2024 Global Methane Forum

Mobilizing Methane Action

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The Importance of Data Collection and Monitoring, Reporting, and Verification (MRV) to Finance Projects in the Biogas Sector

Inventorization of GHG emissions from the Domestic Wastewater Sector in India

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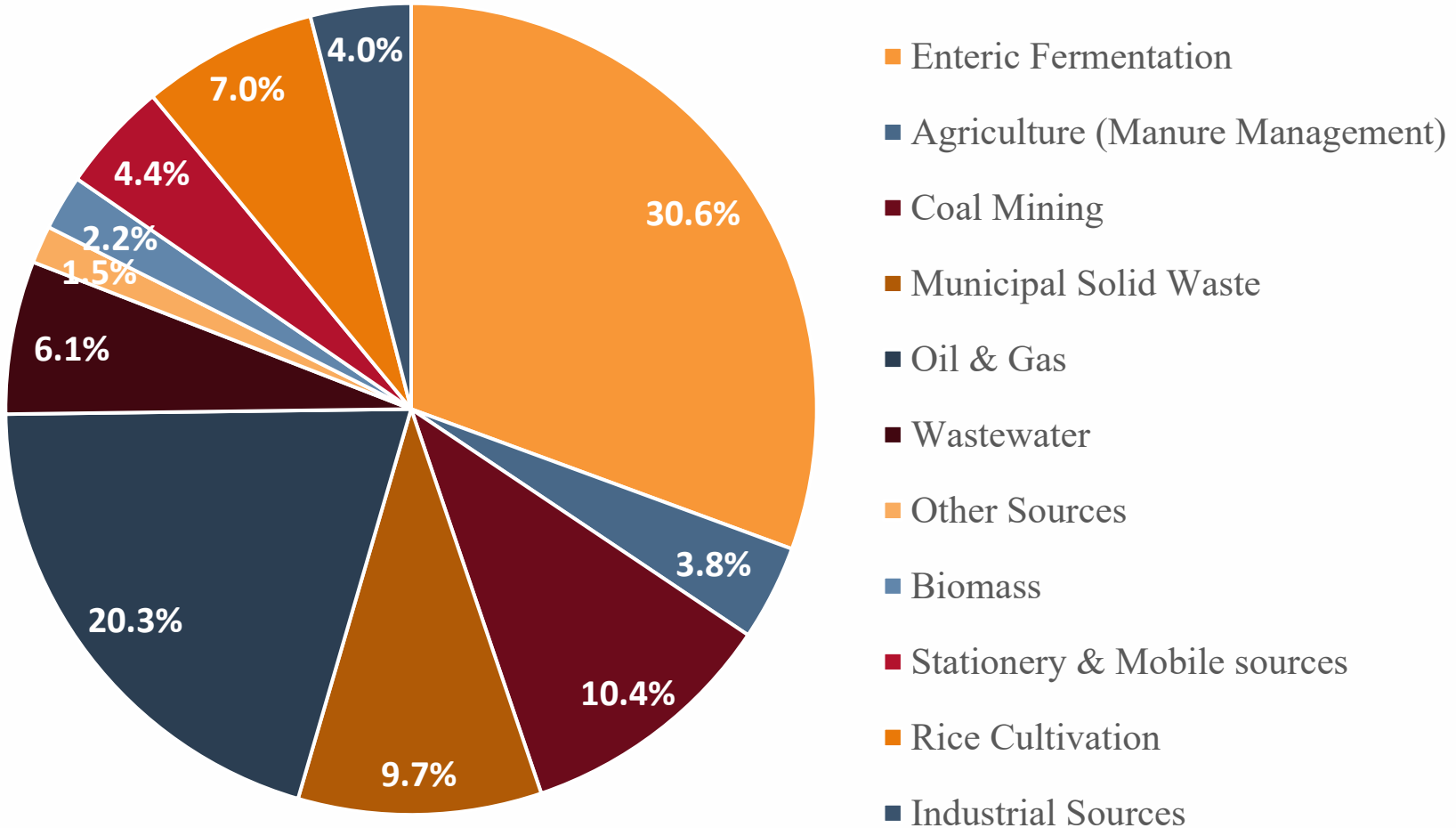
Introduction

- The government of India has been making substantial efforts & investments in expanding the wastewater treatment infrastructure, however, these facilities represent a significant source of anthropogenic GHG emissions.
- Hence, addressing GHG emissions in the wastewater sector is pivotal not only for India's environmental sustainability but also for its commitment to combat climate change at the global arena.
- However, there's a substantial gap between the estimates provided by the Global Greenhouse Gas Program of India (GHGPI) and those submitted to the Intergovernmental Panel on Climate Change (IPCC) by the MoEF&CC, Govt. of India.
- Hence, a thorough assessment of the government's methodology is required. Accurate GHG inventories in this sector are crucial for understanding its contribution to India's overall emissions profile and for developing effective mitigation strategies.
- To resolve these disparities, it's imperative to engage in extensive discussions and cooperation with relevant stakeholders.

