sustainable pathways by generating anticipatory knowledge, co-creating solutions, and building capacities for societal action.

Our initiative, People's Urban Living Lab (PULL) works to co-create, test, and implement equitable climate solutions in mid-sized Indian cities. Through PULL: Net Zero, we are working to discover inclusive net-zero solutions for Indian cities.

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1. Introduction

Cities play a pivotal role in addressing the global challenge of climate change, contributing more than 70 per cent of CO_2 emissions through transportation, energy consumption, industrial operations, and waste management (IPCC 2022).

Urban India is a significant contributor to rising greenhouse gas (GHG) emissions, largely due to increasing energy demand across transportation, industry, and residential sectors. With India pledging to achieve net-zero emissions by 2070, mid-sized cities with populations under 1.5 million, such as Kolhapur, have a rare chance to leapfrog traditional high-carbon growth and go directly to sustainable pathways. While larger cities like Mumbai and Pune have committed to ambitious climate action, smaller cities often remain overlooked. In this context, Transitions Research has launched the People's Urban Living Lab (PULL) initiative in Kolhapur to ensure the city's development pathway aligns with the nation's net-zero ambitions.

Developing comprehensive greenhouse gas (GHG) emission inventories at the city level is a crucial first step for understanding emission sources, enabling targeted policy interventions, and guiding the transition towards sustainable urban development. By identifying their emission drivers and mitigation opportunities, mid-sized cities like Kolhapur can not only contribute to national climate commitments but also improve local air quality, enhance energy security, and strengthen resilience to climate impacts.

Image 1: Panchganga riverside, Kolhapur

2. Kolhapur: City Overview

The city of Kolhapur is located in the southwestern part of Maharashtra, situated along the banks of the Panchganga River and surrounded by the picturesque Sahyadri mountain range. Its geographical setting has historically influenced the city's growth, culture, and economic activities, particularly in relation to agriculture, trade, and urban expansion. The Kolhapur Municipal Corporation (KMC), which serves as the governing authority of the city, administers an area of approximately 66.84 square kilometres. According to the Census of India 2011, the city had an urban population of about 5,49,236 residents, with an average population density of 8,219 persons per square kilometre (Government of India, n.d.). This high density indicates a compact urban fabric, with a significant proportion of residents concentrated in core city areas, while the peri-urban zones are characterised by mixed land uses and emerging patterns of urban sprawl.

Kolhapur comprises approximately 1,24,194 households, distributed across 20 multi-member administrative wards. These wards reflect a blend of urban and peri-urban environments, highlighting the city's transitional character between traditional settlements and rapidly urbanising spaces. As per the most recent notification by the Government of Maharashtra, the 20 wards are represented by a total of 81 councillors, reflecting a system of decentralised governance and representation. Of these, 19 wards are assigned four councillors each, while one ward is represented by five councillors. This arrangement underscores the significance of proportional representation in addressing the diverse needs of Kolhapur's population, which spans across varied socio-economic and geographic contexts (Government of Maharashtra, 2025; Government of India, n.d.).

Known for its rich cultural heritage, Kolhapur serves as a significant commercial and agricultural hub in the region. Its economy blends traditional industries, small-scale manufacturing, and agricultural production, contributing substantially to Maharashtra's state GDP. Kolhapur's annual GDP is estimated at approximately INR 54.63 billion, with a per capita income of INR 1,51,963 in 2020–2021 (Indiastat Districts, n.d.). Unlike other industrialised cities, Kolhapur's industrial activities focus on textile production, sugar processing, and small-scale foundries. The service sector also plays an essential role, employing many in retail, hospitality, and trade.

The city's population grew by approximately 1.86 per cent between 2023 and 2024 (Macrotrends, n.d.), fuelling increased demand for residential and commercial energy. The residential sector primarily relies on electricity, liquefied petroleum gas (LPG), and, in some regions, traditional biomass fuels. Commercial establishments like restaurants, retail stores, and markets further increase the overall energy consumption. The transportation sector, largely comprising private vehicles, remains a significant consumer of petroleum fuel, highlighting Kolhapur's rapid urbanisation and rising vehicle ownership. Kolhapur generates about 180–200 tons of municipal solid waste per day. The Municipal Corporation has installed a digester with 60 per cent biomethanation capacity, converting biodegradable waste into biogas and organic manure while reducing landfill load and emissions (Sarnobbat & Kulkarni, 2019).

