Session 3: Managing Feedstock – Best Practices for Solid Waste Source Separation

Global Methane Initiative

Training on Best Practices for Landfill and Organic Waste Management

October 30, 2024

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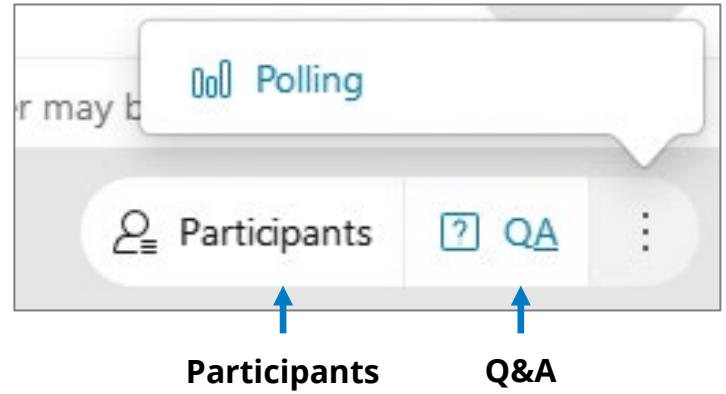

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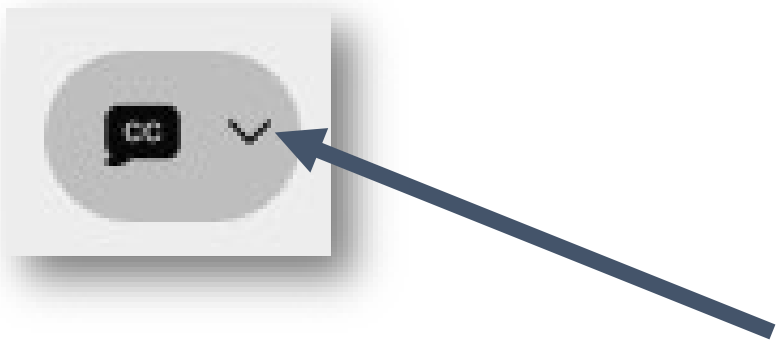

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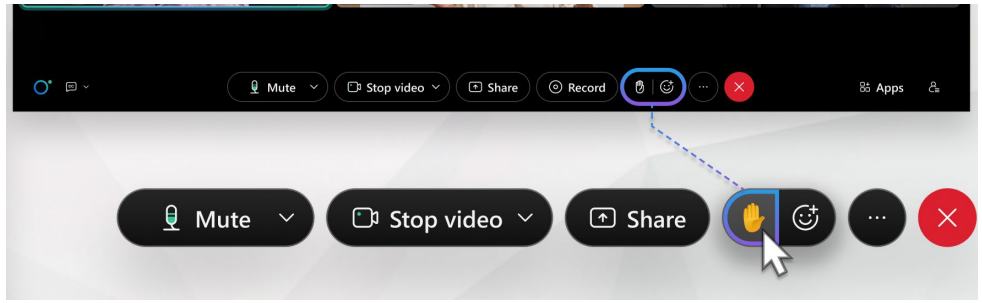

Speakers

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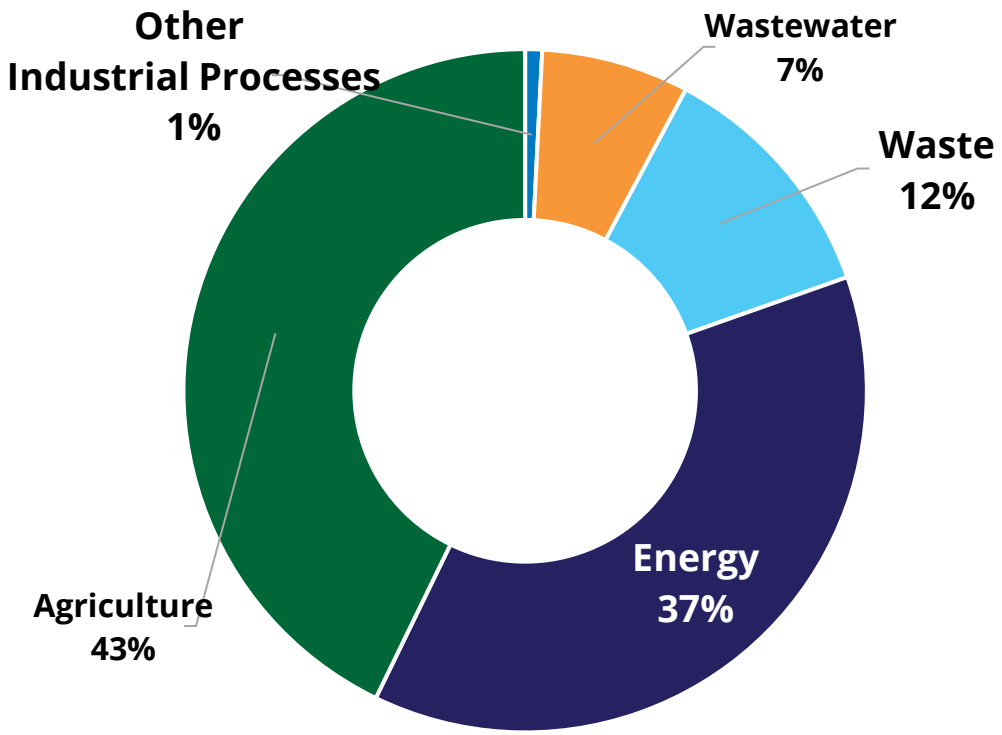
Overview of Session