Estimated Global Anthropogenic Methane Emissions by Source, 2020

Global anthropogenic methane emissions by 2030 are estimated to be 8,796.27 million metric tons of CO_2 equivalent ($MMTCO_2E$) out of which Methane Emissions from India are estimated to be around 603 $MMTCO_2E$.



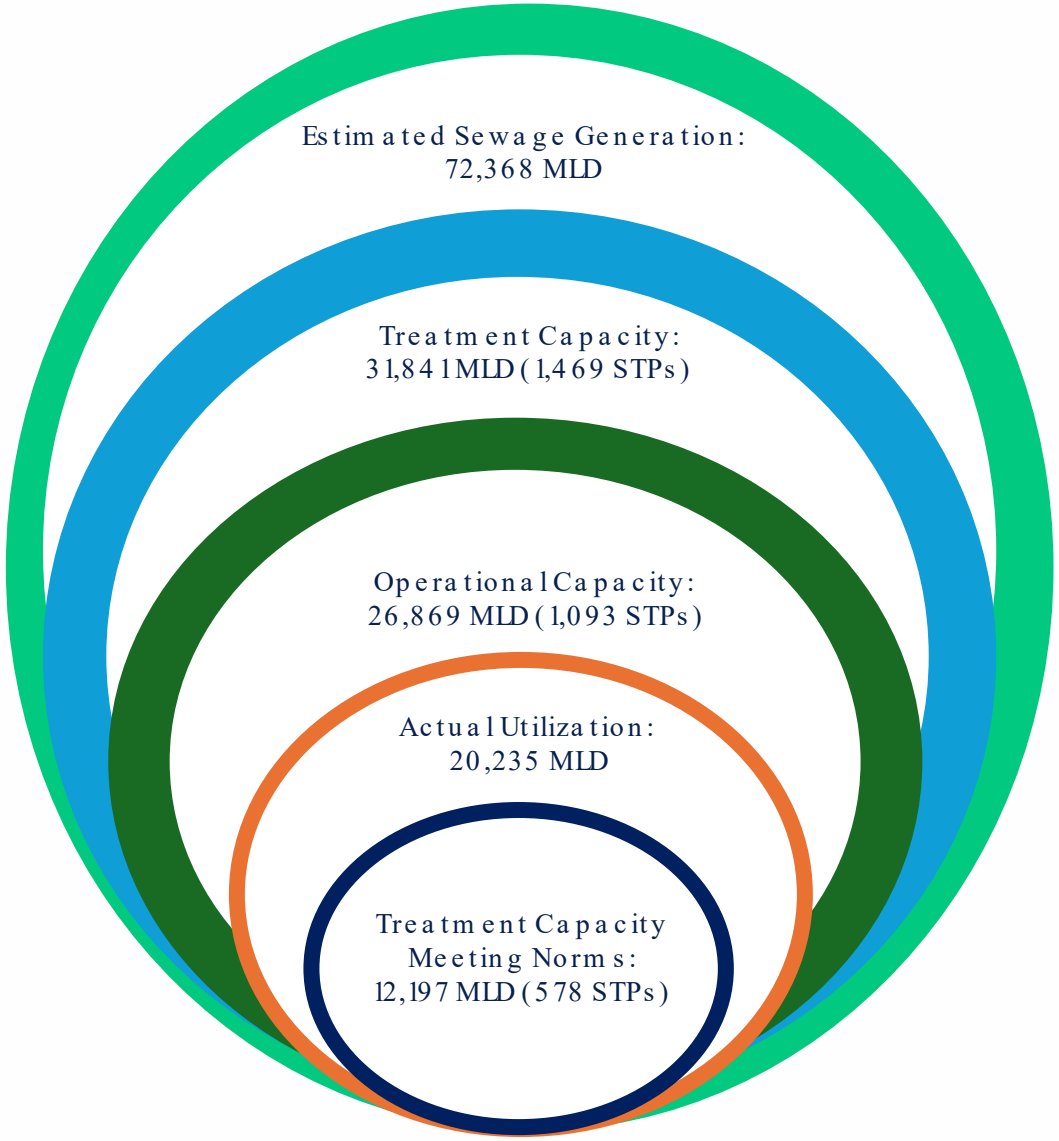
Source: Global Methane Initiative

Project Objectives

- Study wastewater Ecosystem in the country
- Identification of wastewater value chain and inventorize the centralized & decentralized wastewater treatment plants
- Summarize emission sources of GHG across wastewater value chain and quantify the emissions from domestic wastewater sector in India
- Analyze existing reporting methodologies employed by the Government of India and identify opportunities for improvement by comparing it with IPCC methodology.
- Offer recommendations aimed at improving the precision and comprehensiveness of GHG emission estimation.