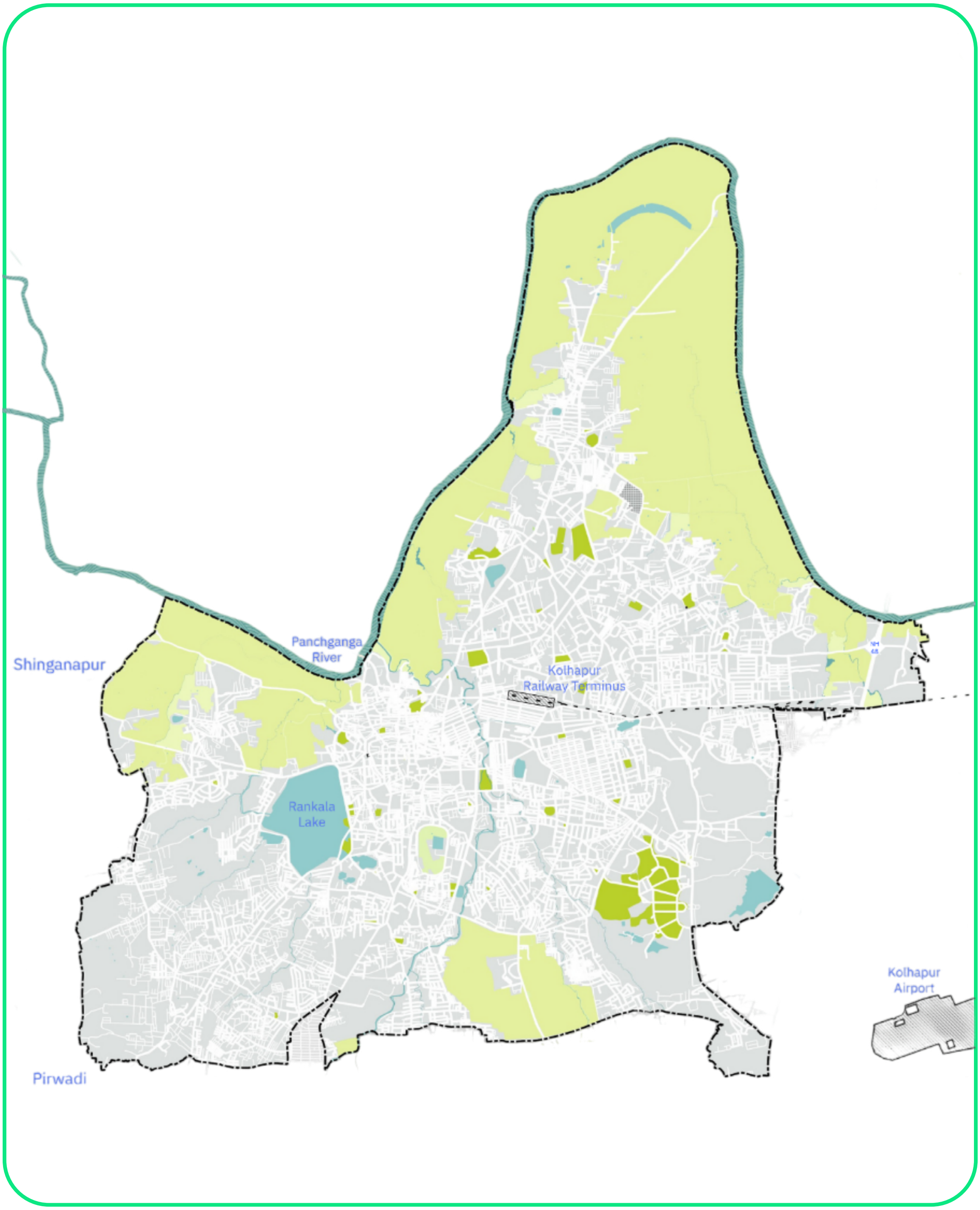

Image 2: Map of Kolhapur

3.Methodology

Every activity within a city, such as electricity consumption, transportation, and so on, can produce greenhouse gas (GHG) emissions that may occur either inside or outside the city's geographic boundary. To differentiate these emissions, they are categorised into three groups:

Table 1: Definition of scopes for inventories

Scope	Definition
Scope 1	Direct GHG emissions from sources and activities within the city boundary
Scope 2	Indirect GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam, and/or cooling within the city boundary
Scope 3	All other GHG emissions that occur outside the city boundary as a result of activities taking place within the city boundary

Such classifications provide cities with a structured way to capture both direct and indirect emissions, supporting integrated climate action.

For Kolhapur, the emissions inventory estimates scope 1 and 2 emissions. Emissions are calculated using energy consumption data for electricity and fuels in these sectors, using FY 2023–2024 as the baseline. The sectors covered in the inventory include:

Stationary Energy
Electricity & fuel in buildings
industrial, commercial, residential

Waste Sector

Transport Sector

Agriculture Sector

The analysis is primarily based on secondary data and information obtained from the Kolhapur Municipal Corporation. In addition, on-ground household field surveys were conducted to provide further insights, informing the emission inventory and capturing local consumption and demand patterns in Kolhapur.

3.1. Stationary energy

Stationary energy refers to the energy consumed in fixed locations such as residential buildings, commercial establishments and industrial facilities. It includes energy used for heating, cooling, lighting, and operating appliances, equipment or machineries. Emissions from stationary energy are generated from fuel combustion (e.g., gas or coal) and electricity usage, covering sectors like residential, commercial, and industrial.

3.1.1. Commercial and industrial sector

The main energy input is electricity, with the inclusion of different fuels like coal, firewood, briquettes, etc. Emissions are estimated considering the electricity composition at the grid, different types of fuel combustion, and their respective emission factors.

3.1.2. Residential sector

Electricity and cooking fuels are the primary energy inputs and major sources of emissions in the residential sector. The consumption of cooking fuels such as liquefied petroleum gas (LPG), kerosene, and traditional biomass is estimated based on primary household survey data. Emissions are then calculated using the grid composition for electricity and standard emission factors for each fuel type.

3.1.3. Other sectors

This section includes electricity-related emissions from public department buildings (e.g., railways and other government facilities), streetlights, and public water works (PWW). Electricity is the primary energy input considered for these sectors, as data on other fuel sources is unavailable. Emissions are estimated using the grid composition and relevant fuel emission factors.

3.2. Waste sector

Kolhapur follows efficient waste management practices, including composting and incineration. Emissions from these processes and waste collection vehicles are estimated based on emission factors for different processing methods for municipal waste.

3.3. Transport sector

Emissions from the vehicles are estimated based on vehicle types, fuel type, and passenger and ton–kilometre metrics.

3.4. Agriculture

Emissions in agriculture are calculated using emission factors for different activities employed. The major crops considered for Kolhapur are sugarcane and paddy. Emissions from activities like irrigation for paddy and sugarcane, sugarcane processing, and cogeneration in sugar mills are accounted for.

4. Key emission drivers

As a rapidly developing urban centre, Kolhapur faces significant emission challenges that are closely linked to demographic expansion, rapid urbanisation, and economic growth. Key drivers include population increase, growth in per capita income, intensification of economic activities, and shifts in consumption and production patterns. These drivers collectively influence energy demand, fuel choice, and land-use dynamics, thereby shaping the city's emission trajectory.

The **transport sector** is the dominant source of emissions, contributing nearly 67 per cent of the total. This is primarily driven by rising motorisation rates, heavy reliance on internal combustion engine vehicles, and an underdeveloped public transport network. Urban expansion has increased commuting distances and freight movement, further raising fuel consumption. Vehicle ownership is highly unequal, with high-income households averaging almost two vehicles while slum and below-poverty-line (BPL) households have fewer than 0.5. Electric vehicle adoption remains marginal, hindered by limited public charging infrastructure, keeping the sector locked into a high-carbon trajectory. With fossil fuels remaining the predominant energy source, the sector's emissions are highly correlated with growth in vehicle kilometres travelled (VKT) and fuel intensity.

The emissions from **stationary energy** sources in buildings (residential, commercial, industrial, and government establishments), is the second largest contributor, responsible for around 14 per cent of total emissions. Household survey data shows that electricity demand in Kolhapur is highly income-linked, with high-income households owning multiple energy-intensive appliances, while poorer groups consume less due to limited access and affordability. LPG is the dominant cooking fuel, but kerosene and diesel use persists in slums and BPL households, whereas some high-income groups have begun shifting to piped natural gas. The built environment is carbon intensive, dominated by RCC and cement housing, with limited adoption of rooftop solar (0.5%) and energy-efficient appliances among lower-income groups. Furthermore, growth in floor-space area, especially in commercial and institutional buildings, and rising penetration of energy-intensive appliances are further intensifying demand. Emissions are estimated based on both grid emission factors and direct fuel combustion.

The **agriculture sector** contributes another 13 per cent of emissions, predominantly through methane (CH_4) and nitrous oxide (N_2O) releases. Emission drivers include paddy cultivation, sugarcane production, fertiliser application, and livestock rearing. Irrigation and mechanisation add to energy-related emissions, while crop residue management practices also influence overall outputs. The sector's emissions are highly dependent on cropping patterns, input intensity, and water-energy use interactions.

The **waste sector** accounts for roughly 6 per cent of total emissions. Population growth and rising consumption have led to higher solid waste generation, while insufficient segregation, treatment, and landfill management result in uncontrolled anaerobic decomposition and methane emissions. Inadequate wastewater treatment also contributes to sectoral emissions.