- Introduction to feedstock management
- Upfront planning for organic waste management facilities
- Working with large producers to address contamination
- Implementing household source separation
- Case studies for success stories and failures

Methane Emissions from Waste

In the waste sector, methane is produced due to the decomposition of organic (biodegradable) materials in landfills and dumpsites.

- **Minimizing Methane Emissions:** Source separation of organic waste diverts it from landfills, minimizing anaerobic decomposition and the release of methane.
- **Enhanced Methane Recovery for Energy Production:** Controlled processing of separated organic waste through anaerobic digestion captures methane for renewable energy, preventing atmospheric emissions.



Global Methane Emissions By Sector

Introduction to Feedstock Management

Presenter: Dana Blumberg

Introduction to Feedstock Management

- **Definition**: Managing materials in an efficient way so that minimal amount ends in landfills.
- **Importance**: Essential for optimizing recycling, composting, and energy recovery processes.
- **Challenges**:
  - Contamination
  - Variability in composition
  - Quality, economic
  - Logistical concerns

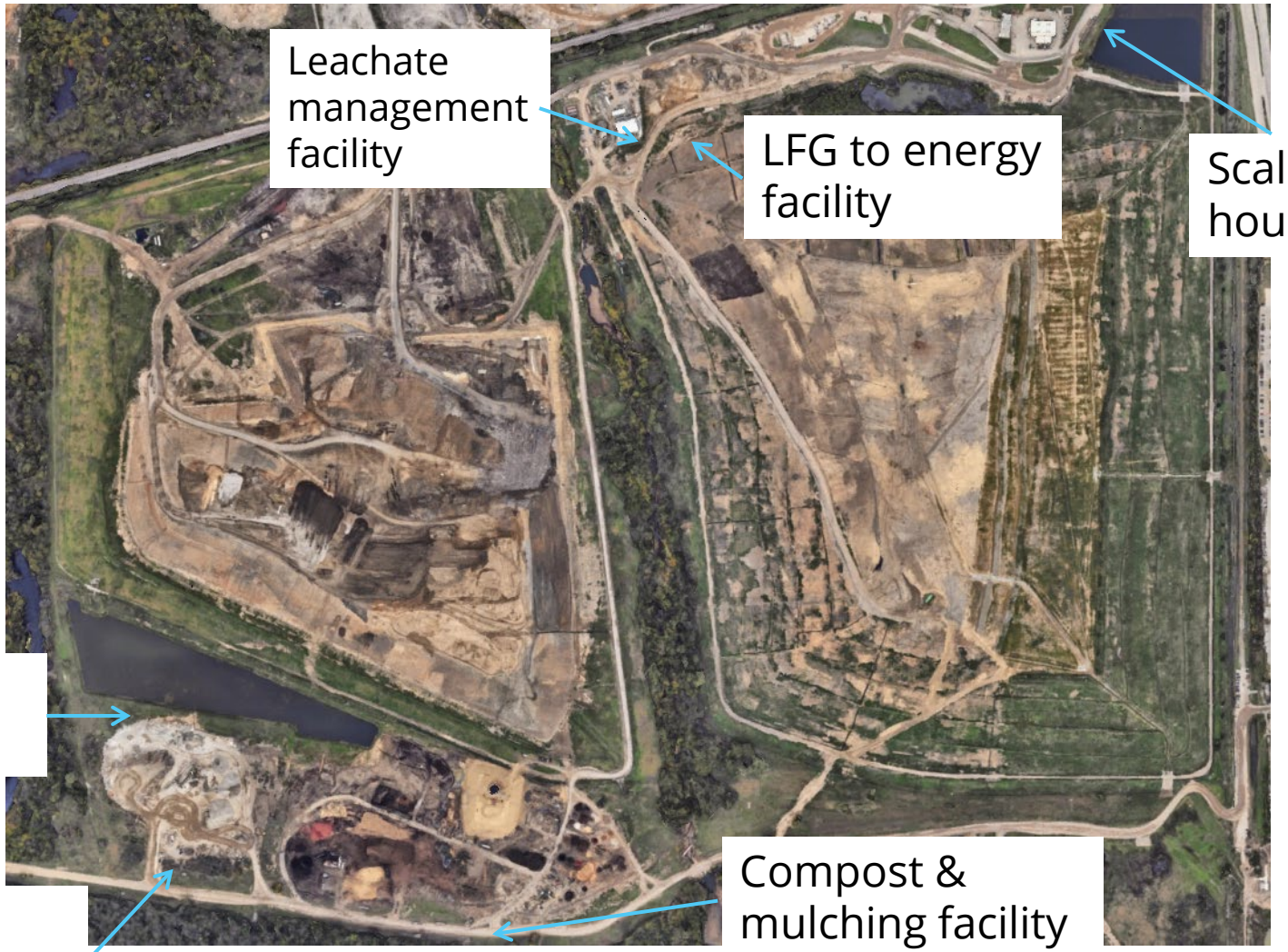
Upfront Planning for Organic Waste Management Facilities