Wastewater (Sewage) Ecosystem in India

- India generates 72,368 million liters per day (MLD) of sewage, highlighting the immense challenge of managing wastewater in a densely populated nation.
- 72,368 MLD Sewage is generated and only 20,235 MLD (28%) gets treated, while 12,197 MLD (17%) meets norms.
- This data underscores the pressing need for infrastructure expansion, efficiency improvements, and sustainable wastewater management practices to bridge the gap between sewage generation and treatment capacity.



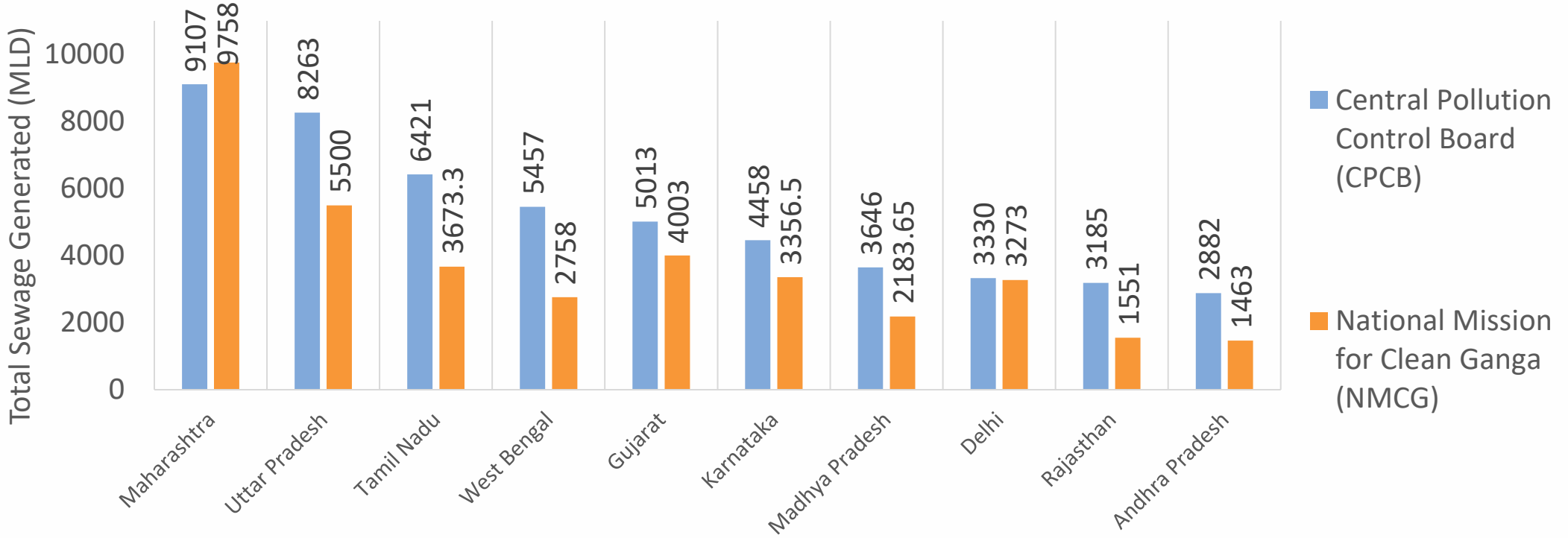
Source: Central Pollution Control Board (CPCB), March 2021

State-wise Contribution in Sewage Generation:

Top Ten Sewage Generating States in India

#	State	Total Sewage Generation (MLD) (% of Total)	Number of STPs Installed	Cumulative Capacity of STPs in MLD	Sewage Treatment Capacity as % of total Sewage Generation in that State
1	Maharashtra	9107 (13%)	154	6890	76%
2	Uttar Pradesh	8263 (11%)	107	3374	41%
3	Tamil Nadu	6421 (9%)	63	1492	23%
4	West Bengal	5457 (8%)	50	897	16%
5	Gujarat	5013 (7%)	70	3378	67%
6	Karnataka	4458 (6%)	140	2712	61%
7	Madhya Pradesh	3646 (5%)	126	1839	50%
8	Delhi	3330 (5%)	38	2896	87%
9	Rajasthan	3185 (4%)	114	1086	34%
10	Andra Pradesh	2882 (4%)	66	833	29%
	10 States combined	51762 (72%)	928	25,397 (35%)	Source: CPCB, March 2021
	National Estimate	**72,368**			

Comparison of Sewage Generation Data Reported by CPCB, MoEFCC, GoI & NMCG, MoJS, GoI



- Notable variation between the two datasets, with some States like Uttar Pradesh, West Bengal & Andhra Pradesh showing significant differences.
- CPCB has calculated the sewage generation by assuming 185 lpcd water supply and 80% of it as waste, while states have reported to NMCG considering 135 lpcd water supply and 80% of it as waste.
- This underscores the importance of accurate sewage generation assessments nationwide.

