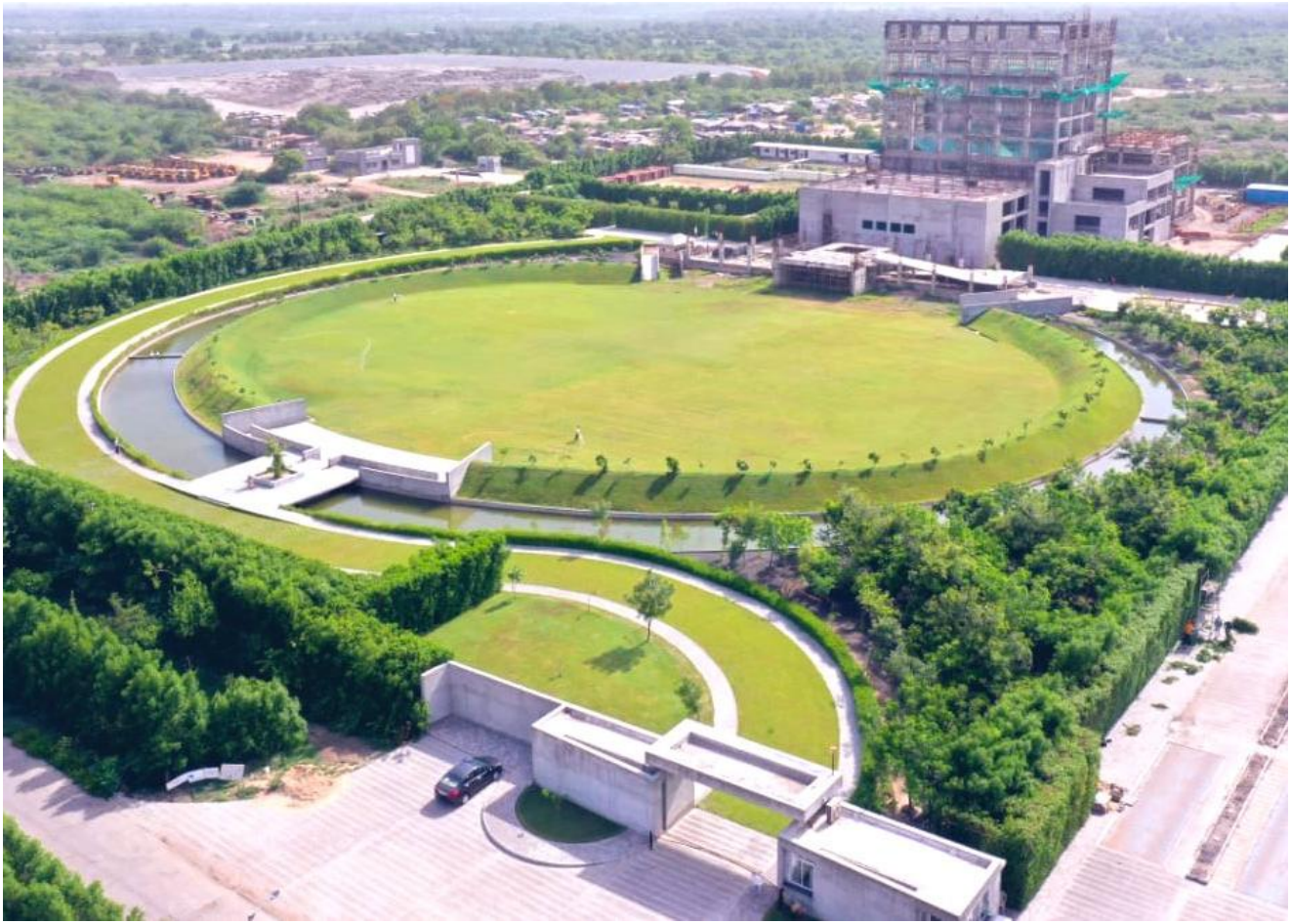


Leveraging “Carbon Credits”

through Solid Waste Management

The Case of Ahmedabad, India

CONTENTS:

1. Sector Introduction

Solid Waste Management (SWM) in Indian cities is overseen by the Government of India (GoI) through various regulations like the SWM Rules 2016 and the Plastic and C&D Waste Management Rules 2016, which are notified under the Ministry of Environment, Forest and Climate Change (MoEFCC). Additionally, nationwide cleanliness missions such as the Swachh Bharat Mission and Urban 2.0 are instrumental in guiding and financing Urban Local Bodies (ULBs) to achieve SWM targets. ULBs across the country work towards meeting these targets and often compete with each other.

Ahmedabad, which was ranked 15th cleanest city in India according to the Swachh Survekshan ranking in 2023, serves as an exemplary case study. The city has implemented several effective practices to enhance SWM. However, despite these efforts, Ahmedabad faces significant challenges in SWM due to its rapid urbanization. The evaluation of Ahmedabad's solid waste management (SWM) sector revealed significant challenges and gaps that need addressing. Our Vision for Solid Waste sector is By 2041, Ahmedabad strives for circularity, prioritizing waste management efficiency, reuse, and GHG reduction on the path to Net Zero.

For this, our Objectives include:

- How is solid waste (MSW, BMW, C&D and E-Waste) infrastructure and services delivered in Ahmedabad (AMC, AUDA-R, AUDA-U)?
- How is SWM represented in statutory planning and other documents?
- How are people responding to SWM services?
- What are the gaps and opportunities?
- What are the expected developments and challenges for Ahmedabad over the next 20 years, and what strategies can be employed in the short, medium, and long term to overcome these challenges?
- Identify gaps, areas of improvement, opportunities, potential and devise strategies, roadmaps & pilots for the future.

The study conducts an assessment of solid waste management (SWM) practices in Ahmedabad, achieving its objectives through a combination of desk research, literature review, site visits to Ahmedabad Municipal Corporation (AMC) offices, stakeholder discussions, and visits to treatment, processing, and disposal facilities. In order to realize its vision, the solid waste sector is categorized into five proposals, addressing on-ground challenges encountered throughout the value chain:

Project 1: Leveraging Carbon Credit from Municipal Solid Waste Management.
Project 2: Implementing Integrated Municipal Solid Waste Management in RURBAN Ahmedabad.
Project 3: Establishing a Closed-loop Process for Biomedical Waste Management.
Project 4: Rethinking the Treatment of Rubble in Construction and Demolition Waste.
Project 5: Designating Zones for E-Waste Collection.