Presenter: Dana Blumberg

Key Considerations for Site Planning

- **Site Selection Criteria**
  - Availability of land
  - Accessibility and proximity to urban areas
- **Essential infrastructure**
  - Storm water management
  - Electricity for anaerobic digestion (AD)
  - Prepared surface for composting (i.e., gravel pad, asphalt etc.)
  - Facility to receive and sort organic waste
- **Co-locate with existing landfill advantages**
  - All traffic goes to same place
  - Share infrastructure (scale house, maintenance, office and locker rooms)
  - Contamination can be easily disposed
  - Flexibility with workforce allocation
  - Combined environmental controls (leachate, stormwater, biogas)

Example of Upfront Site Planning



Typical landfill in U.S.

Challenges in Siting Organic Waste Facilities

- **Leachate Production:** Organic waste decomposition will produce more leachate requiring management.
- **Operational Constraints on a Landfill:** settlement occurs with decomposition of organic waste so paved areas may have uneven settlement.
- **Increased Odor Potential:** improper management of organic processing facility will produce odors.

Benefits of Upfront Planning for Organic Waste Management

- **Environmental Benefits:** Reduction in greenhouse gases through composting and anaerobic digestion. Resource conservation enhances ecological sustainability and minimizes landfill impacts.
- **Operational Efficiency:** Improved landfill lifespan and efficiency result from effective organic waste management, reducing leachate treatment requirements significantly.
- **Community and Compliance:** Enhances public health and community relations while ensuring compliance with environmental regulations, fostering sustainable practices.

Working with Large Producers to Address Contamination Issues

Presenter: Dana Blumberg

Introduction to Waste Contamination

- **Definition:** The mixing of different types of waste materials that should be separated for their proper treatment (i.e., composting, AD, recycling).

- Presence of packaging and bags in food scraps contaminates organics for their use in organic waste treatment facilities.
  - Contaminated organic waste ends up in landfills/dumpsites
  - Methane is produced due to the presence of organics in landfills/dumpsites
  - Hinders operations of facilities.

- Contaminated organic waste like paper and cardboard is burned mostly in developing countries resulting in GHG emissions and black carbon.

Importance of Preventing Waste Contamination in Solid Waste Management

- **Challenges to recycling**
  - Reduction in recycling efficiency
- **Increased landfill use**
  - Contaminated waste is directed towards landfills
- **Environmental harm**
  - More organic waste ending up in landfill results in higher methane emissions
- **Health and safety risk**
- **Economic impact**
  - Increased processing costs
  - Lost value from recyclables
- **Regulatory concerns**
  - Non-compliance penalties

Contamination in Waste Generated by Large Producers

- **Restaurants** generate food scraps, packaging waste, and grease.
  - Contamination source includes food waste interacting with plastic packaging.
  - Up to 25% of restaurant recycling fails due to contaminated recycling bins.
- **Educational Institutions** typically produce cafeteria food waste, paper products, and plastics.
- **Farmers/Open Markets and Wholesale Produce Markets** generate spoiled produce and fruit and vegetable culls
  - Contamination source includes packaging such as plastic bags and film.
  - Opportunity to provide organic waste collection for the community.
- **Commercial** (non-manufacturing, e.g., retail and offices) produce mixed waste including paper, carboard, plastic, aluminum, and food scraps
  - Contamination source includes improper separation

Challenges in Addressing Waste Contamination

Lack of Awareness: Bulk producers often lack knowledge regarding proper waste management practices, resulting in contamination and sustainability issues.

Resource Limitations: Limited financial and material resources hinder bulk producers ability to implement effective waste management strategies consistently.

Employee Training Gaps: Inadequate employee training on sorting and handling waste contributes significantly to ongoing contamination challenges at facilities.

Challenges for Restaurants

- Need for continuous education as new staff is hired.
- No assigned responsibility.
- Unclear separation protocols leads to increased contamination rates and hampers effective waste management.
- No designated place for bins.
- Bins not large enough.
- Bins are inaccessible for collection vehicle.