Overall, Kolhapur's emission profile is shaped by interlinked drivers across sectors, including demographic trends, urban form, energy intensity, and economic activity. Without interventions, these drivers will continue to accelerate the city's energy demand and greenhouse gas emissions, posing challenges for sustainable urban development.

Image 4: A market in Kolhapur

5.Sectoral emissions

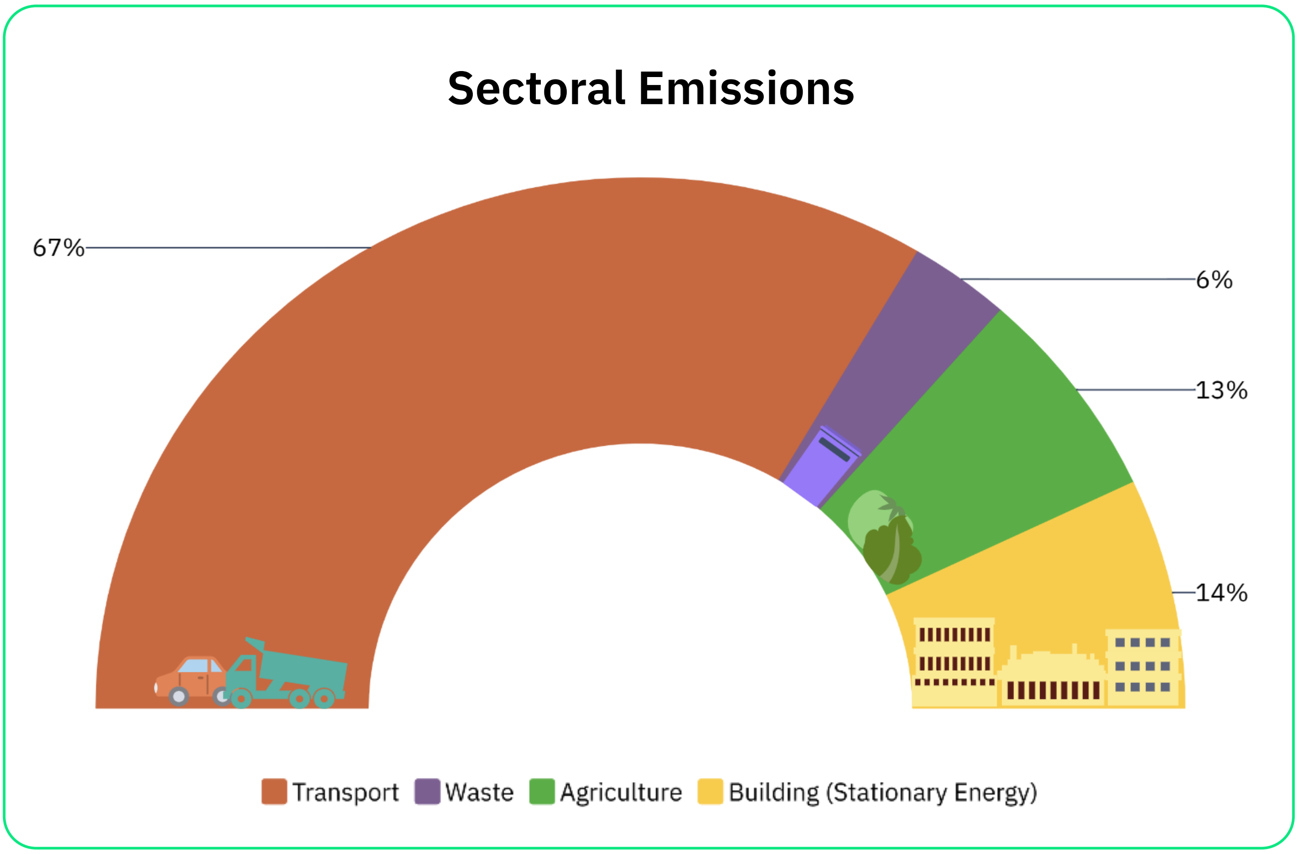

Figure 1. Sectoral Emissions

5.1. Stationary energy

Kolhapur's stationary energy emissions in FY 2023-24 reached 4,296,228 million tCO_2-eq, almost entirely driven by grid electricity, which accounts for 98.8 per cent. This heavy dependence on the Maharashtra grid—where over 82% of electricity is fossil-fuel based, primarily coal—means that emissions are largely indirect (Scope 2) but highly carbon-intensive. Industrial and commercial activities dominate this demand, contributing nearly approx 17% of electricity-related emissions, followed by agriculture and residential use. Direct fuel combustion plays only a small role in overall emissions, though it is still largely dependent on coal. In addition, losses in electricity transmission and distribution further increase the overall carbon intensity of the system. The presence of renewable and hydro energy in the grid have avoided ~17% of the total stationary emissions.

5.1.1. Grid-supplied electricity

Electricity remains a major contributor to emissions in Kolhapur. Like many cities in Maharashtra, Kolhapur relies on electricity supplied by the state grid managed by the Maharashtra State Electricity Distribution Company Limited (MSEDCL). The state grid sources its electricity from a mix of energy producers, including coal-fired power plants, hydropower, and renewable energy generation. However, the bulk of Maharashtra's electricity still comes from fossil fuels, particularly coal, accounting for 79.7 per cent of the total electricity generated.

Table 2. Fuel sources for electricity supplied in Maharashtra

Maharashtra electricity supply – fuel type	Percentage of the total supply
Thermal	79.70%
Natural gas	2.90%
Renewables	12.14%
Hydro	5.26%

In FY 2023–24, stationary energy emissions in Kolhapur were estimated at 4,318,861.16 tCO_2-eq per year. An overwhelming 98.3 per cent of these emissions were attributable to grid-supplied electricity, while the remaining share came from direct fuel combustion in the residential and industrial sectors.

Maharashtra, one of the forerunners in renewable energy deployment, gets 12.14 per cent of its electricity generated from renewable sources like solar, wind, and other sources. In FY23-24, the use of renewable electricity helped avoid approximately 884,281 tCO_2, reducing overall emissions by about 17.4%.

Image 5: A Factory, Kolhapur

Within grid-supplied electricity emissions, commercial establishments and industries were the largest consumers, accounting for 2,945,373 t(CO_2)-eq/yr or 69.36 per cent of the total. This was followed by the agriculture sector (14.7%), the residential sector (11.9%), and public services such as water works and street lighting (4.1%).