This compilation focuses on project 1: Leveraging Carbon Credit from MSWM

2. Introduction

Ahmedabad, a bustling city on the Sabarmati River, is Gujarat's largest and India's seventh-largest urban center. Its population has surged to approximately 73 lakhs, up from 55.8 lakhs in 2011, driving rapid urban expansion. Ahmedabad's urban landscape has undergone remarkable expansion. Between 2007 and 2017, the city's urban footprint expanded by a staggering 132%, expanding at a rate of 6 square kilometres per decade.

Despite its commendable solid waste management (SWM) practices, Ahmedabad grapples with formidable challenges stemming from its rapid urbanization. As the city continues to expanded, AMC faces the relentless task of enhancing its solid waste services—from collection to disposal—to accommodate the expanding population. However, the current model of Solid Waste collection to disposal is cost intensive and centralized. Presently, the city boasts key infrastructural assets, including a 1000 TPD Waste to Compost Plant, a 1000 TPD Construction and Demolition (C&D) Plant, and an 800 TPD Material Recovery Facility (MRF) Plant. These assets signify the city's commitment to sustainable waste management practices.

In this context, the study delves into the potential of Carbon Credits as a strategic tool for the AMC to not only bolster its revenue streams but also to align itself with global imperatives surrounding greenhouse gas (GHG) emissions. By leveraging Carbon Credits, Ahmedabad can fortify its position as a frontrunner in sustainable urban development while meeting its international commitments.

2.1 Background and need of the study

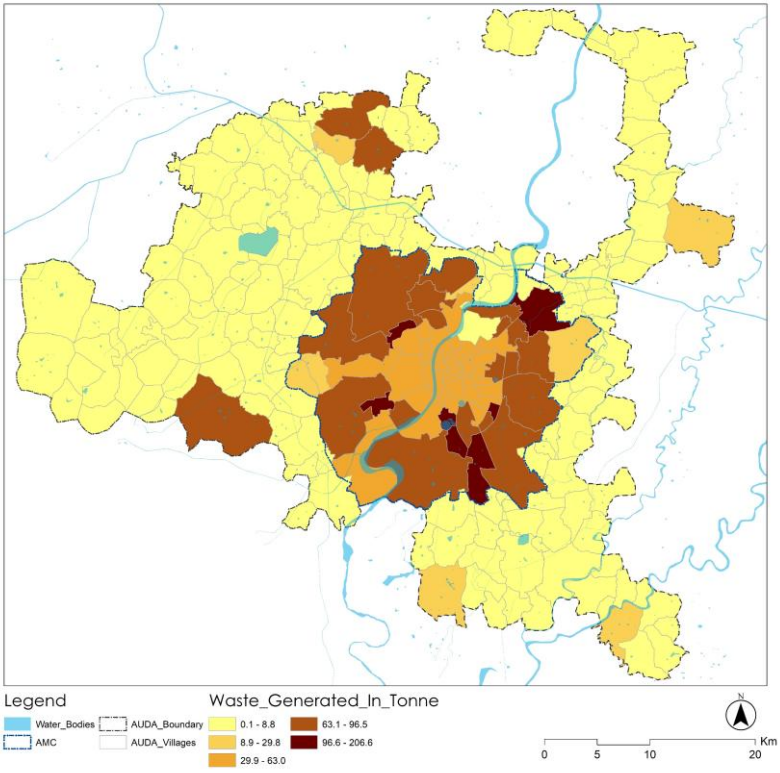
Ahmedabad generates 4200 tons of municipal solid waste (MSW) daily but only manages to collect 3400 tons. Of this, 1800 tons are processed in facilities such as compost plants, construction and demolition plants, and material recovery facilities, while the remaining 1600 tons end up in landfills due to limited processing capacity. This shortfall in waste treatment infrastructure poses a significant challenge for Ahmedabad's waste management sector, exacerbated by difficulties in revenue generation.

Cities worldwide are diversifying revenue streams, with Carbon Credits gaining traction. These credits are earned by cities committed to reducing carbon emissions under international agreements like the Kyoto Protocol. Through initiatives such as zero-waste programs, cities can earn credits by cutting greenhouse gas emissions. This transition from conventional waste management to comprehensive resource management isn't solely about waste—it's about unlocking new revenue sources. By addressing current gaps in waste management infrastructure and embracing sustainable practices, cities position themselves to capitalize on future opportunities in environmental stewardship and economic development.

In essence, the shift to comprehensive resource management enables cities to address current waste management challenges, mitigate environmental impacts, and seize opportunities to generate revenue while contributing to a more sustainable future.

2.2 Ahmedabad Municipal Solid Waste Management

Current Scenario



Total Solid Waste Generated (TPD) **5200**

Annual Budget of SWM FY2024-25 In ₹ Cr **1000**

700g
Per capita waste/ day standard (0.50Kg)