Best Practices for Restaurants

- **Separate waste bins:** Set up separate bins for food scraps and compostable materials.
- **Recycle packaging:** Ensure proper recycling of cardboard, plastics, and other packaging materials.
- **Proper grease disposal:** Use designated containers for grease and oils; partner with specialized grease recycling services.
- **Staff training:** Educate employees on waste segregation and the importance of preventing contamination.
- **Assign responsibility:** Designate who is responsible for implementation.

Challenges for Educational Institutions

- Need for continuous education for new students and staff.
- No assigned responsibility.
- Contract employees in cafeteria.
- Unclear signage on bins.
- No designated place for bins.
- Bins not large enough.
- Bins are inaccessible for collection vehicle.

Best Practices for Educational Institutions

- **Waste sorting stations:** Implement sorting stations for recycling paper, plastic, and organic waste from cafeteria food.
- **Signage on bins:** Include pictures of common items on each bin.
- **Encourage reusable items:** Promote reusable lunch containers and utensils to reduce single-use plastics.
- **Paper recycling programs:** Ensure paper waste, such as worksheets and notebooks, is recycled in dedicated bins.
- **Composting food waste:** Establish school composting programs for leftover food and organic material.

Challenges for Food and Farmers Markets

- Need for continuous education for vendors and customers.
- No assigned responsibility.
- Plastic bags and packaging contaminating bins for organics and recycling.
- Unclear signage on bins.
- Bins not large enough. Vendors disposing of unsold produce.
- Schedule collection after the market closes.

Best Practices for Food and Farmers Markets

- **Composting bins for spoiled produce:** Provide composting options for employees and vendors to discard unsellable or spoiled fruits and vegetables.
- **Separate packaging and organic Waste:** Ensure that packaging materials (plastic, cardboard) are separated from organic waste.
- **Educate employees and vendors:** Offer guidance on waste sorting, composting, and recycling options available at the market.
- **Encourage minimal packaging:** Promote the use of reusable or biodegradable packaging to reduce waste.
- **Ensure collection:** Once market closes.

Challenges for Commercial Facilities

- Need for continuous education of employees and janitorial staff
- Determining materials to be collected.
- No assigned responsibility.
- Unclear signage on bins.
- Bins not large enough.
- No designated area for bin collection that is accessible for collection vehicle.

Best Practices for Commercial Facilities

- **Regular Waste Audits:** Conducting regular audits allows identification of contamination sources
- **Dedicated Waste Streams:** Create separate streams for recyclables (i.e., aluminum, paper, plastics) and general waste.
- **Signage on Bins:** Include pictures of common items.
- **Employee Training:** Train staff proper separation.
- **Assign Responsibility:** Designate who is responsible for implementation.
- **Bin Collection:** Designated area for bin collection

Summary:
Best Practices for Waste Separation

- **Color-Coded Bins:** Utilizing color-coded bins enhances visual cues, facilitating accurate waste separation among bulk production facilities.
- **Visual Aids Implementation:** Integrating visual aids like posters and labels educates employees on proper waste disposal techniques effectively.
- **Consistent Training Programs:** Regular training sessions reinforce knowledge, ensuring employees consistently apply waste separation practices in operations.

Questions?

Implementing Household Source Separation

Presenter: Hussain Ali

Introduction to Household Source Separation

- **Household Source Separation:** the segregation of different types of solid waste at the household
  - **Wet waste:** recovery of energy and compost from wet wastes
  - **Dry waste:** recovery of resources from dry wastes
- **Significance of Source Separation in Waste Management:**
  - Improves recycling efficiency
  - Reduces the amount waste disposed in landfills
  - Enhances waste treatment options
  - Produces a cleaner, marketable compost
  - Reduces methane generated in landfills

Challenges to Implement Household Source Separation

- **Low level of participation among citizens**
  - Lack of responsibility
  - Lack of trust
- **Pre-collection removal of recyclables**
  - Collection of dry waste by informal workers
- **Unbalanced resources**
  - Lack of expertise
  - Inadequate budget
  - Uncollected areas
- **No source separation policies**
  - Lack of priority given to source separation at household level
  - Lack of public education
  - Lack of inter-organizational and intra-organizational coordination and proper lines of communication
  - Lack of enforcement
- **No available waste characterization data**
- **Poor performance of private sector**
  - Not much profit for private sector