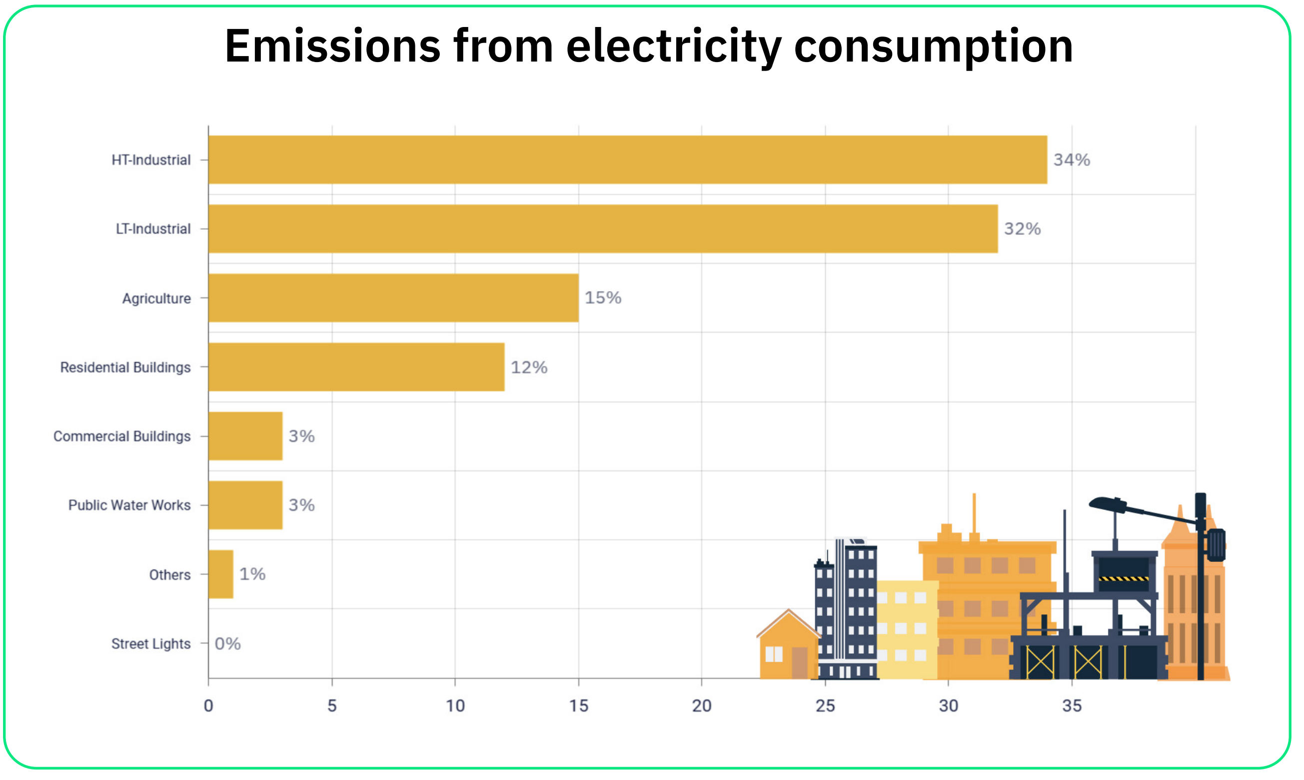

Figure 2. Emissions from consumption of grid-supplied electricity

Kolhapur's industrial emissions are largely driven by its sugar mills, categorized under HT (high-tension) industries, which require significant electricity for energy-intensive processes like crushing, boiling/heating and refining sugarcane (Mahavitaran, 2019). Similarly, the outdated machinery in the powerloom sector leads to higher electricity consumption, as older machines are less energy-efficient. As a result, these units contribute significantly to the overall energy demand within the LT (low-tension) category, increasing operational costs and environmental impact. Public water works (PWW) also add to emissions through energy use for water pumping and distribution systems.

In addition to emissions from electricity generation, transmission and distribution (T&D) losses contribute significantly to the emissions from the power sector. The transmission losses (6%) and distribution losses (7.51%) are considered for estimating T&D losses (Maharashtra State Electricity Distribution Co. Ltd, 2018).

With Kolhapur's transmission and distribution (T&D) losses at 15 per cent, additional emissions are generated due to inefficiencies in the electricity distribution system.

5.1.2. Fuel combustion

Fuel combustion accounted for 72,340 tCO_2-eq/yr from stationary energy sources. This includes on-site fuel combustion in industrial processes, which utilise fuels such as wood, fuel oil, diesel, high-speed diesel (HSD), light diesel oil (LDO), coal, liquid petroleum gas (LPG), briquettes, and petcoke, as well as cooking fuel in the form of LPG in the residential sector. Coal accounted for the largest share in the industry's fuel combustion emissions at 56.35 per cent, followed by briquettes and fuel oil at 14.93 per cent and 14.7 per cent, respectively. LPG's share of emissions in the industrial sector was 165.5 tCO_2-eq/yr or 0.33 per cent. LGP serves as the dominant cooking fuel across most income groups in the residential sector.

Fuel usage in commercial establishments (shopes, eateries, etc.) is not considered due to lack of data.

