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Toward Triple Benefits for Air, Climate, and Land in Ulaanbaatar: A Hybrid Waste Treatment System Optimized by Composition Data

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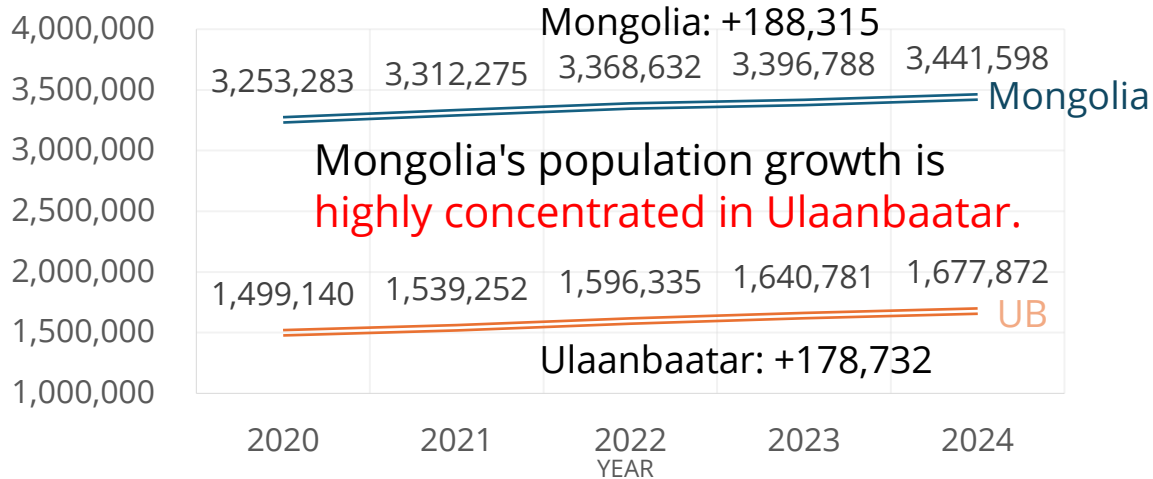
Consultant, EXRI (EX Research Institute, Ltd.)