Best Practices for Household Source Separation

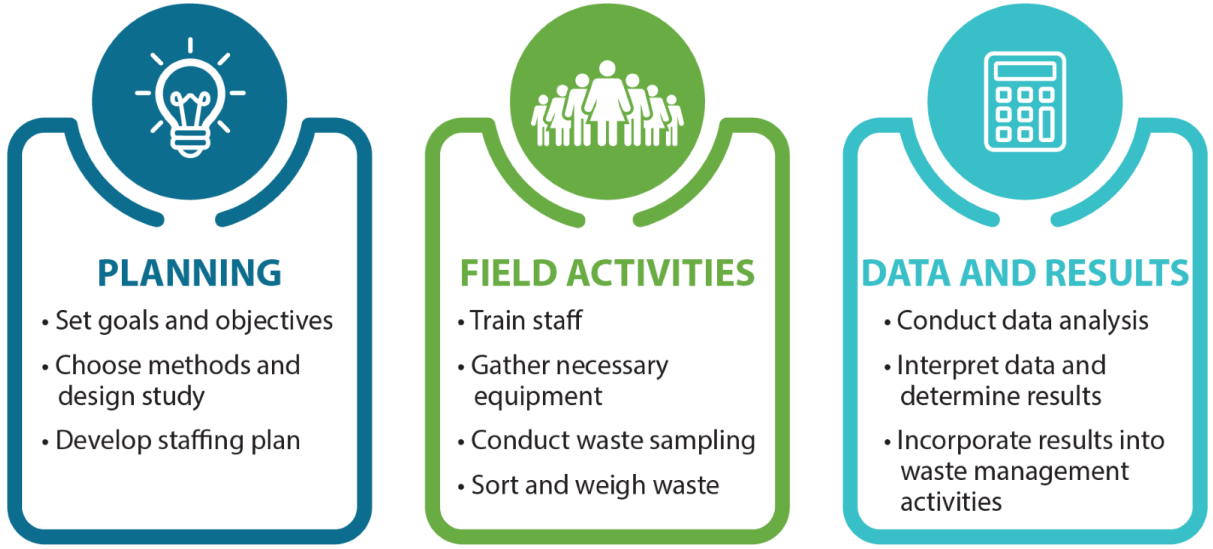
- **Collection methods:**
  - Dedicated organic waste bins or bags
  - Curbside collection programs
  - Community drop-off centers
  - Commercial partnership with parks and public works departments
- **Availability of national/local policies, regulations, monitoring and enforcement mechanisms**
  - Availability and effective implementation of an integrative, comprehensive, long-term SWM strategy and plans
  - Enforcement mechanism – audits, lid flipping
- **Presence of trained staff and skilled professionals in MSWM positions**
- **Conduct waste composition study**
  - Available resource: GMI's Waste Characterization Handbook & Excel Tool

Best Practices for Household Source Separation (continued)

- **Availability of offtakers**
  - Existence and profitability of market systems relying on recycled-material, involvement of small businesses, middlemen and large industries
- **Integration of the informal sector in any system**
- **Good governance**
  - Presence of effective coordination, collaborative and information sharing mechanisms with other stakeholders
- **Sufficient sources of funding**
  - Adequate budget for infrastructure investment and operational costs
  - Availability of waste collection and disposal fees, and willingness to pay by residents
- **Public outreach and education**

GMI's Waste Characterization Handbook & Excel Tool

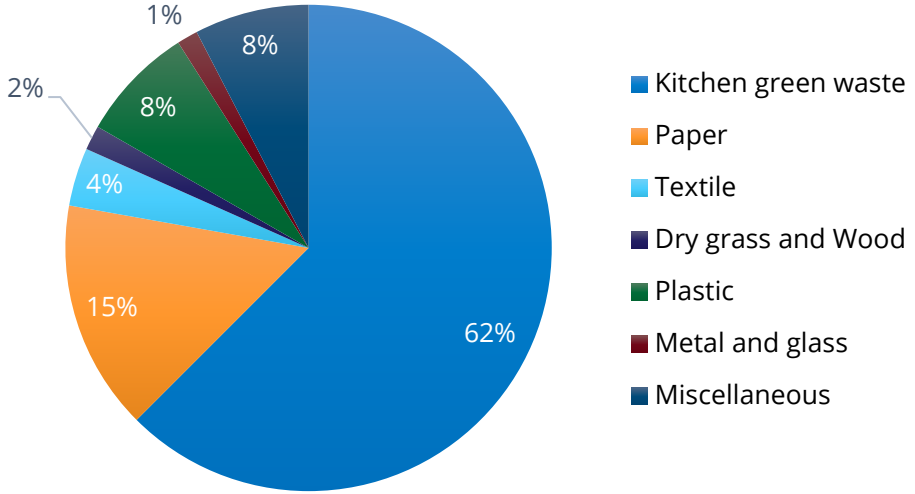
- The **Handbook** includes recommended activities and resources to:
  - Plan an appropriate study for specific site conditions
  - Conduct field activities to collect the data
  - Analyze the data to help make informed solid waste planning decisions



- **Excel-based tool** that streamlines data entry and analyzes the composition of waste streams
  - Designed for field use
  - Analyzes material types and amounts

Visit GMI's Tools and Resources Library to download the Handbook and tool:
https://www.globalmethane.org/resources

Waste Composition at Household Level in Pakistan (Gujranwala)



1% hazardous waste to hazardous landfill

64% (organic) waste goes to compost/AD facility

Source Separation

24% (paper, metal, plastic and glass) waste to recycling facility

11% mixed/contaminated waste to landfill

Environmental Benefits of Source Separation

- Diverts organic matter from landfills, reducing methane emissions
- Closes the nutrient cycle, reducing need for synthetic fertilizers
- Conserves water by improving soil moisture retention

Questions?