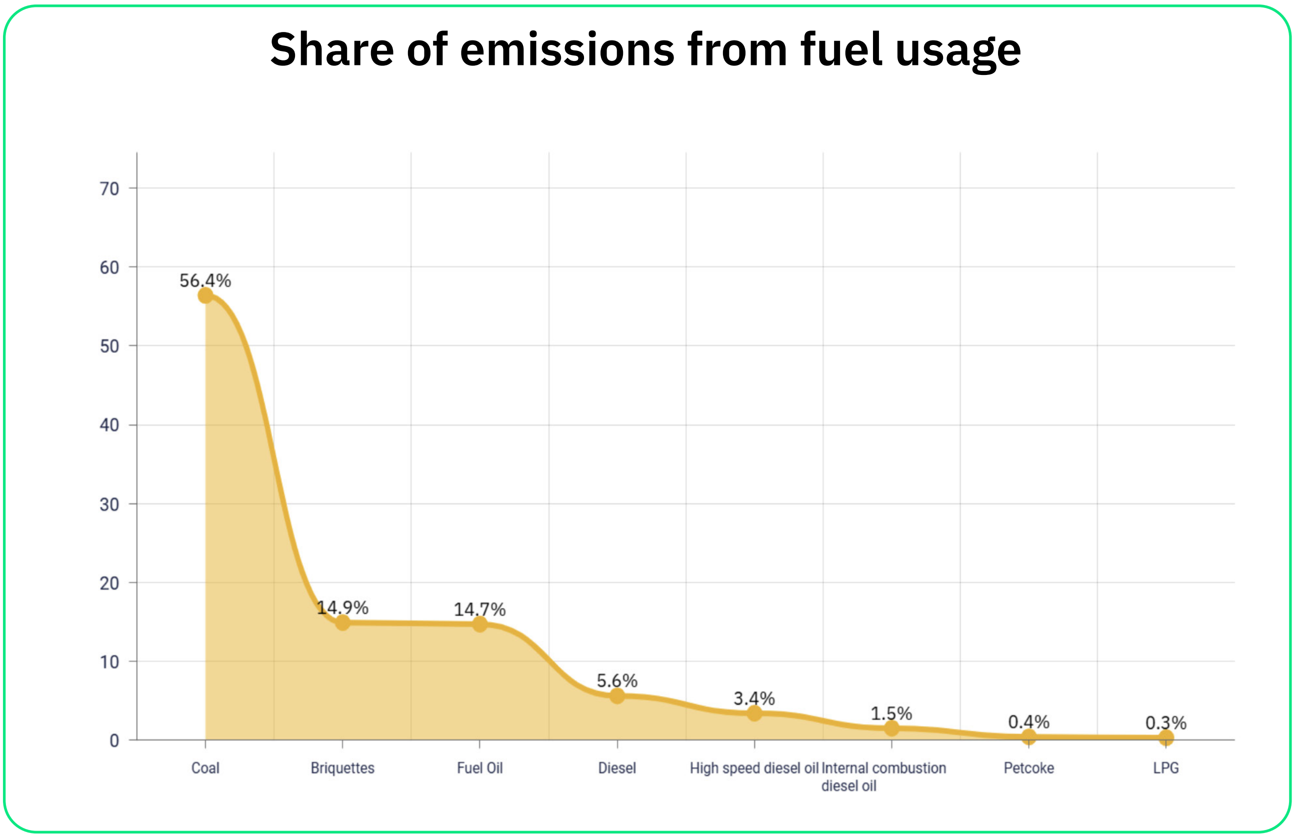

Figure 3. Share of emissions from fuel usage

5.2. Transportation

The emissions from on-road transportation account for 67 percent of the total emissions in Kolhapur.

A key driver of emissions in Kolhapur is the rapid expansion of private vehicle ownership, closely linked to urbanisation and rising household incomes. This growth has far outpaced the public transport available, creating a heavy dependence on petrol- and diesel-powered vehicles that significantly add to greenhouse gas emissions and air pollution. Vehicle ownership is highly unequal across income groups: high-income households average nearly two vehicles each, with widespread use of two-wheelers and 90 per cent owning four-wheelers; middle-income households report 91 per cent two-wheeler and 50 per cent four-wheeler ownership; on the other hand, slum and below-poverty-line households own fewer than 0.5 vehicle on average.

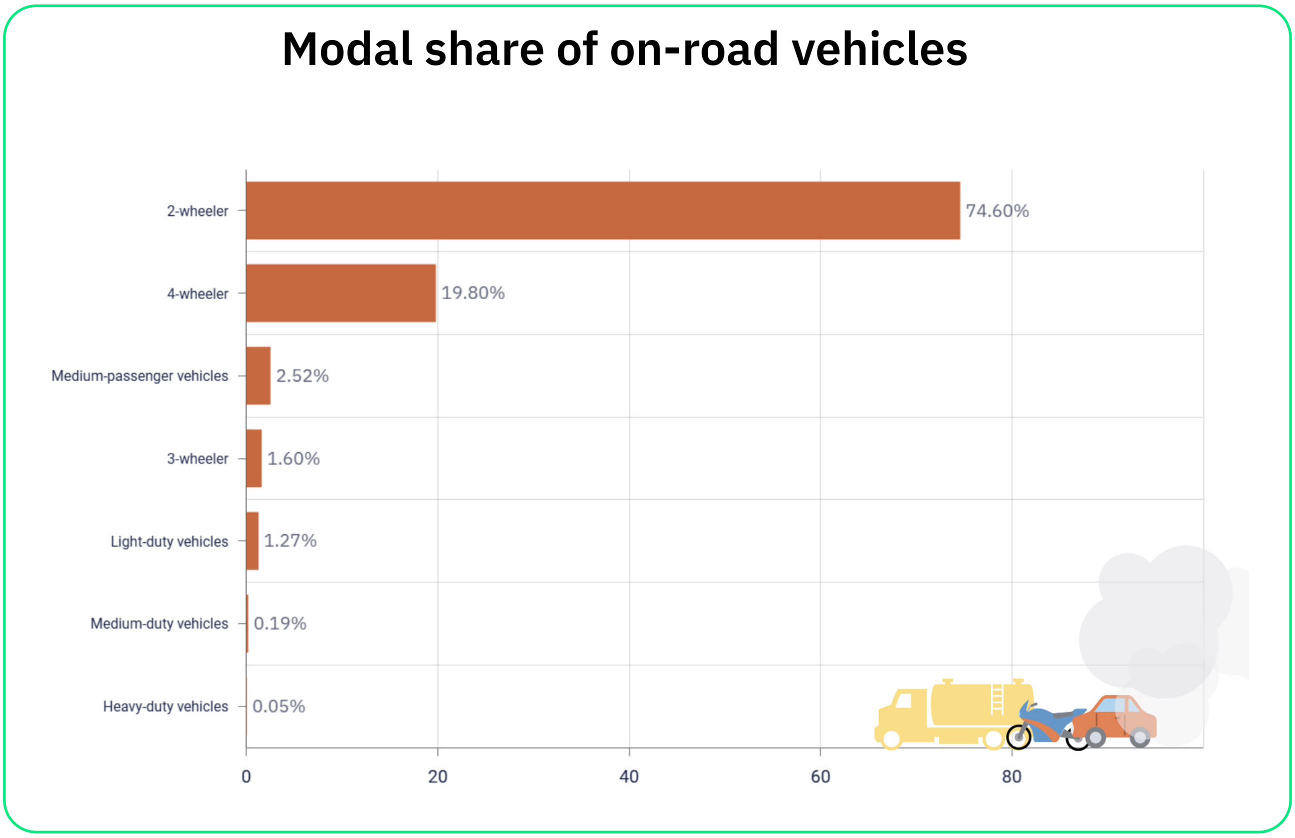

Figure 4. Modal share of on-road vehicles

5.2.1 On-road transportation

The transport sector in Kolhapur is driven primarily by individual mobility modes, with total road transport amounting for 23,234,268 tCO_2-eq/yr and include all passenger vehicles (two wheelers, three wheelers, four wheelers, and buses) and freight vehicles (trucks, and tempos).

Figure 4, depicting the modal share of on-road transport in Kolhapur, reveals a mobility profile overwhelmingly dominated by two-wheelers, which constitute 74.60 per cent of the vehicle mix. Four-wheelers follow at 19.77 per cent, reflecting increasing private vehicle ownership and a gradual shift towards higher-comfort travel. Three-wheelers account for 1.60 per cent, playing a modest yet vital role in Intermediate Public Transport (IPT) and last-mile services. Light duty vehicles stand at 2.52 per cent, while medium-duty and heavy-duty vehicles represent 0.19 per cent and 1.27 per cent respectively, highlighting the relatively limited share of freight movement vehicles within the overall fleet. Medium passenger vehicles form only 0.05 per cent, indicating minimal reliance on such modes for public conveyance. Collectively, this distribution underscores a transport system heavily skewed towards personal mobility rather than shared or mass transit, with significant implications for urban congestion, emissions, and the need for integrated public transport planning.