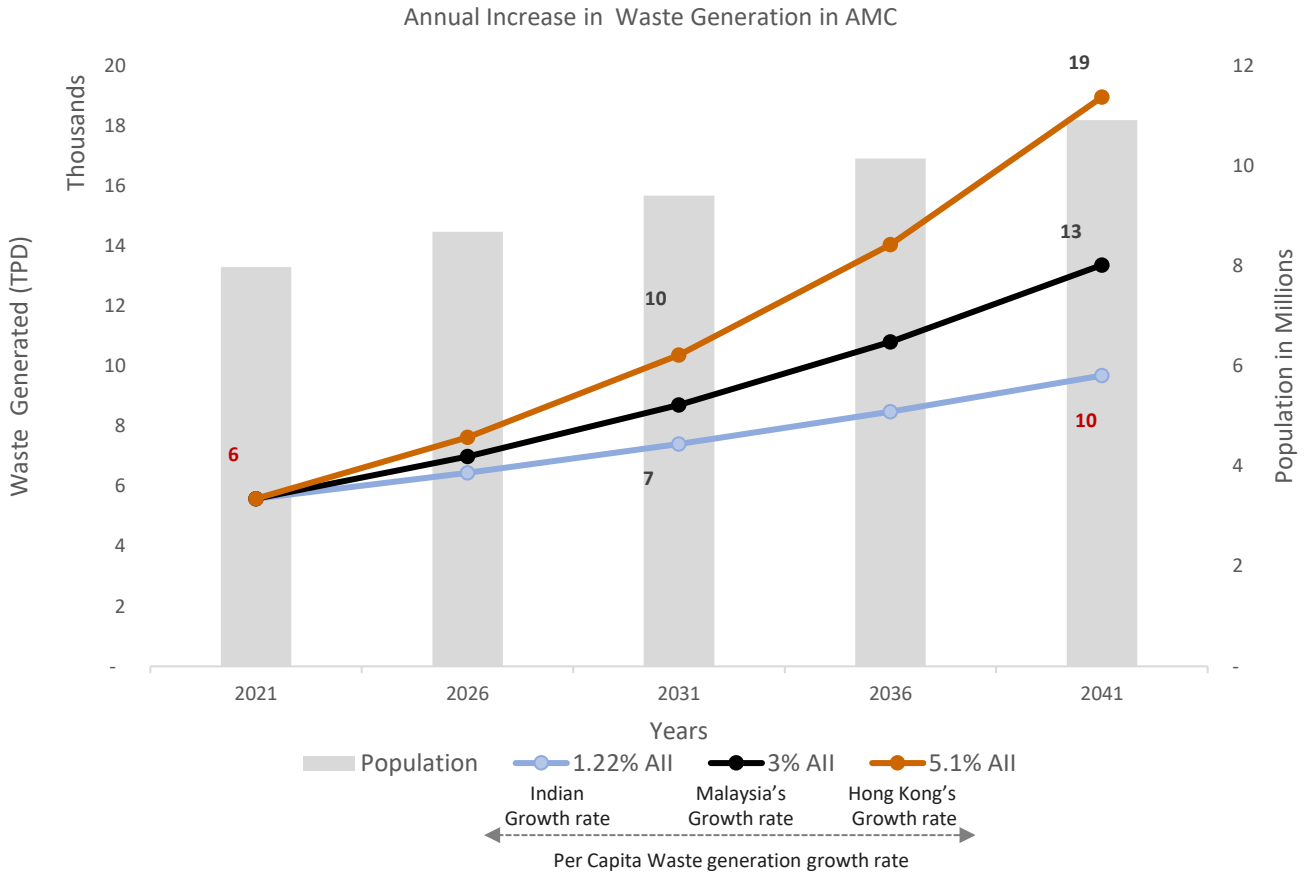
₹1,793
Per capita Spent on Waste

₹1.98 Cr
Spent per Sq.Km

Currently, Ahmedabad generates 5200 TPD of waste, with 1000 TPD from C&D. Per capita waste is 700 grams, costing ₹1,793 each, totaling ₹1.98 crore spatially. To enhance waste management services, increased investment is essential, highlighting the urgent need for additional resources to tackle escalating waste challenges effectively.

2.2 Ahmedabad Municipal Solid Waste Management

Future Scenario



The population projection for Ahmedabad indicates a potential doubling by 2041, consequently leading to a significant increase in waste generation. **Under Indian growth rate projections**, waste generation is estimated to reach 7000 TPD by 2031 and **10,000 TPD by 2041**. However, considering Ahmedabad's rapid economic growth, alternative scenarios predict even higher waste generation levels: **13,000 TPD** under **Malaysian growth rate** projections and a staggering **19,000 TPD** under **Hong Kong growth rate** projections for per capita waste generation **by 2041**. This underscores the urgent need for proactive waste management strategies to address the impending challenges posed by escalating waste volumes in the city.

2.3. Ahmedabad Municipal Solid Waste Existing Processing Facilities

Sr. No.	Processing Type	Daily treatment capacity
1	MSW to Compost	300 TPD
2	MSW to Compost & RDF	300 TPD
3	MSW to Compost & RDF	400 TPD
4	C &D Waste treatment	1000 TPD
5	Automated MRF	100 TPD
6	Waste to Energy	1000 TPD - 15 MW electricity

3. Aim, Objectives and Scope

AIM

To Leverage carbon credits from the municipal solid waste system in Ahmedabad (AMC region) through innovative processing steps, transforming waste into a valuable resource while reducing environmental impact and advancing sustainability for future generations.

Objectives

- Understanding the concept of Carbon Credit through assessment of case studies in global & Indian context.
- Identify the project to leverage carbon credits.
- Create baseline profile for the selected project.
- Proposing suitable model and projects for leveraging Carbon credits.

Scope

The scope of this initiative is to explore the potential for Carbon Credits in municipal solid waste management projects in Ahmedabad City, with a focus on evaluating the environmental, social, and financial impacts of selected projects.

4. Carbon Credits

According to UNFCCC, a carbon credit is a certificate or permit to emit greenhouse gases that is equal to the global warming potential of one metric tonne of carbon dioxide. One credit allows the release of one metric ton (2204 pounds) of carbon dioxide (CO2) or an equivalent amount of another greenhouse gas (GHG) into the atmosphere.
Individuals, governments, and corporations can utilize carbon credits to offset emissions they produce elsewhere, and any surplus can be sold on the market if not fully utilized.