Methane Mitigation Case Studies

Presenter: Dana Blumberg

Case Study: Chetpet BioCNG Plant

Chetpet BioCNG Plant Overview

- **Location: Chennai, India.** The Chetpet BioCNG Plant is strategically located in Chennai, addressing local organic waste issues.
- **Operator: Srinivas Waste Management Services.** Srinivas Waste Management Services operates the facility, emphasizing sustainable management of organic waste.
- **Purpose: Convert Organic Waste.** The primary aim of the facility is to efficiently convert organic waste into BioCNG for energy.
- **Feedstock:** organic waste from bulk generators (i.e., restaurants, hotels) and large wholesale produce market

Operational Details of Chetpet BioCNG Plant

- **Daily capacity:** The plant handles 150-160 tons of feedstock daily.
- **Challenges:** Waste contamination ~ 40%. Waste must be sorted by hand and by machine.
- **BioCNG production:** Production is estimated at 3,000-3,100 kg of BioCNG each day, showcasing effective waste transformation.
- **BioCNG sale**: Gas sold to the Gas Authority of India Limited (GAIL) and various hotels.
- **Workforce composition:** About 80 employees operate the plant, with women making up about half of staff.

Business Model of Chetpet BioCNG Plant

- **Cost:** Cost to produce CNG is 116 INR per kg.
- **Revenue streams:** The plant generates income through intake charges for organic waste and sale of BioCNG.
  - Operators are currently looking into carbon credits
- **Intake charge:** Bulk waste generators pay 2 INR per kg to send their organic waste to the facility.
- **Environmental Benefits:** Organic waste diverted from dumpsite resulted in decreased *methane emissions* and produces renewable energy.
- **Return on investment:** Operators anticipate a return on investment within four years of commencing operations.
- **Replicability:** The city of Chennai plans to build another 6 plants with similar capacity.

Crop Residue Burning in Pakistan

Crop Residue Burning in Pakistan

- **Research objectives:** To explore the causes of crop residue burning and analyze the socio-economic factors influencing farmers' decisions in Gujranwala.
  - Research was conducted in Gujranwala, Punjab
  - 200 farmers were interviewed from 28 villages
- Practice produces black carbon
- Missed opportunity for AD/Renewable energy production using crop residue as feedstock

Burning Practices Breakdown

- **Complete burning:** Approximately 26.5% of surveyed areas are designated for complete burning of crop residues.
- **Partial burning:** About 30.5% of the regions engage in partial burning, impacting soil health and nutrient retention.
- **No burning practices:** The remaining acreage is either fully removed or incorporated into the soil to improve sustainability.

Farmers' Reasons for Burning

Quick field clearing: Burning residue expedites field preparation, allowing farmers to swiftly transition to the next crop cycle.

Cost constraints: Farmers often face financial limitations, making burning an economically favorable option compared to removal.

Pest control: Fire serves as a tool for pest and weed management, reducing potential agricultural threats effectively.

Conclusions from Study Findings

- **Influential Factors Identified:** Farm size, straw length, cattle ownership, time pressure, distance, and information access are crucial.
- **Environmental Awareness Needed:** Enhancing awareness among farmers about residue burning impacts on health, soil, and GHG emissions associated with it is essential.
- **Sustainable Management Recommendations:** Encouraging sustainable practices like anaerobic digestion and composting can significantly mitigate GHG emissions associated with crop residue burning.

Case Study: Indore Waste Management Success Story

Indore Waste Management Success Story

- Indore has consistently ranked the "**cleanest city in India"** since 2017, according to the Swachh Survekshan cleanliness survey

- The Government of India, as part of the **Swachh Bharat Mission**, conducted the Swachh Survekshan surveys in **73 cities** in January 2016 and expanded to **4,400** in 2023

- Key parameters assessed include:
  - ✓ Waste collection and transportation
  - ✓ Processing and disposal
  - ✓ Open defecation
  - ✓ Information, education, and communication
  - ✓ Capacity building

- Indore's top ranking is due to advancements in sustainable waste management practices, which:
  - ✓ Improve public health
  - ✓ Protect the environment
  - ✓ Mitigate methane

- Indore's success provides valuable insights and serves as a **model for cities globally**

स्वच्छ भारत
एक कदम स्वच्छता की ओर

Swachh Bharat Mission

Indore at a Glance

Population	3.2 million people
Total Waste Generation	1,115 metric tons (MT) of waste per day
Waste Composition	Wet: 58.25% Dry: 41.75% Hazardous: 0.5%

Challenges Faced Before 2016

- **Pre-2016 waste collection challenges:** Waste collection was infrequent, leading to unsystematic disposal and significant public health concerns.
- **Lack of waste segregation:** Citizens did not separate waste, and waste collection was infrequent, disorganized, and unsystematic.
- **Risk of state intervention:** Poor waste management performance raised alarms, prompting potential state takeover of Indore's waste responsibilities.