The transport sector in Kolhapur is driven primarily by individual mobility modes, Private motorised transport, comprising two-wheelers and four-wheelers, constitutes the dominant emissions source due to extensive fleet volume, high trip frequency, and reliance on internal combustion engines operating under variable urban load conditions, generating 23,214,878 tCO_2. Intermediate public transport, represented by three-wheelers and medium passenger vehicles, contributes 19,113 tCO_2 of the total emissions. Although freight vehicles – light-, medium-, and heavy-duty segments – contribute only a marginal share of the overall inventory, their operational profiles result in 276 tCO_2 within the administrative boundary of the city. Emissions from garbage trucks and small garbage vans are accounted for in the waste sector.

This emissions profile clearly reflects the dominance of personal vehicle use and indicates the need for focused measures such as cleaner vehicle technology, stronger public transport alternatives, and fuel transition strategies to support Kolhapur's long-term pathway towards reduced transport emissions.

5.3. Waste

Emissions from waste in Kolhapur make up 6 per cent of the total emissions. The composting process of municipal solid waste (MSW) contributes to 94.8 per cent of the total emissions in the waste sector.

This high contribution is primarily linked to unmanaged or poorly managed composting practices, where organic waste decomposes anaerobically, leading to significant methane (CH_4) emissions. Unlike controlled organic waste composting recommended as a sustainable solution, these emissions arise from conventional, open-air methods often practised in Kolhapur.

5.3.1 Municipal waste management

The disposal and treatment of waste generates GHG emissions, primarily from aerobic and anaerobic decomposition.

The sub-categories of emissions are

- Municipal solid waste management and disposal
- Incineration or open burning of waste
- Biological treatment of solid waste

Table 3. Municipal solid waste generated

Waste treatment facility	Volume (tons/yr)
Slurry treatment	7,300.00
Compost treatment	19,345.00
Horticulture treatment	1,460.00
Refuse derived fuel (RDF)	54,750.00
Organic waste composter treatment (OWC)	730.00
Waste recycling	3,650.00
Biogas treatment	14,600.00

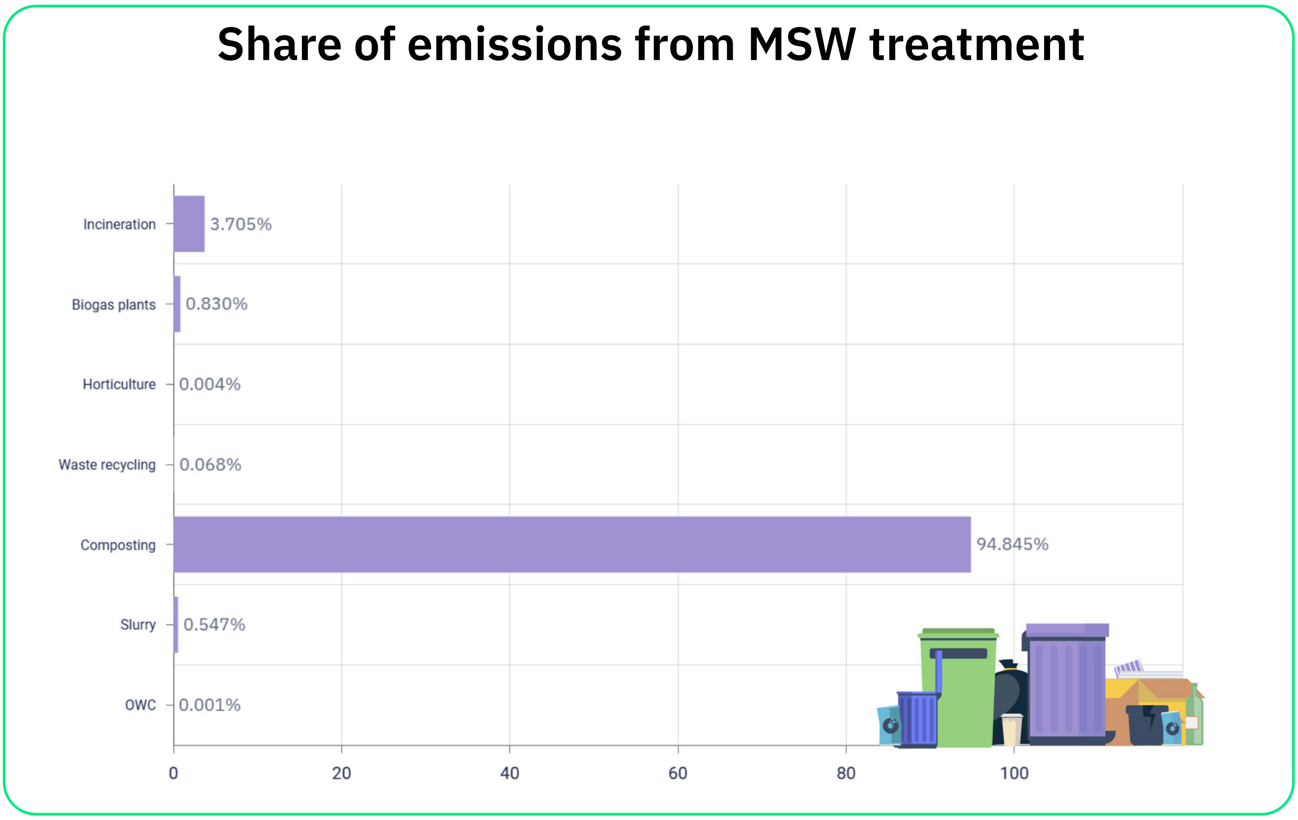

Figure 5. Share of emissions from municipal solid waste treatment

Composting is the dominant contributor to emissions from MSW treatment, accounting for a significant 94.845 per cent of the total share. This high percentage underscores the methane emissions likely arising from anaerobic decomposition in inadequately managed composting systems. Incineration follows with 3.705 per cent, reflecting emissions from the combustion of organic and inorganic materials. Biogas plants contribute 0.830 per cent, showcasing their comparatively lower emissions due to controlled decomposition processes. Emissions from slurry treatment, organic waste converters, horticulture, and waste recycling are minimal, collectively accounting for just 0.62 per cent of the total emissions, highlighting their relatively minor impact in comparison to composting and incineration.

In Kolhapur, the disposal of MSW refers to waste collected by the municipal authorities or local bodies. The city's waste management is overseen by the municipal corporation, in coordination with the sanitation department.

5.3.2 Waste transportation

Waste collection in Kolhapur involves multiple stages, with unsegregated waste being collected from households through a door-to-door programme, along with aggregated waste from streets. Transportation is managed using large waste collection vehicles for bulk waste and smaller vans for household pickups.

Emissions from transportation of waste account for 72.15 tCO_2-eq/yr.