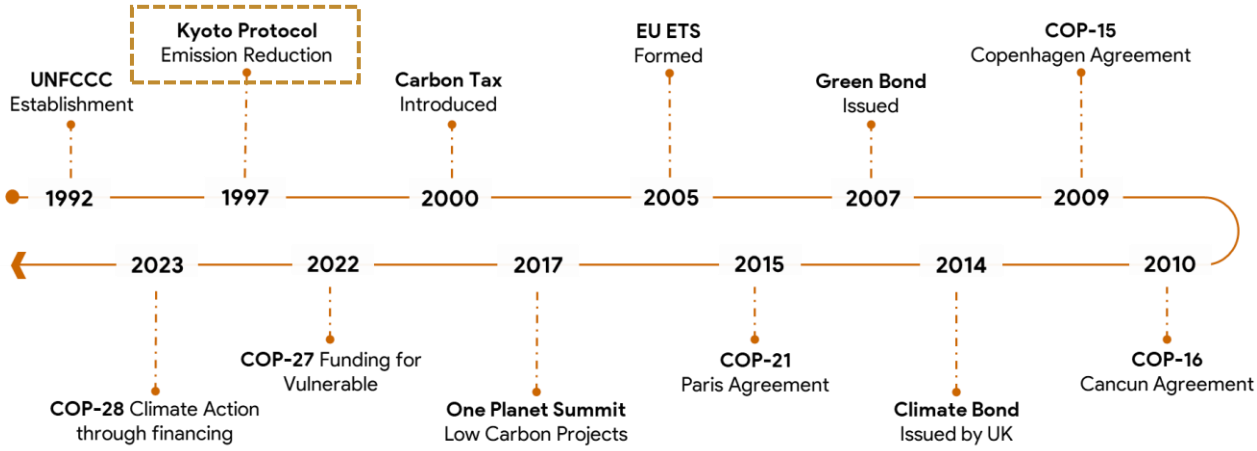
There are two types of carbon credits:
- Carbon offset credits (COC's)
- Carbon reduction credits (CRC's)

Carbon offset credits are made up of clean energy sources such as wind, solar, hydro and biofuels.
Carbon reduction credits are the efforts to store and collect carbon from our atmosphere.

The Paris Agreement's Article 6.4 mechanism allows countries to transfer carbon credits earned from reducing greenhouse gas emissions to help other countries meet their climate targets.

Let's explore the origins of the concept of carbon credits.

4.1 Origin of the Concept



4.2 The Necessity of Enhancing Climate Finance

7.6 trillion USD
Demand

0.65 trillion USD
Supply

Mobilization

Multilateral and Bilateral Institutions And Special Climate adaptation and Mitigation Funds

Supply is 8.5% of the total demand thus, there is a need to look into sources for Financing Climate Adaptation and Mitigation Projects.

The importance of investigating funding avenues for Climate Adaptation and Mitigation Projects becomes clear, underscoring the pressing need for financial assistance to effectively tackle environmental challenges.

4.3 Evolving carbon credit market in India

Who manages Carbon Trading in India?

United Nations Climate Change
Global Climate Action

The Clean Development Mechanism (CDM) Authority of India monitors the carbon credit market in India under UNFCCC

Who approves Carbon Credits in India?

सत्यमेव जयते
Goverment Of India

The union government or any approved agency is given the authority to issue "carbon credit certificates" for the reduction of carbon emissions to registered enterprises under Section 14 of the bill. The market can then be used to sell these credits.

Who are currently trading Carbon Credits in India?

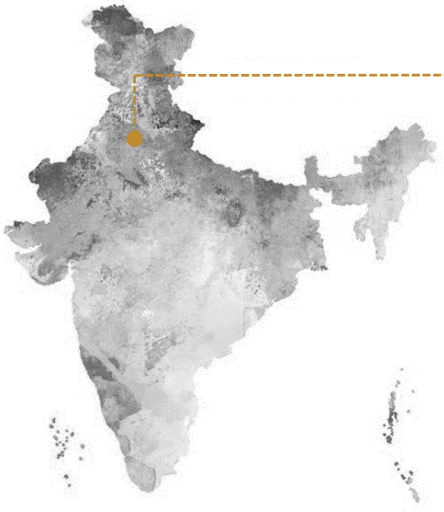
Carbon Trading

There are several companies that are currently buying carbon credits in India, including the Adani Group, the Tata Group, Reliance Industries and the Mahindra Group.

Why these companies are trading Carbon Credits in India?

These Companies are trading carbon credits in India in order to comply with the emission regulations set out by the Indian government, as well as to offset their own carbon emission in order to reduce their carbon footprint.

4.4 Case Study : Chandigarh



Focus: Windrow composting of municipal solid waste

Chandigarh composting: Prevented **346,700 tons CO2,** generating credits.

Revenue: Approximately **8.71 lakhs** from carbon credit sales in the global market.

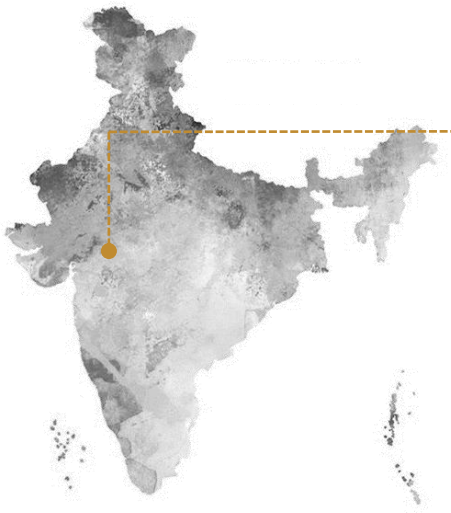
Methodology:

Two-stage composting strategy: FOODIE bioreactor in stage one, windrow composting in stage two.

Monitoring physico-chemical parameters: temperature, pH, moisture content, electrical conductivity, C/N ratio.

Solid waste composting presents a significant opportunity for carbon mitigation, with the potential to generate tradable carbon credits. Initiatives like the Chandigarh case study demonstrate successful co-composting of green and kitchen waste, resulting in both environmental benefits and economic value through carbon credits and organic compost production.