Day 1 1530–1700 Financing Modalities for Clean Air
MR-F, LEVEL 1, UNCC

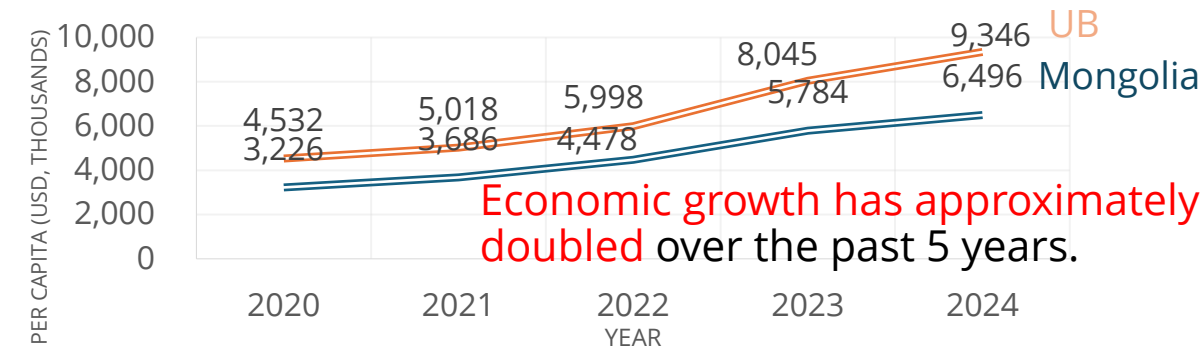


1-1 Background

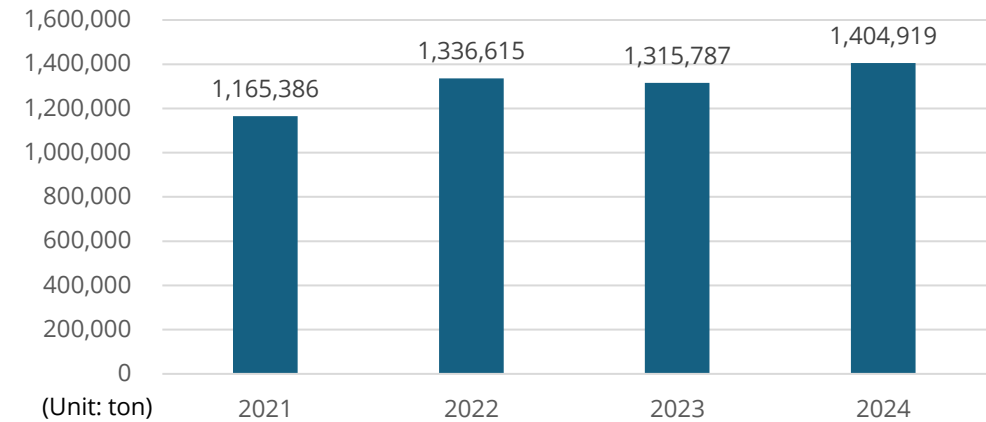
Rapid Increase in Waste Disposal



Source: National Statistics Office of Mongolia
FIG.1 POPULATION



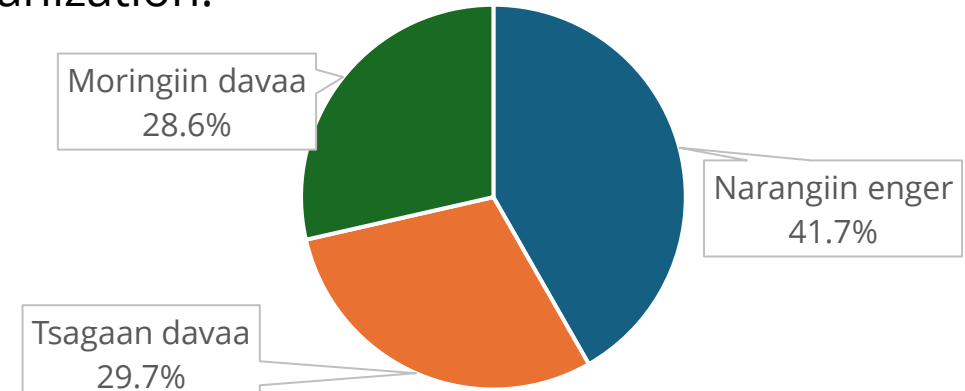
*Converted using real exchange rate (2025)
Source: National Statistics Office of Mongolia
FIG.2 GDP PER CAPITA (USD)



Source: Data provided by the Ulaanbaatar City Landscaping and Cleaning Service Department (January 2026); processed by the author.

Fig.3 Amount of Waste Disposal

- ✓ **Surging Waste volume: Final disposal volume grew 1.2 times** (2021-2024) driven by economic growth and urbanization.



Source: Data provided by the Ulaanbaatar City Landscaping and Cleaning Service Department (January 2026); processed by the author.

Fig.4 Proportion of Waste Disposed at Each Landfill (2024)

- ✓ **Over-reliance on Landfills:** 42% of waste goes to Narangiin Enger, which is facing imminent closure.
- ✓ **Urgent Need:** An urgent overhaul of the entire waste management system, from collection to disposal, is critical.



1-2 Background

Air Pollution and Surging Methane Emissions

1) Air Pollution: Driven by Coal Heating in Ger Districts

Heavy Coal Reliance: Coal accounts for 96% of national fuel consumption, causing severe air pollution.

Largest GHG Source: The energy sector (incl. heating) emits 45% (19.29M t-CO₂e) of national GHGs.

2) Climate Change: Methane Emissions from Existing Landfills

High Warming Potential: CH₄ is the 2nd largest GHG, comprising 34% of national emissions.

* CH₄ has a GWP over 21 times that of CO₂.

Landfills as Primary Source: Generate CH₄ accounting for 62% of the waste sector's emissions.

Flawed Management: Anaerobic conditions from open dumping and simple soil covering—lacking semi-aerobic systems (e.g., Fukuoka Method)—trigger massive CH₄ generation.

Source: Adapted by the author based on Mongolia's Fourth National Communication (NC4)

2. Project Objective

Propose an **"Integrated Waste Management System"** based on scientific data for Triple Benefits.

Targeted Environmental Issues & Actions:

1) **Air Pollution:** Driven by winter coal heating in Ger districts.

Action: Supply WtE exhaust heat to district heating, **reducing coal reliance**.

2) **Climate Change:** Potent methane emissions from existing landfills.

Action: **Minimize landfill volume and replace fossil fuels** with WtE (Waste to Energy).

3) **Land Degradation:** Destruction of soil and vegetation from scattered landfill waste ("White Pollution").

Action: **Conserve urban ecosystems** by minimizing the environmental burden from the landfills.