Table 4: Methodology for estimating emissions from the waste sector

Vehicle category	Vehicle stock (number)	Emissions (tCO2-eq/yr)
Light goods vehicle (LGV)	169	71.58%
Heavy goods vehicle (HGV)	7	0.58%

However, there are several inefficiencies in the system. A heavy reliance on the Kasba Bawada site for dumping, along with only two alternate sorting stations (one privately operated and one at Puikhadi), increases transportation demands. More decentralised sorting stations would significantly reduce these transport-related emissions. Additionally, the absence of effective by-laws to incentivise waste reduction, or to make bulk-waste generators treat their waste, adds to the challenge. With around 176 vehicles making over 300 trips daily, optimising the collection process could be crucial. Setting up door-to-door collection with local waste points would let larger vehicles cover more area and avoid narrow lanes. Using transfer stations where smaller vehicles feed waste into larger trucks can further reduce trips and emissions.

Image 6: Kasba Bawada site for dumping, Kolhapur

5.4. Agriculture

The total emissions from agriculture make up 13 per cent of the total emissions from Kolhapur. Agricultural emissions within Kolhapur's city boundary refer to the environmental impact caused by farming practices, particularly the cultivation of major crops such as paddy and sugarcane. These activities are significant sources of greenhouse gas emissions, primarily methane (**CH_4**) from sugarcane and paddy fields.

Paddy is cultivated mainly during the kharif season, benefiting from monsoon rains and intensive farming practices that maximise yields. Sugarcane is a major crop, with Kolhapur leading in production and sugar recovery rates in Maharashtra. Sugarcane productivity in Kolhapur between 2023 and 2024 was 14.239 million tons.

The emissions inventory for Kolhapur includes only major crops like sugarcane and paddy, due to limited data availability for other crops and agricultural activities.

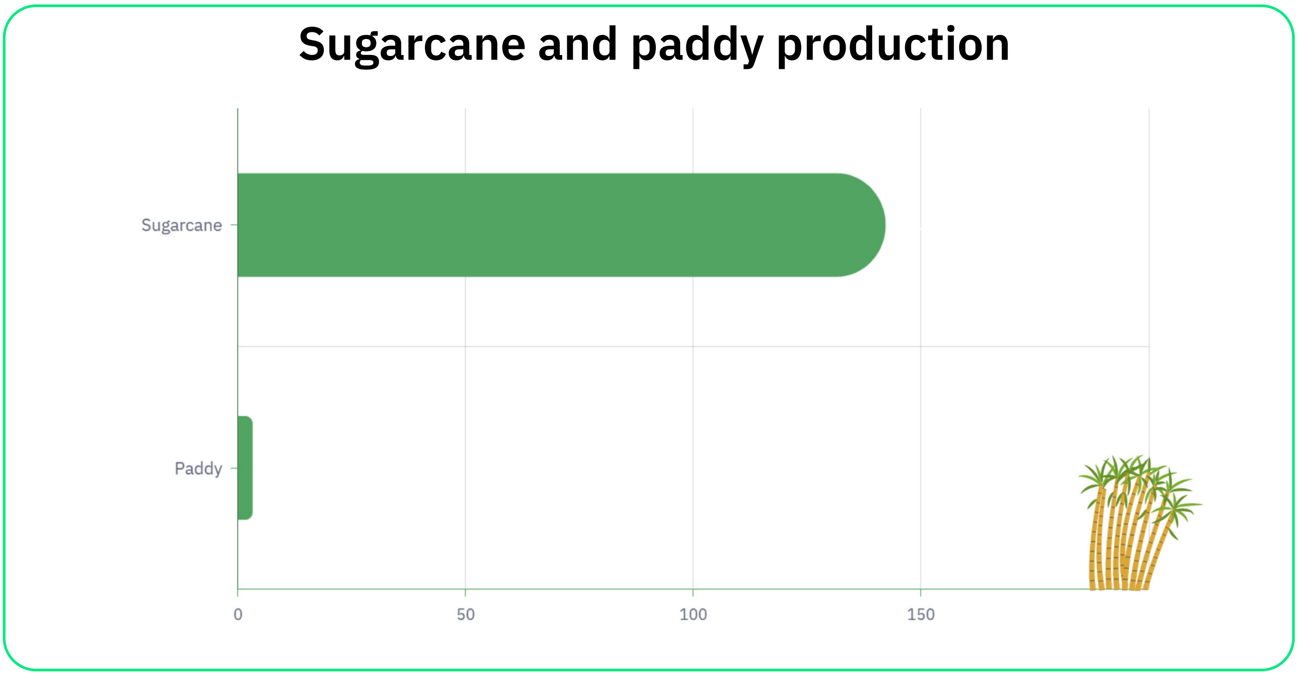

Figure 6: . Sugarcane and paddy production in Kolhapur

Image 7: Sugarcane field, Kolhapur

Emissions from paddy and sugarcane cultivation in Kolhapur are primarily due to the continuous flooding method of irrigation. This practice creates anaerobic (oxygen-deprived) conditions in the soil, which promote the activity of methanogenic bacteria. These bacteria break down organic matter and release methane (CH_4), a potent greenhouse gas. Methane emissions from this process contribute significantly to the overall carbon footprint of paddy cultivation, highlighting the need for more sustainable irrigation practices to reduce emissions and environmental impact.
Continuous flood irrigation for paddy and sugarcane contributes to 290,366 tCO2-eq/yr and 4,261,071 tCO2-eq/yr respectively.