4.5 Case Study: Indore



Name of the Project – Carbon Credit Aggregator Model
Project Cost – **150 Cr.**

Unique Recognition: **First Urban Local Body in South Asia to tap Carbon Finance**

Phase 1

Oct 12, 2017, to June 30, 2019

1. Wet Waste Management (Composting),Bio-Methanation and Solar Energy Production
2. Carbon Credits Generated: **1.70 lakh**
3. Total Revenue: Approximately **69 lakhs**
4. Reduced Emission Costs: **1.5% return on expenditure**

Phase 2

July 1, 2019, to Dec 31, 2020

1. Revenue: Rs. **8.34 Crore** (Received in Sept 2021)
2. New Registered Projects:
   - Sewage Treatment Plant
   - Decentralized Composting
   - Forestry Plastic Recycling
   - LED Lighting

Carbon trading enables enterprises to meet emission targets by acquiring credits, incentivizing emission reduction and technological upgrades. ISCDCL's success underscores the value of aggregating environmentally beneficial projects for significant carbon credit gains. This approach highlights the potential for leveraging market mechanisms to drive environmental progress and sustainable development.

5. Project Component

The project is designed to explore and capitalize on revenue-generating opportunities in Ahmedabad through the utilization of financial instruments like carbon credits. These credits are envisioned as crucial tools in reducing the city's environmental footprint while advancing sustainability efforts for generations to come.

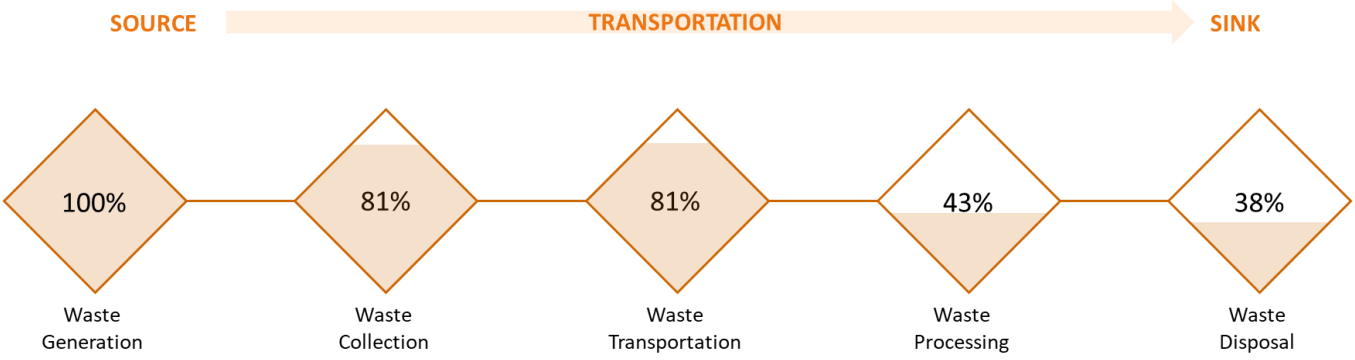
Furthermore, the project delves into specific pilot initiatives aimed at quantifying greenhouse gas (GHG) emissions, particularly within waste-to-compost and waste-to-energy projects. Additionally, a key aspect of the project involves the development of user-friendly tools for accurately calculating GHG emissions.

Moreover, the project emphasizes the importance of streamlining processes for proposal preparation and application, ensuring efficient implementation. It also prioritizes establishing mechanisms for sustaining and scaling up these initiatives, thereby maximizing their long-term impact on the city's environmental and economic landscape.

5.1 Project Identification

Waste Processing Analysis

To comprehend the waste processing dynamics, we analyzed the Municipal Solid Waste (MSW) value chain in the AMC region. Our assessment revealed a leakage of 19% of waste, either collected informally or indiscriminately dumped elsewhere. Moreover, out of the incoming 3400 TPD waste, 32% of organic waste is composted, while 21% of dry waste is segregated at the Material Recovery Facility (MRF). However, due to inadequate recycling facilities, 38% of the waste ultimately finds its way to landfills.



Source to Sink chain of solid waste management in Ahmedabad municipal corporation

5.1 Project Identification

Technology & capacity Evaluation

In the evaluation of technology and capacity for AMC, we focused on two plants: the Waste to Composting Processing Plant and the Waste to Energy Processing Plant, taking into account their current technology and existing capacity.

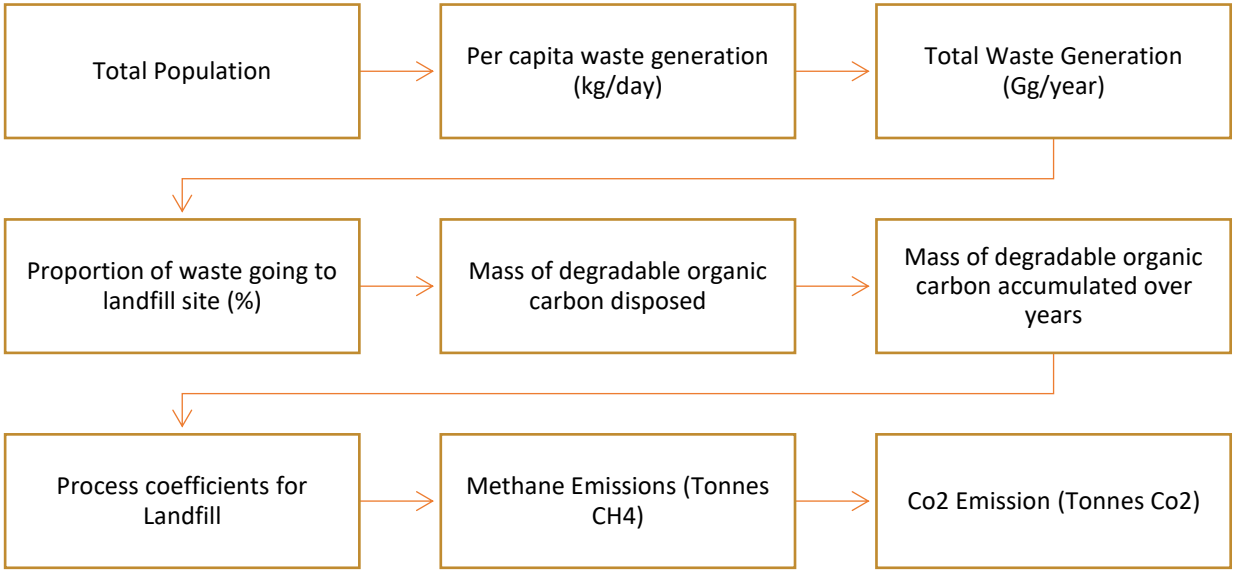
Accessing carbon emission

Calculate the carbon emissions generated by both the Composting and Waste to Energy facilities, assessing their environmental impact.