3. Survey Methodology

Waste Composition Survey

- **Survey Period:**
 - First: Oct. 6 – 12, 2025 (7 days)
 - Second: Nov. 28 – Dec. 4, 2025 (7 days)
- **Location:** Narangiin Enger Landfill
- **Activity:** Waste Composition Survey
- **Number of Samples:** 24 (each)



Fig.5 Landfill Location Map in UB



4. Survey Results

- **Apartment Districts:** High proportion of paper and plastics; high calorific value makes it an excellent energy source.
- **Ger Districts (Severe Winter):** 74% consists of coal ash, making it unsuitable for incineration.

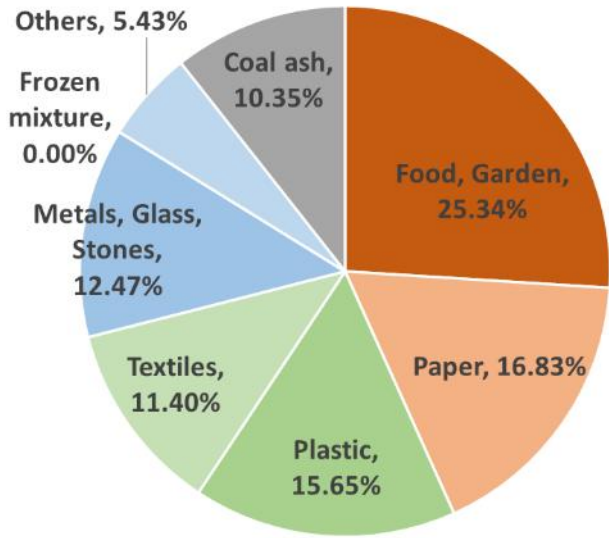


Fig.6 Waste Composition Ratio (Oct 2025)

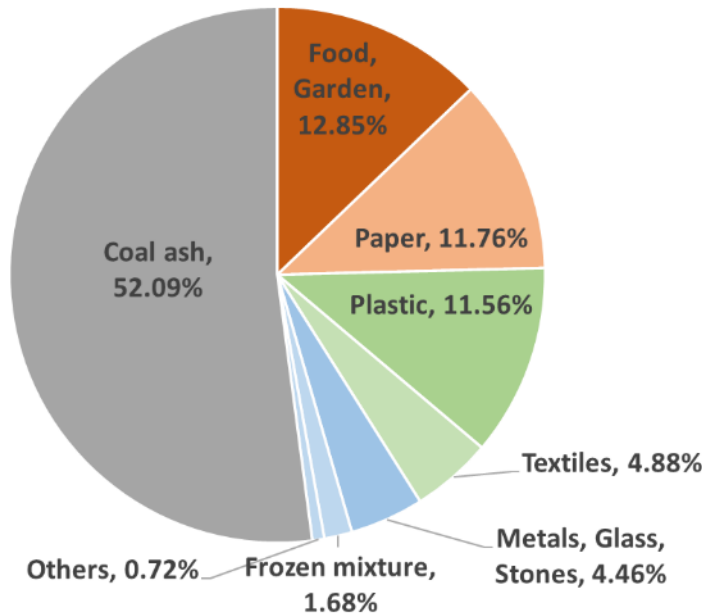


Fig.7 Waste Composition Ratio (Dec 2025)

Table1 Composition Ratio by Residential Area

Category	UB	Apartment	<u>Ger</u>
Food, Garden	12.85%	(31.08%)	(4.79%)
Paper	11.76%	(27.08%)	(4.99%)
Plastic	11.56%	(22.16%)	(6.88%)
Textiles	4.88%	(6.01%)	(4.39%)
Metals, Glass, Stones	4.46%	(7.38%)	(3.17%)
Frozen mixture	1.68%	(2.72%)	(1.23%)
Others	0.72%	(1.82%)	(0.24%)
<u>Coal ash</u>	52.09%	(1.76%)	(74.32%)

*Lower Heating Value (LHV): Under analysis.

*Results are weighted averages.



5. Conclusion: Toward an Integrated Waste Management System

The Need for a Hybrid Treatment System

- **Beyond a Single Solution:** No single "silver bullet." We must design **an optimal "Best Mix" of facilities based on empirical data** and regional characteristics.
- **Strategic Combination:** Shift from simple mass-burning to a planned combination of facilities with necessary quality and scale.
- **Example Strategy by District:**
 - **Apartment Areas:** Primary source for WtE (heat recovery).
 - **Ger Areas (Especially in Winter):** Directed to sanitary landfilling or ash recycling.