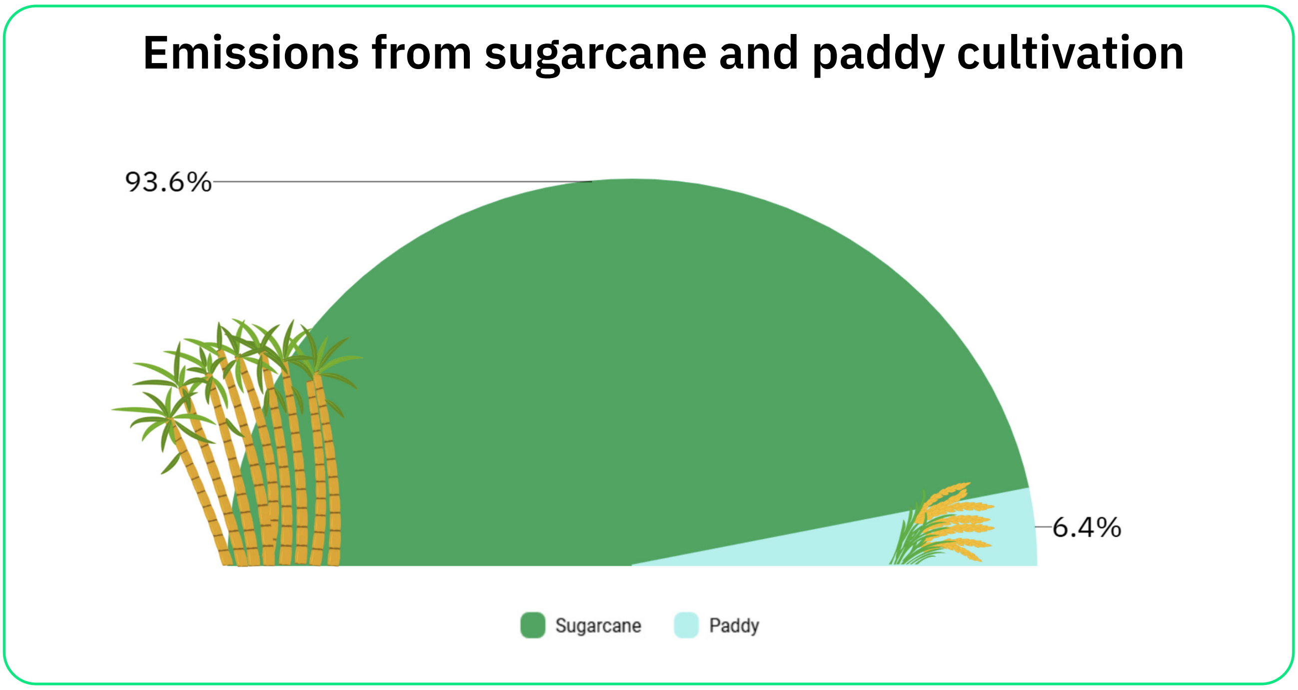

Figure 7: Emissions from sugarcane and paddy cultivation

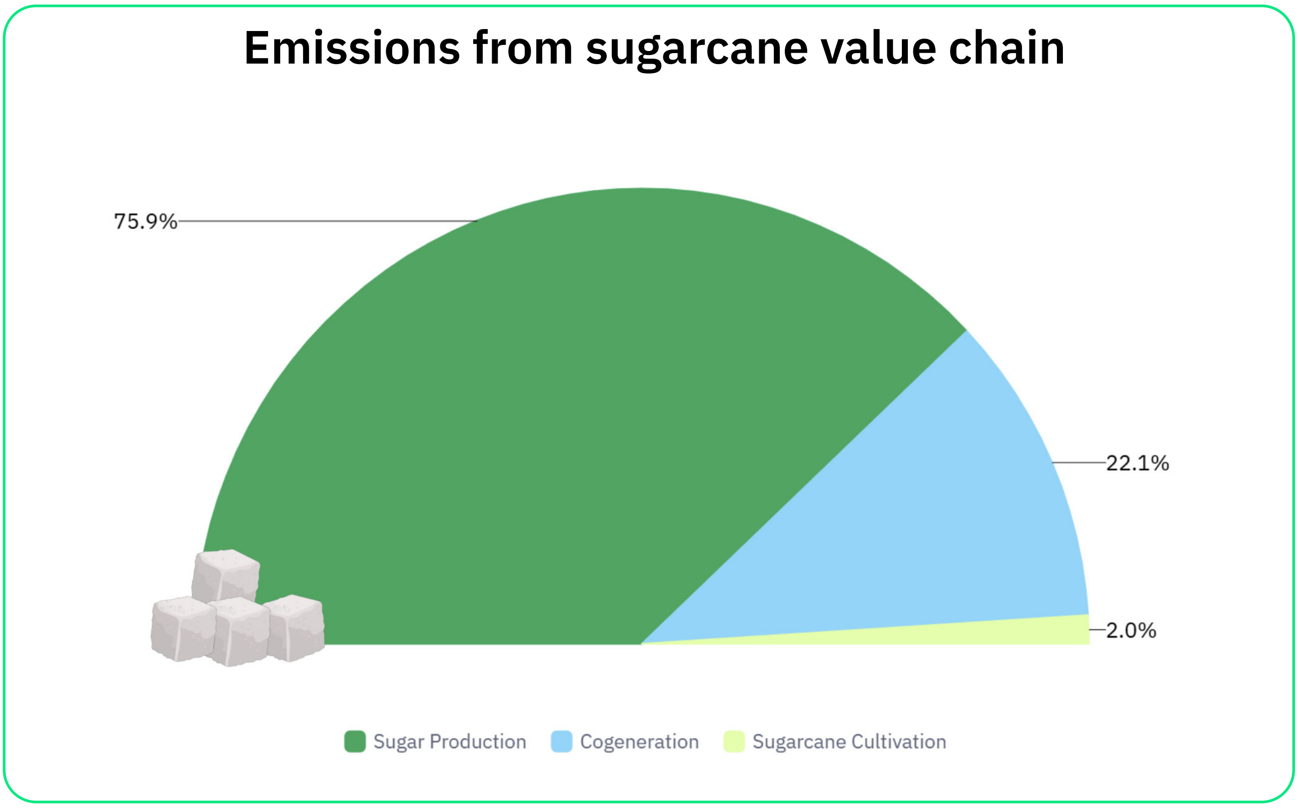

Figure 8: Emissions from sugarcane value chain

Sugarcane, however, is further processed in sugar mills in Kolhapur for sugar and syngas (a mixture of carbon monoxide and hydrogen) production, used for meeting heat and power requirements in sugar mills.

Emissions from sugar production account for 3,232,344 tCO2-eq/yr and emissions from cogeneration in sugar factories amounts to 943,668.26 tCO2-eq/yr.

Shifting from water-intensive crops like sugarcane and paddy to diversified, climate-resilient crops, along with agroforestry, can limit emissions, serve as alternatives to water-intensive crops, and reduce reliance on continuous flooding irrigation in Kolhapur.

6. Conclusion

The sector-wise emissions inventory for Kolhapur provides a clear picture of the city's greenhouse gas profile, highlighting the relative contributions of transport, stationary energy in buildings, and other sectors. With transport contributing nearly 67 per cent of emissions and stationary energy accounting for around 14 per cent, the inventory makes it possible for policymakers, urban planners, and citizens to identify priority areas for intervention. By linking emission sources with underlying drivers – such as rapid motorisation, income-linked appliance use, and uneven access to clean fuels – the inventory also points to where policy action, subsidies, and technological adoption can be most effective in promoting sustainable energy use and reducing emissions.

However, to strengthen the robustness of Kolhapur's inventory, it is essential to address existing data gaps. While the primary household survey has generated valuable insights into housing stock, appliance ownership, fuel use, and mobility patterns, coverage remains uneven across sectors such as freight transport, informal energy use, and emissions from smaller industrial and commercial establishments. These gaps limit the ability to capture the full scope of the city's carbon footprint.

Future work should therefore focus on establishing a more comprehensive data system for Kolhapur. This will require systematic household surveys at regular intervals, integration of administrative records from agencies such as Kolhapur Municipal Corporation (KMC), and more detailed tracking of electricity consumption, fuel sales, and vehicle activity. Constant, regular updates through subsequent survey rounds would allow the inventory to be refined, ensure consistency in emission estimates, and capture changes in technology adoption, such as the diffusion of rooftop solar, piped natural gas, and electric vehicles.

A strengthened emissions inventory, anchored in reliable and regularly updated data, will not only provide a more holistic and detailed assessment of Kolhapur's emissions trajectory but also serve as a vital decision-support tool for designing targeted policies, monitoring progress, and guiding the city towards a sustainable and low-carbon future.

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