5.2 GHG Emission Quantification

In quantifying the CO2 emissions originating from landfills, a comprehensive approach is adopted, following the methodology outlined by the Intergovernmental Panel on Climate Change (IPCC). This methodology is widely recognized and accepted as a standard for assessing greenhouse gas emissions from various sources, including waste management practices such as landfills.

The process flow for this methodology is outlined below:



Source: IPCC Methodology for estimation of methane emission from solid waste disposal

5.3 Co2 Emission quantification for Waste to Compost Plant

According to a case study conducted in Chandigarh, composting helps reduce CO2 emissions by 60%.

Population =**7,355,256**
Waste generated = **1879 gigagram**
Waste going to Landfill = **38%**
Waste going for Composting = **20%**

Emission from Landfill (In Tons) = **143,503.02 Tons CO2e**
Emission from waste composted if gets disposed at landfill = **79224.4**
Emission from Composting = **31689.8 Tons CO2e**
Total emission saved through waste composting process = **47534.6**

1 Carbon Credit = 1 tons of CO2 Emission
Total Carbon Credit Earned = 47534.63
1 Carbon Credit = US 5$

Total Revenue generated = 5*83*47534.6
= ₹ 1.97 Cr.

To determine the amount of CO2 emissions captured, we utilize GHG emission quantification to assess CO2 emissions from landfills, followed by a case study of Chandigarh for further analysis. The same process is then applied to calculate CO2 emission quantification for the Waste to Energy Plant.

5.4 Co2 Emission quantification for Waste to Energy Plant

According to a case study, Waste to Energy helps reduce CO2 emissions by 75%.

Population =**7,355,256**
Waste generated = **1879 gigagram**
Waste going to Landfill = **38%**
Waste going for WTE = **20%**

Emission from Landfill (In Tons) = **143,503.02 Tons CO2e**
Emission from waste to Energy if gets disposed at landfill = **79224.4**
Emission from Waste to Energy = **19806.1 Tons CO2e**
Total emission saved through waste composting process = **59418.3**

1 Carbon Credit = 1 tons of CO2 Emission
Total Carbon Credit Earned = 59418.3
1 Carbon Credit = US 5$

Total Revenue generated = 5*83*59418.3
= ₹ 2.5 Cr.

The 15 MW WTE facility replaces 417 t coal/day, reducing greenhouse gas (GHG) emissions of 300.38 tCO2eq/day through coal replacement

In a year it saves **109638.7 Tons CO2e**

Total Revenue generated = 5*83*109638.7
= ₹ 4.55 Cr.

5.5 Toolkit for GHG Emission

To simplify the calculation and quantification of GHG emissions for both government organizations and private companies, a user-friendly toolkit has been developed. This toolkit, designed with considerations from the Intergovernmental Panel on Climate Change (IPCC), streamlines the process by requiring users to input requested data, after which all outputs are automatically generated.

The table below outlines the inputs required and the corresponding outputs generated by the toolkit.

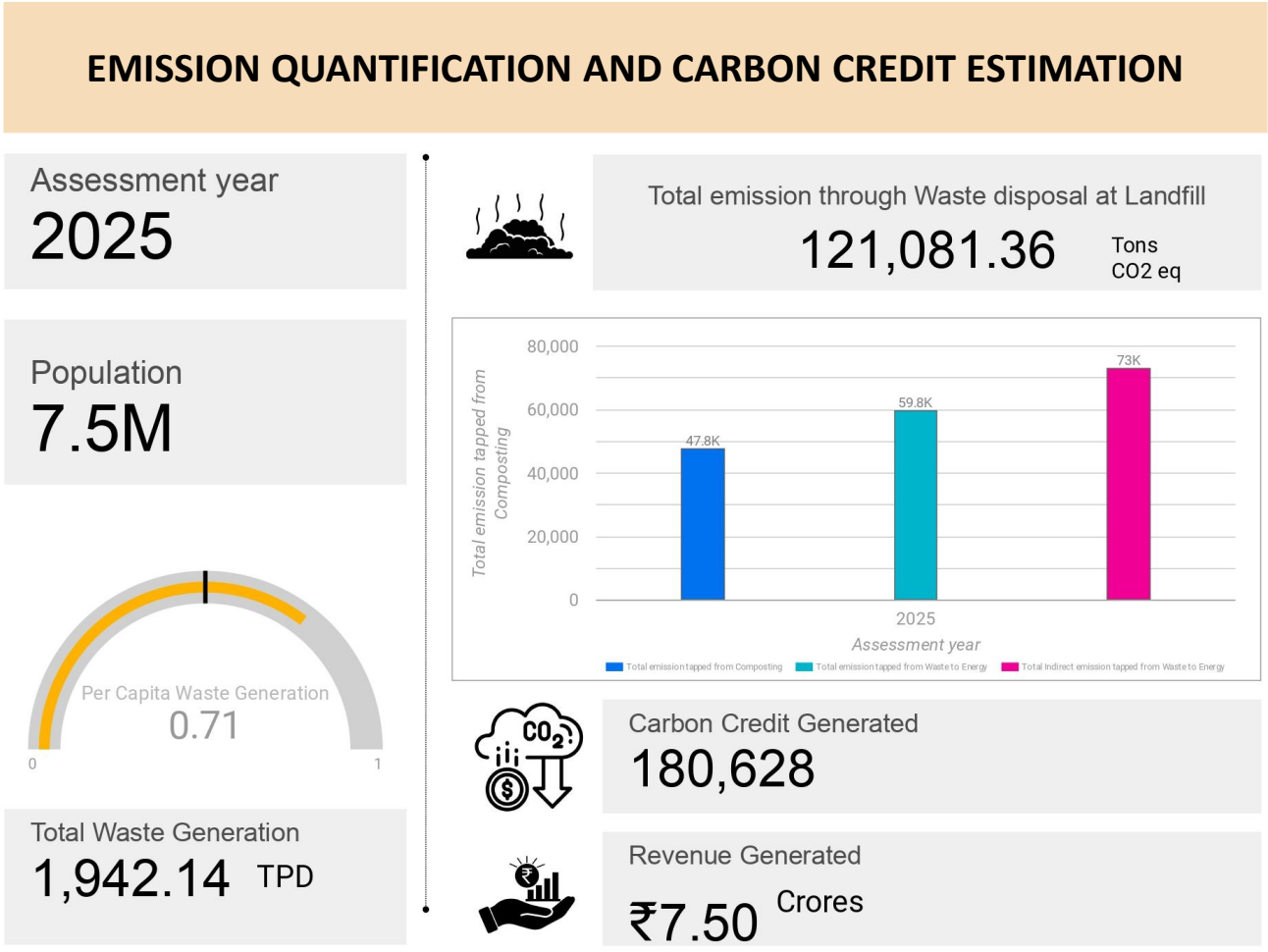
Data Input	Output
Assessment	Assessment year
Year	Population
Proportion of the Total Waste Generated that is sent to Solid Waste Disposal sites (%)	Total Waste Generation
Proportion of the Total Waste Generated that is sent to Solid Waste Disposal sites in previous year (%)	Per Capita Waste Generation
Proportion of Waste going for Composting (%)	% of waste disposed at Landfill
Proportion of Waste going for Waste to Energy (%)	Total emission through Waste disposal at Landfill
Waste to energy generation capacity (MW)	Total emission tapped from Composting
	Total emission tapped from Waste to Energy
	Total Indirect emission tapped from Waste to Energy
	Total Carbon Credit Generated
	Revenue Generated from Carbon Credit