- **Candidate Facilities:** MRF (Material Recovery Facilities), Plastic Recycling, Biogas, WtE, Semi-aerobic Landfill, Ash Recycling, E-waste, CDW (Construction and Demolition Waste) Treatment, etc.



6. Expected Impact: "Triple Benefits" for a Better Future

(1) Air Quality (Decarbonization)

- WtE heat supply to District Heating directly substitutes coal stoves in Ger districts.
- High-calorie sorted waste (excluding coal ash) ensures stable heat supply.

(2) Climate Change (Double GHG reduction)

- Incineration significantly reduces potent methane currently generated by landfills.
- Replaces fossil fuel (coal) energy with waste-derived energy.
- Quantifying these GHG reductions and monetizing them as **JCM credits** for sustainability.

(3) Land & Society (Ecosystem Protection)

- Minimizing landfill volume prevents the unchecked site expansion.
- Proper management halts plastic scattering ("White Pollution"), protecting soil and vegetation.

7. Way Forward: Introducing High-Efficiency WtE via the JCM

1. Benefits of the JCM Scheme (GHG Reduction & Profitability)

- Enhances the feasibility of high-efficiency WtE, contributing to Mongolia's NDC.
- Financial Support:** Provides CAPEX subsidies and potential O&M revenue via JCM credits.

2. Policy Decisions Based on Reliable Waste Data

- Strict Requirements:** For MRV (Measurement, Reporting, and Verification), regular surveys for reliable waste data (composition, LHV) are essential.
- Strategic Recycling:** Need policies to ensure WtE receives "appropriate waste," eliminating auxiliary fossil fuels.

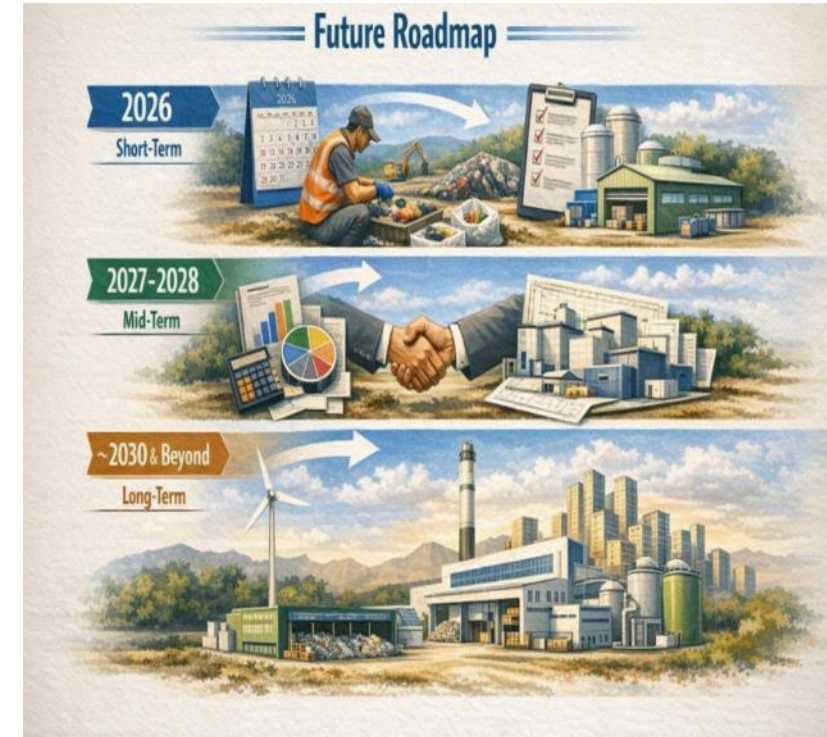
8. Future Roadmap and Recommendations for Clean Air & Blue Sky

1. Short-Term Action (2026): Summer Surveys & Detailed FS

- **Conduct summer waste composition surveys** to understand year-round fluctuations.
- Advance business feasibility (FS) verification for the integrated facility plan.

2. Medium-to-Long-Term Action (~2030): Master Plan & Frameworks

- **Position the integrated system within the city's Master Plan** for a systematic approach.
- Design financial mechanisms: apply WtE to FIT (Feed-in Tariffs), set appropriate tipping fees, and establish a robust recycling system.



BAQ 2026

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Thank you (Arigatou)

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