What were the keys to Indore's successful transformation of its waste management system?

1. Leadership buy-in
2. Active engagement and participation of citizens
3. Successful pilot testing
4. Installation of modern and efficient infrastructure
5. Public and private financing

Key to Success #1: Leadership Buy-In

- **Leadership Commitment:** The strong commitment from local leadership initiated transformative changes in Indore's waste management system.
- **Termination of Non-Performing Contracts:** Immediate termination of contracts with underperforming private contractors ensured more efficient waste collection services.
- **Enforcement of Waste Separation:** Implementation of stringent waste separation policies mandated citizens to segregate waste at the source effectively.

Key to Success #2: Active Engagement and Participation of Citizens

- **Engaging citizens for change:** Indore Municipal Corporation leveraged surveys and participatory approaches to understand citizen perspectives on waste management.
- **Innovative 311 phone app:** The '311' app allowed citizens to report issues and provide feedback, fostering transparency and accountability.
- **Broad awareness campaigns:** Collaborated with local celebrities, religious groups, and self-help organizations to amplify waste segregation messaging effectively.

Key to Success #3: Successful Pilot Testing

Pilot Collection Project: Initiated door-to-door waste collection pilot in two wards, focusing on practical execution and community feedback.

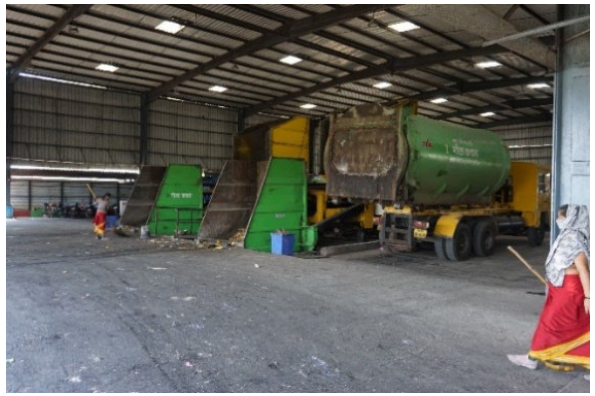
Key Lessons Learned: Success highlighted the importance of timely collection and built public trust, essential for wider adoption.

Full-Scale Implementation: Results from the pilot enabled expansion of door-to-door collection to all 85 wards by end of 2016.

Key to Success #4: Installation of Modern and Efficient Infrastructure

Collection vehicles with separate chambers for different waste materials

Integrated command and control center



Transfer stations

Biogas facility

Material recovery facilities
Source: SmartCityIndore.org

Sanitary landfills
Source: GettyImage (Image is not from Indore)

Key to Success #5: Public and Private Financing

Capital Costs: Funding was secured from central, state, and local governments, as well as from corporate social responsibility funds.

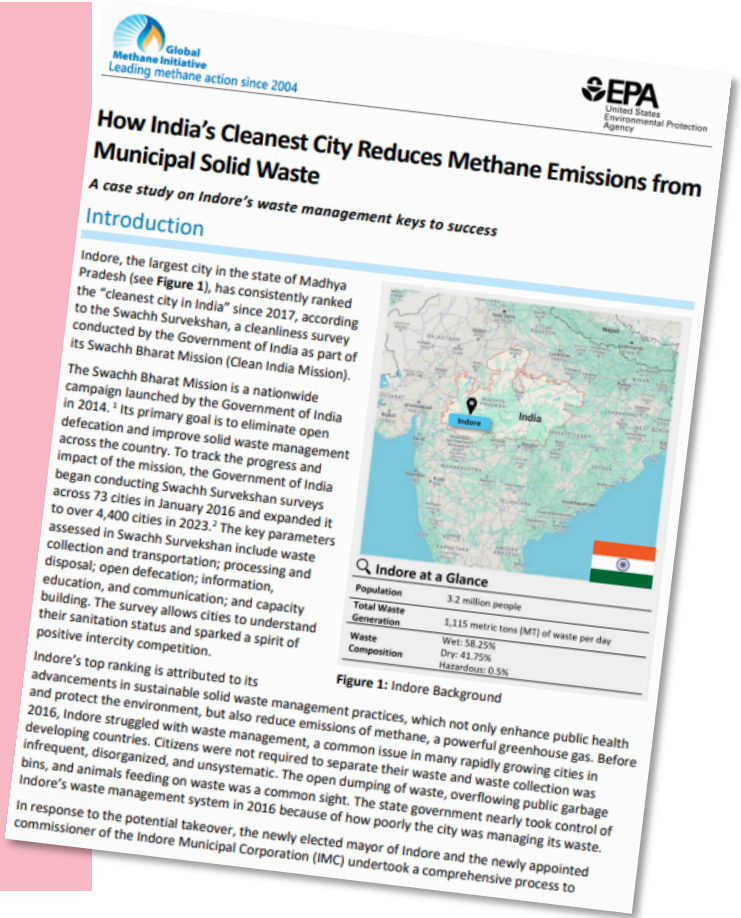
Operational Cost Coverage: Operational expenses were supported through collection fees, fines for noncompliance, and sale of waste management by-products.