Source: CPCB, March 2021

3rd Quarterly report of Central Monitoring Committee constituted by NGT, NMCG dated Feb 2021

Variation in Reporting of Sewage Generation

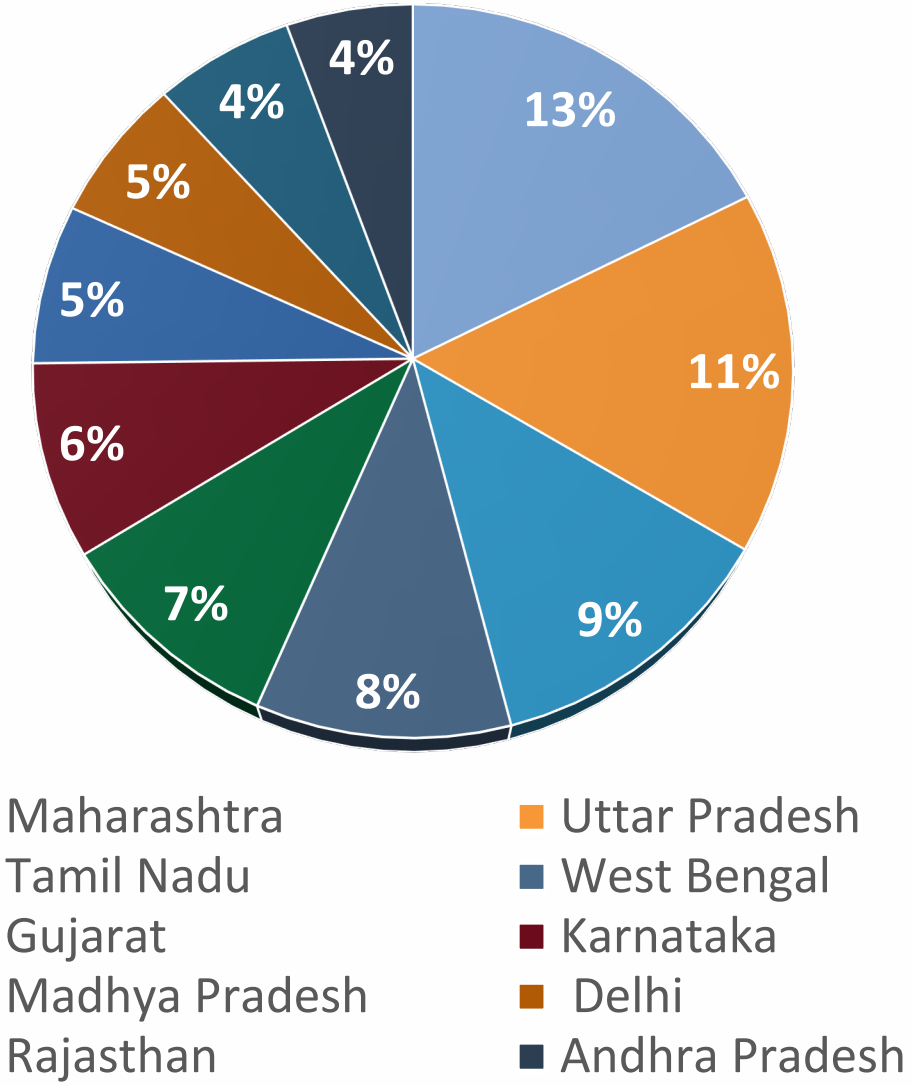
#	State	Total Sewage Generation (MLD) Reported by CPCB	Total Sewage Generation (MLD) Reported by NMCG	Difference %
1	Maharashtra	9107	9758	7%
2	Uttar Pradesh	8263	5500	-33%
3	Tamil Nadu	6421	3673	-43%
4	West Bengal	5457	2758	-49%
5	Gujarat	5013	4003	-20%
6	Karnataka	4458	3356	-25%
7	Madhya Pradesh	3646	2183	-40%
8	Delhi	3330	3273	-2%
9	Rajasthan	3185	1551	-51%
10	Andra Pradesh	2882	1463	-51%

Source: Central Pollution Control Board (CPCB), March 2021
3rd Quarterly report of Central Monitoring Committee constituted by NGT, NMCG dated Feb 2021