Toolkit for GHG Emission Quantification
Scan and Explore

The toolkit is seamlessly integrated with a dashboard, providing convenient access and enhancing data visualization for improved representation.

5.6 Dashboard for Toolkit

The dashboard is linked with the toolkit, facilitating a seamless connection and enabling efficient utilization of both tools.



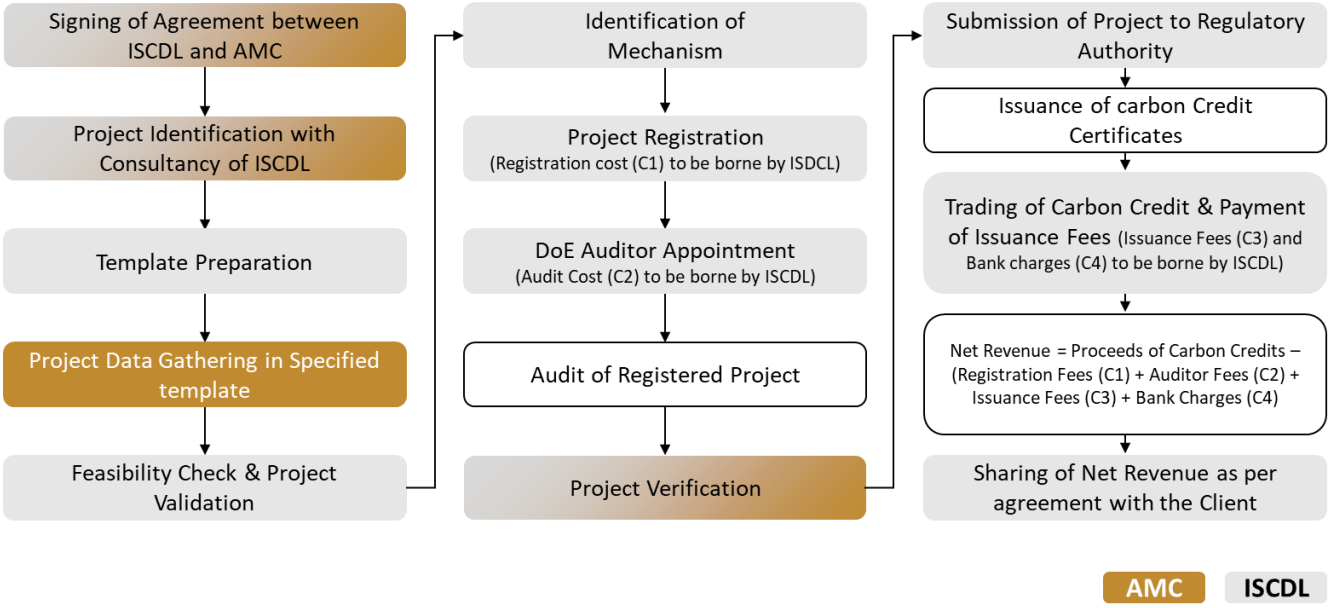
Link to Access Dashboard:
https://lookerstudio.google.com/u/0/reporting/a666e62530eb453cb4477aacda05f2c5/page/oPcxD

6. Proposal Preparation and Application

During the initial stages of Project Preparation and Application, AMC will engage ISCDCL (Indore Smart City Development Corporation Limited) for consultancy services, agreeing to share the net revenue.

AMC does not opts for this approach due to several factors:

1. The substantial project registration cost, exemplified by $10,000.
2. The intricate nature of the process flow.
3. The presence of multiple mechanisms such as VCS, CDM, GCC, and GS.
4. The absence of accessible trading platforms for Carbon Credits.



This represents the consultancy model for monetization employed by ISCDCL, the Indore Smart City Development Corporation Limited.

7. Project Phasing and Scaling up

PROJECTS	SHORT TERM						MID TERM					LONG TERM					
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Identification of potential projects to leverage carbon credit																	
GHG emission quantification of waste to compost plant.																	
Project application preparation for waste to compost.																	
Partnership with ISCDL for carbon credit application.																	
Identification of more projects to leverage carbon credit.																	
GHG emission quantification of waste to compost plant & waste to energy plant.																	
Bundling of waste processing facility projects.																	
Provision of consultancy to other ULBs by AMC for carbon credit.																	
Developing AMCs model for carbon credit and climate financing.																	
Bundling of overall projects of solid waste management including collection.																	