Public-Private Partnership Model: Engaged public-private partnerships to share risks, optimize resources, and enhance overall financial sustainability in operations.

New! GMI Case Study on Indore

Available at:
https://globalmethane.org/resources/details.aspx?resourceid=5412

Generation and Segregation	Collection and Transportation	Processing and Treatment	Final Disposal
Old waste management system (pre-2016)			
Waste was mixed at the point of generation	**Infrequent waste collection**. Collection trucks **did not have separate chambers** for different waste materials	Mixed waste was transported to central waste bins. Some wet waste was treated at a **composting facility**	Mixed waste from central waste bins was **dumped in an open dumpsite**
New waste management system (adopted 2017)			
Wet, dry, hazardous, and e-waste from households and bulk waste generators are **segregated** at the point of generation	Segregated waste collected door-to-door in **trucks with separate chambers** for each waste category. Trucks move along **optimized routes monitored by command center**	Dry waste sorted at **material recovery facilities**, wet waste converted to clean energy at **bio-CNG plant**, hazardous waste incinerated at **hazardous waste treatment facility**	Inert waste is disposed in two **sanitary landfills**



Global Methane Initiative
Leading methane action since 2004

EPA United States Environmental Protection Agency

How India's Cleanest City Reduces Methane Emissions from Municipal Solid Waste

A case study on Indore's waste management keys to success

Introduction

Indore, the largest city in the state of Madhya Pradesh (see **Figure 1**), has consistently ranked the "cleanest city in India" since 2017, according to the Swachh Survekshan, a cleanliness survey conducted by the Government of India as part of its Swachh Bharat Mission (Clean India Mission).

The Swachh Bharat Mission is a nationwide campaign launched by the Government of India in 2014.[1] Its primary goal is to eliminate open defecation and improve solid waste management across the country. To track the progress and impact of the mission, the Government of India began conducting Swachh Survekshan surveys across 73 cities in January 2016 and expanded it to over 4,400 cities in 2023.[2] The key parameters assessed in Swachh Survekshan include waste collection and transportation; processing and disposal; open defecation; information, education, and communication; and capacity building. The survey allows cities to understand their sanitation status and sparked a spirit of positive intercity competition.

Indore's top ranking is attributed to its advancements in sustainable solid waste management practices, which not only enhance public health and protect the environment, but also reduce emissions of methane, a powerful greenhouse gas. Before 2016, Indore struggled with waste management, a common issue in many rapidly growing cities in developing countries. Citizens were not required to separate their waste and waste collection was infrequent, disorganized, and unsystematic. The open dumping of waste, overflowing public garbage bins, and animals feeding on waste was a common sight. The state government nearly took control of Indore's waste management system in 2016 because of how poorly the city was managing its waste.

In response to the potential takeover, the newly elected mayor of Indore and the newly appointed commissioner of the Indore Municipal Corporation (IMC) undertook a comprehensive process to

Indore at a Glance

Population	3.2 million people
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Figure 1: Indore Background

Questions?

References

- Dickella Gamaralalage, P. J., Ghosh, S. K., & Onogawa, K. (2022). Source separation in municipal solid waste management: Practical means to its success in Asian cities. *Waste Management & Research*, *40*(3), 360-370.

- Asian Development Bank, Hobson, M., & Javed, N. (2022). Solid Waste Management Sector In Pakistan: A Reform Road Map For Policy Makers. In Solid Waste Management Sector in Pakistan. Asian Development Bank. https://www.adb.org/sites/default/files/publication/784421/solid-waste-management-pakistan-road-map.pdf

- Zimmerman, K. & U.S. Environmental Protection Agency. (2024). Waste Characterization Handbook: Understanding Municipal Waste Streams to Develop Data-Driven Methane Mitigation Strategies. https://www.globalmethane.org/documents/Day%201%201750%20(161)%20GMI%20Waste%20Characterization%20ISWA%20Final.pdf

Thank You!

Please reach out with any questions to: biogastoolkit@epa.gov

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