State-wise Contribution in Sewage Generation

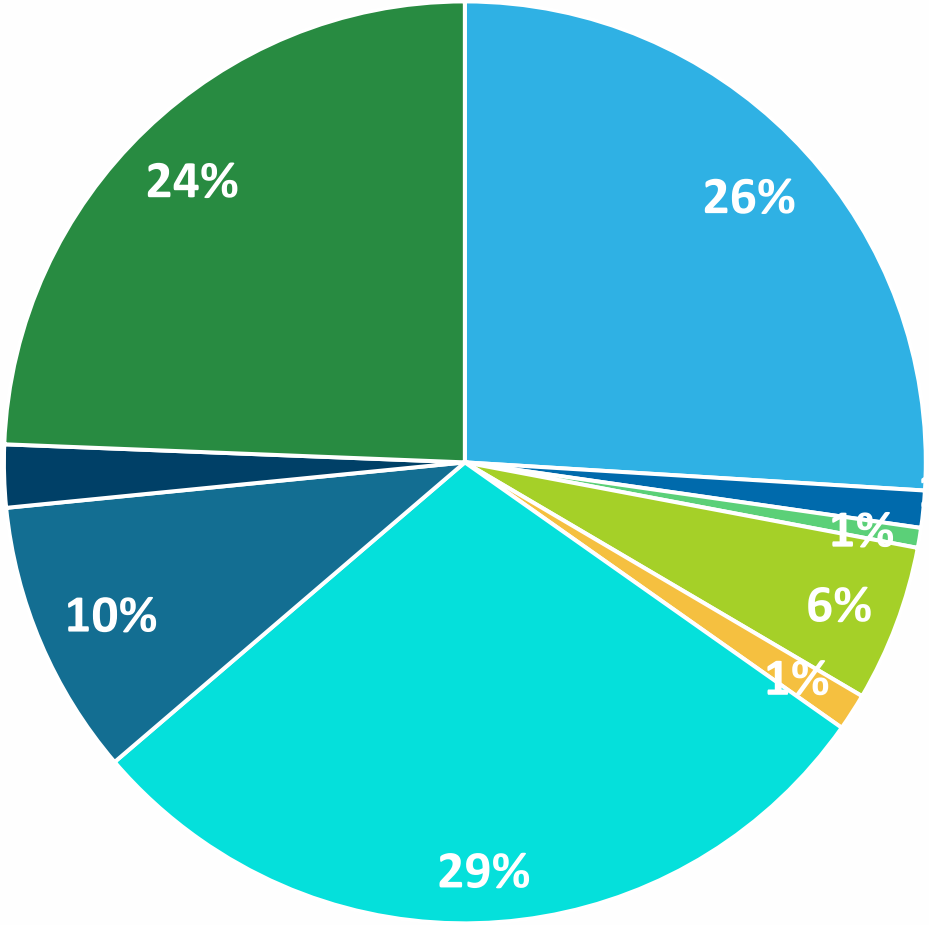
Top 10 States in Sewage Generation

- 10 States alone contribute to 72% of total sewage generation.
- Maharashtra tops the list contributing 13% to the total sewage generation and treatment capacity of 76%.
- Delhi generates 6% of national estimates of Sewage but 87% treatment capacity.
- While West Bengal has least treatment capacity.



Source: CPCB, March 2021

Sewage Treatment Technologies Used in India

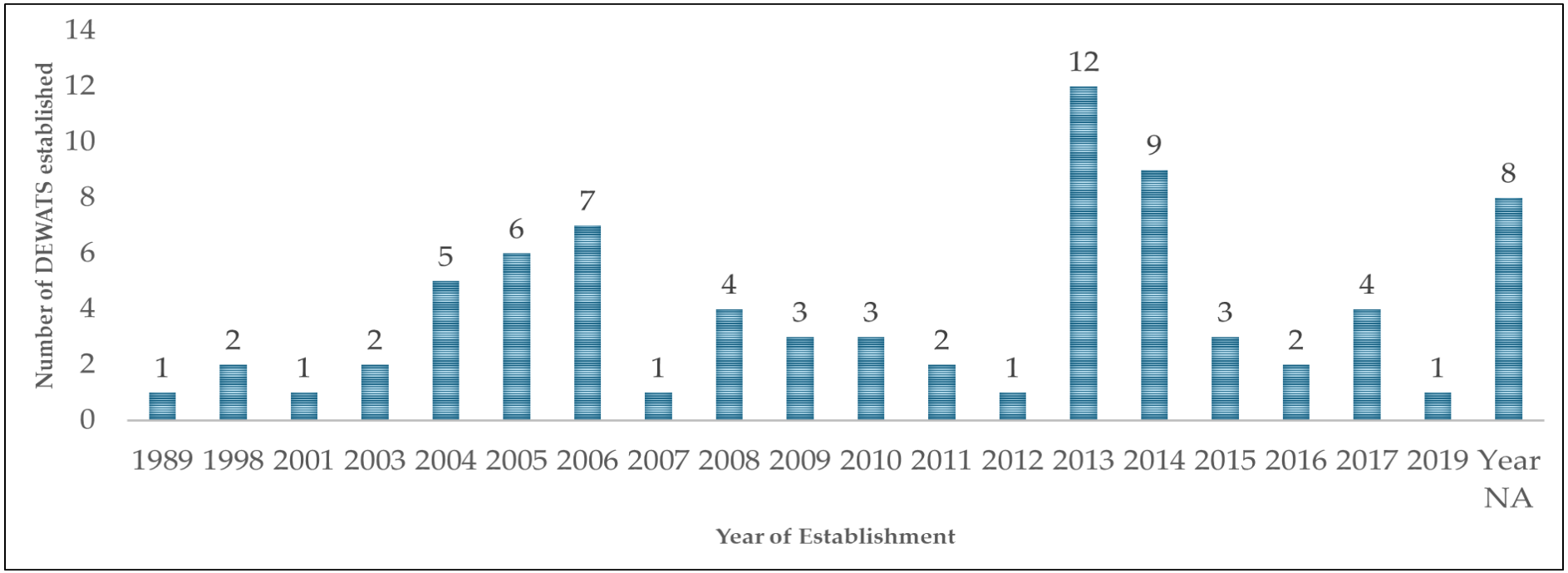


- Activated Sludge Process
- Extended Aeration
- Fluidized Aerobic Bio-reactor
- Moving Bed Biofilm Reactor
- Oxidation Pond
- Sequencing Batch Reactor
- Up flow Anaerobic Sludge Blanket

- SBR and ASP are most commonly adopted technologies.