Goals	ST Goals	MD Goals	LT Goals
Priority	High	Medium	Low

Inference:
The strategic timeline outlines a progression from short-term initiatives focused on specific waste processing plants and carbon credit partnerships, to mid-term efforts aimed at broader waste processing facility projects and consultancy services for ULBs. Ultimately, the long-term vision involves comprehensive strategies for carbon credit management and financing, highlighting AMC's commitment to sustainable waste management practices and environmental stewardship over the coming decades.

8. Impact Assessment

Environmental Impact

- Decreased air and water pollution.
- Reduced methane emissions from waste diversion.
- Potential energy savings.

Social Impact

- Improved public health.
- Improved living standards nearby
- Job creation in waste management.

Policy Compliance

- Adherence to environmental policies.
- Cost-effectiveness within budget.
- Compliance with waste and carbon regulations.

Economic Impact

- Revenue from carbon credits and recycling.
- Economic opportunities in waste sector.
- Cost reduction through efficient waste management.

Comprehensive waste management not only safeguards the environment and public health but also drives economic prosperity through revenue generation and cost-saving measures, ensuring sustainable development while meeting regulatory requirements.

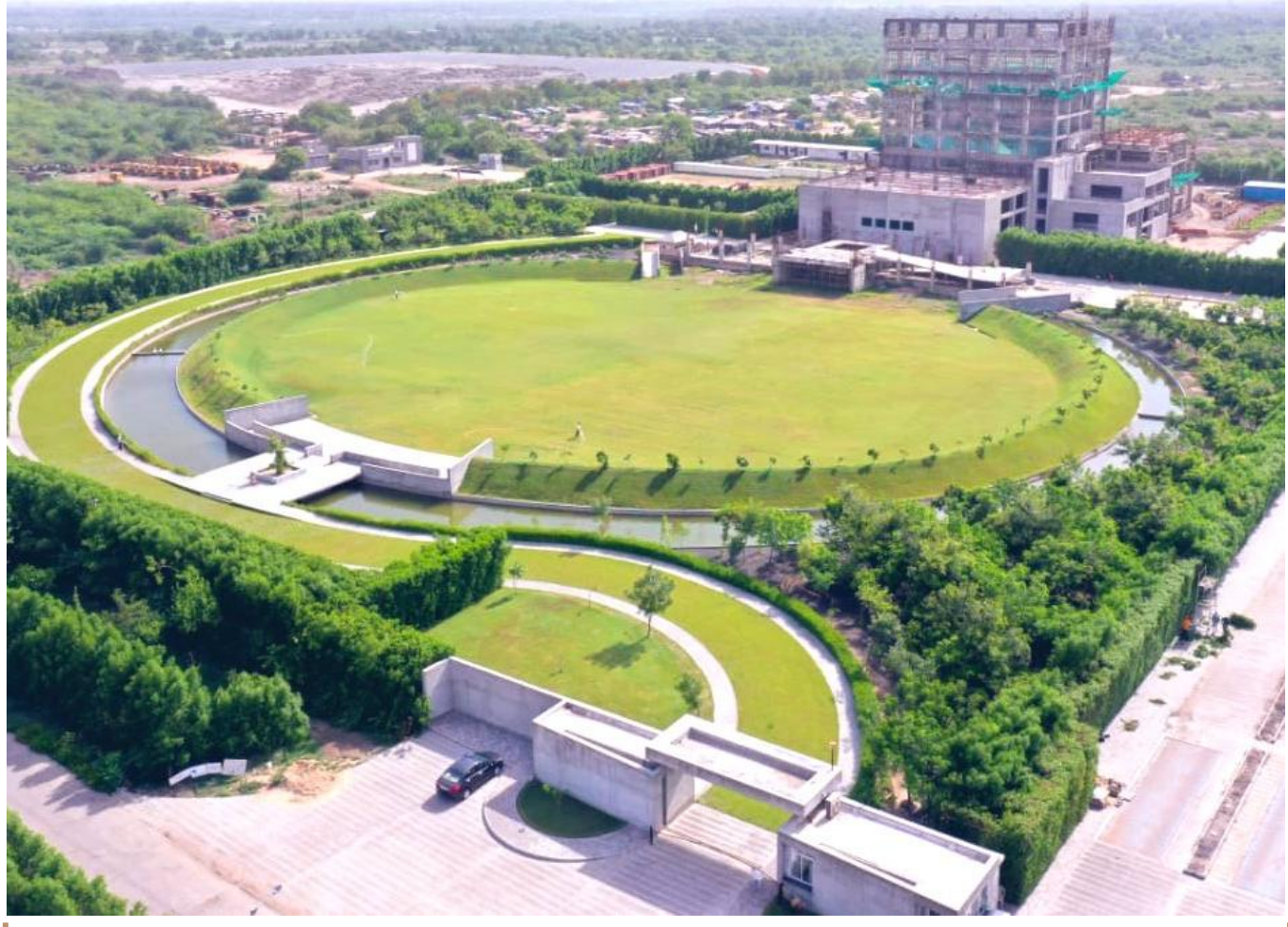
9. SDGs Linkages

Sustainable waste management plays a vital role in advancing the Sustainable Development Goals (SDGs), particularly emphasizing SDGs 5, 11, 12, 13, 14, 15, and 17.

Solid waste management is directly linked to SDG 12 among these goals.

10. Conclusion

In conclusion, rather than solely perceiving greenhouse gas emissions as an environmental challenge to tackle, let's reframe it as an avenue for revenue generation. Specifically, in the context of solid waste management, initiatives aimed at reducing emissions from waste can be monetized through mechanisms like carbon credits. By implementing efficient waste management practices that minimize emissions, cities and organizations can not only mitigate environmental harm but also capitalize on financial incentives. This shift in perspective transforms waste management from a cost burden to a potential source of income, creating a win-win scenario where environmental sustainability aligns with economic prosperity.



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"Carbon Credit Quantification Toolkit Demo”
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