Source: CPCB, March 2021

Decentralized Wastewater Treatment Systems (DEWATS) in India

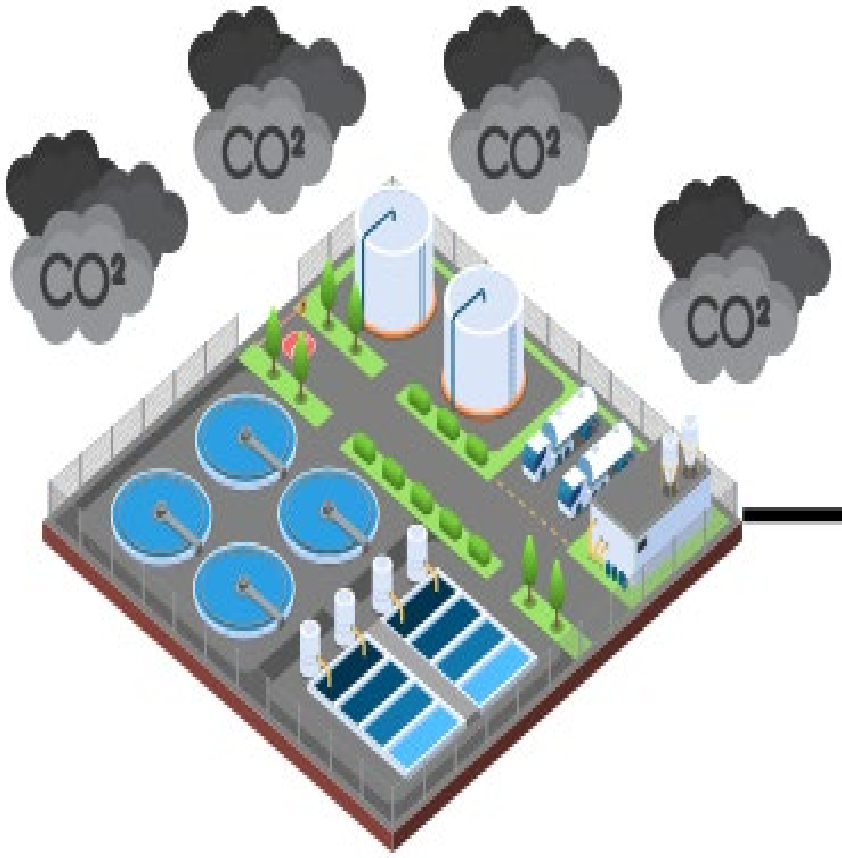


- DEWATS involve treating, releasing, or reusing wastewater near its source and can treat both domestic and industrial wastewater for wastewater flows from 1 to 1,000 m^3/day.
- A notable increase in DEWATS occurred from 2004, with the establishment and subsequent years witnessed a rise, reaching a peak of 12 plants in 2013.

Source: Anju Singh et al., 2019.

Estimates of GHG Emissions from Domestic Wastewater Sector in India

Potential Sources of GHG Emissions



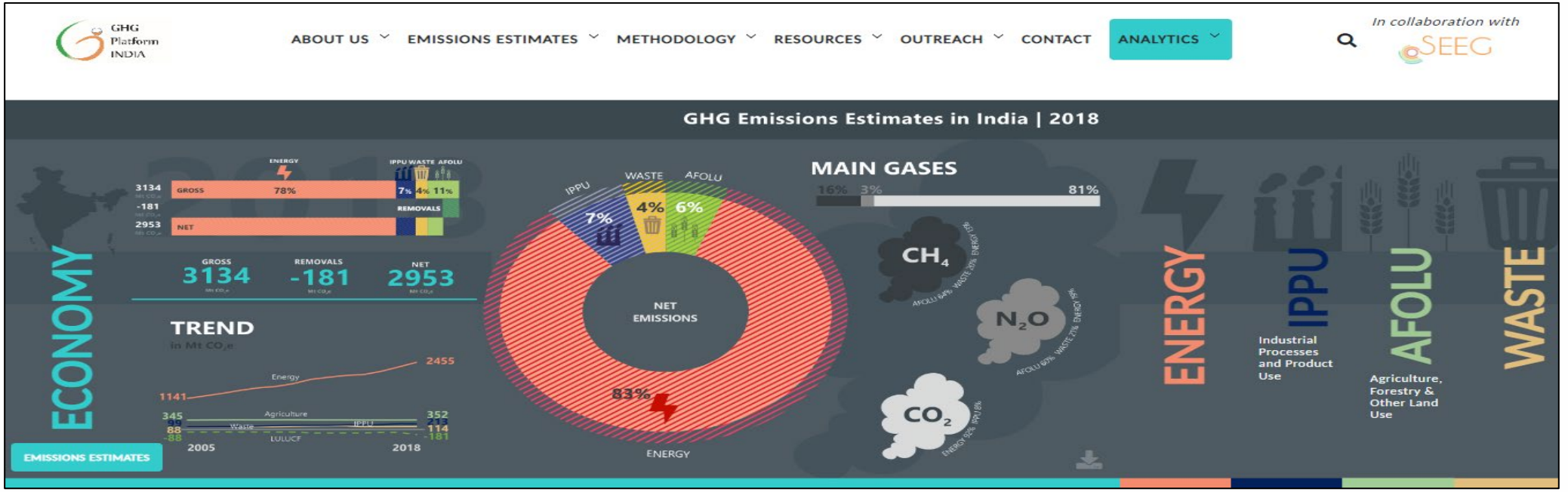
On Site/direct emissions
CO_2 from Anaerobic Decomposition
CO_2 from Conversion of Organic Matter
CH_4 from Anaerobic Digestion Process
N_2O from Denitrification Process

Off Site/ in-direct emissions
Transportation
Disposal of Sludge
Energy Consumption
Purchased Raw Materials

- Note: According to the IPCC Guideline, 2006, Direct/on-site CO_2 emissions from wastewater treatment plants are biogenic and therefore not included in the total emissions

Study Approach

- GHG Platform – India (GHGPI) provides independent estimation and analysis of India's GHG emissions across various sectors.
- Platform published a report in 2022 on National GHG estimates from the Waste Sector for the period 2005 to 2018 which is a major source of data for this study.
- The GHGPI estimates were then compared to the estimates given in India's Biennial Update Reports (BURs) submitted to the UNFCCC.



GHG Emissions from the Waste Sector in India

IPCC ID	Source Category	GHG Emission (million tonnes of CO_2e based on GWP values from the IPCC Second Assessment Report (AR2)		
		2005	2018	Percent Change (2005 – 2018)
4	Total from Waste Sector	88.23	114.50	29.77%
4A	Solid Waste Disposal	7.05	13.23	87.66%
4D	Total Wastewater Treatment and Discharge	81.18	101.27	24.75%
4D1	Domestic Wastewater Treatment and Discharge	43.82	63.76	45.50%
4D2	Industrial Wastewater Treatment and Discharge	37.36	37.51	0.40%

Source: GHGPI

Sewage Generation versus GHG Emission

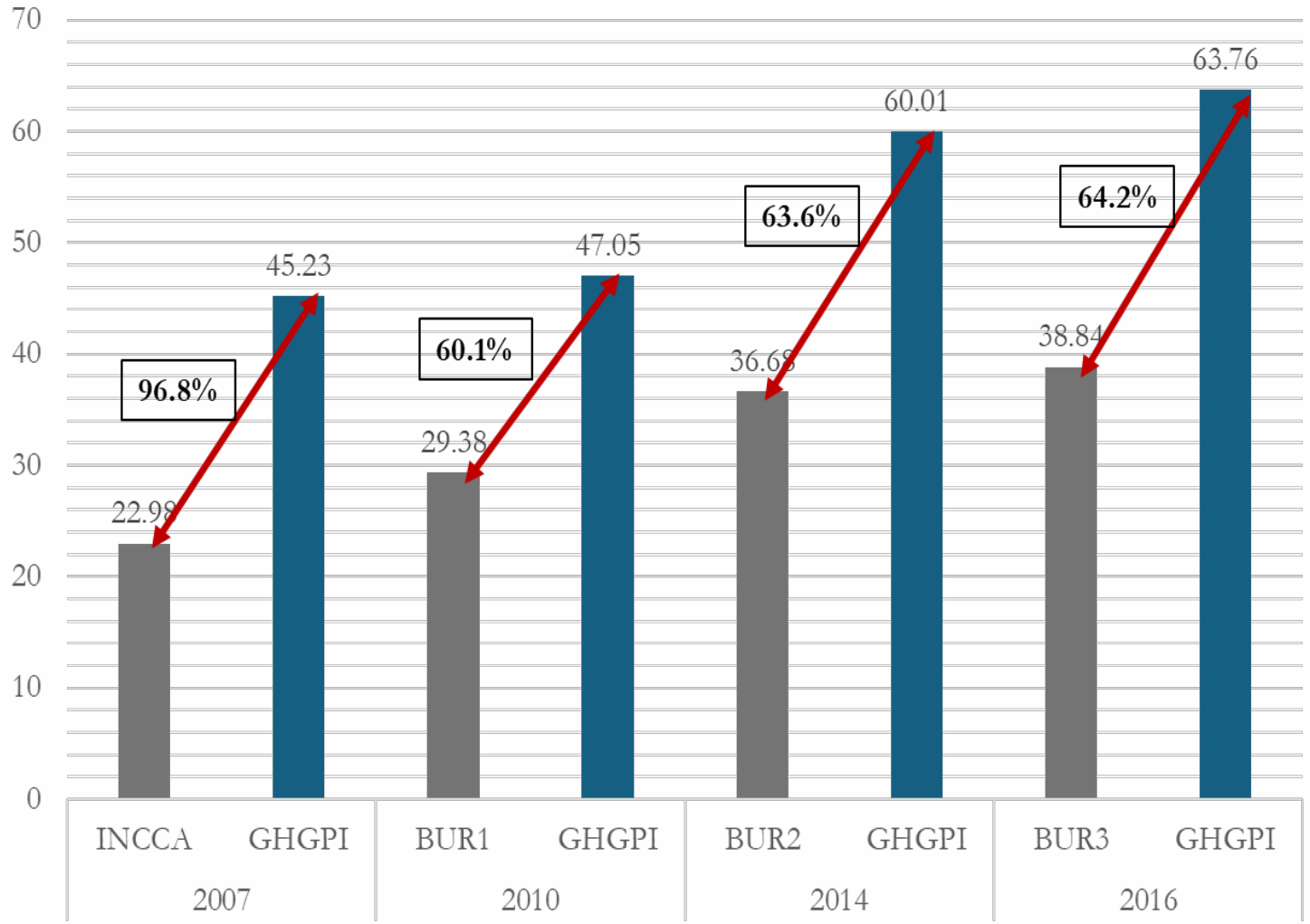
#	Name of State	Contribution in Total Sewage Generation
1	Maharashtra	13%
2	Uttar Pradesh	11%
3	Tamil Nadu	9%
4	West Bengal	8%
5	Gujarat	7%
6	Karnataka	6%
7	Madhya Pradesh	5%
8	Delhi	5%
9	Rajasthan	4%
10	Andhra Pradesh	4%

#	Name of State	Contribution in GHG emissions from Domestic wastewater
1	Uttar Pradesh	16%
2	Maharashtra	10%
3	West Bengal	7%
4	Bihar	7%
5	Tamil Nadu	6%
6	Rajasthan	6%
7	Madhya Pradesh	5%
8	Gujarat	5%
9	Karnataka	5%
10	Andhra Pradesh	6%

Delhi is amongst the top 10 sewage-generating States but not in terms of GHG emissions, which shows that Delhi has better managed STPs and GHG Emissions.

Source: GHGPI

Comparison of GHGPI estimates with National GHG Inventories for Domestic Wastewater



References:

1. GHGPI
2. INCCA - Indian Network for Climate Change Assessment, India: Green House Gas Emissions 2007 (INCCA)
3. BUR1 - India's First Biennial Update Report (having reference point of 2010)
4. BUR2 - India's Second Biennial Update Report (having reference point of 2014)
5. BUR3- India's Third Biennial Update Report (having reference point of 2016)

Note: BUR's mention that the IPCC Tier I and Tier II with country-specific data were used to calculate the GHG emissions from the wastewater sector. However, the reports do not provide the data used.

Key Takeaways

- In 2018, domestic wastewater treatment and discharge emerged as the primary contributor, constituting 55.7% of total GHG emissions from the waste sector.
- From the trend of top 10 States with regard to Total Sewage generation and cumulative GHG Emissions, we see that the State like Uttar Pradesh which has 2nd highest sewage generation (8263 MLD), has very low sewage treatment capacity (41%) and hence, highest GHG emissions (120.47 million tones of CO2e).
- Delhi is amongst the top 10 sewage-generating States but not in terms of GHG emissions, which shows that Delhi has adequate treatment capacity and optimally managed plants, hence mitigated GHG Emissions.
- Emissions from the domestic wastewater sector amounted to 43.82 million tonnes of CO2e in 2005, rising to 63.76 million tonnes of CO2e in 2018.
- The biennial reports of the Government of India are expected to provide more clarifications on the data used for the estimation of GHG emissions from the domestic wastewater sector, which may prevent such huge variations in the reported estimates and ultimately help better and accurate conclusions for mitigation measures.

Way-forward

- Baseline data need to be strengthened for sewage generation, treatment capacities, and treated water for each State along with the type of treatment technology employed.
- Inventorization of STPs in various States need to be updated with both the Central Pollution Control Board (CPCB), GoI and Ministry of Jal Shakti, GoI.
- MoEFCC, GoI need to release GHG Emission data for Tier I for all States from 2018-2022.
- Developing Tier II & Tier III methodology with on-field calculations is crucial for deriving an accurate estimation of India-specific methane emissions in the domestic wastewater sector.

Coming together is the beginning.
Keeping together is progress.
Working together is success.

HENRY FORD

THANK YOU!

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