



ADB Waste Analytical Resource Planning Scenarios (WARPS) Tool

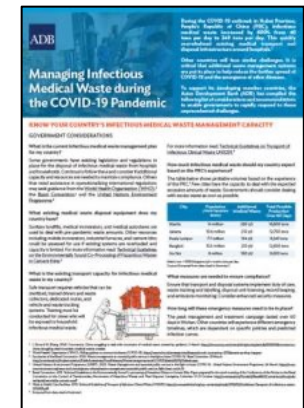
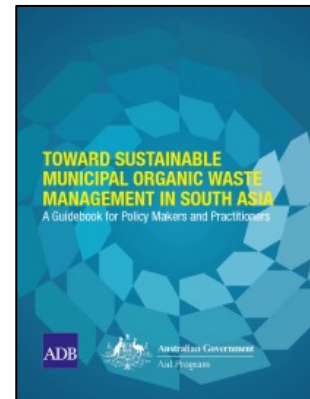
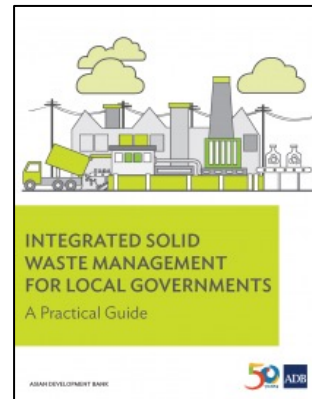
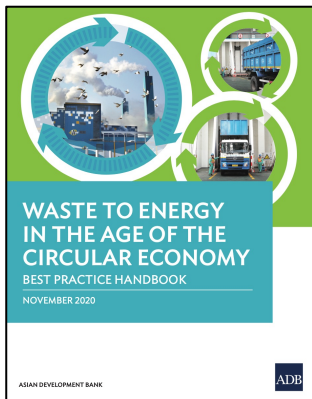
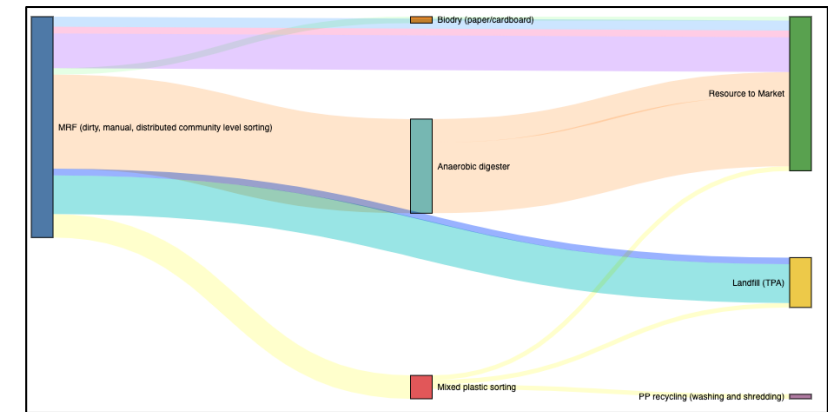
- Piya Kerdlap, ADB Consultant - Circular Economy Modelling Specialist
- Steve Peters, Senior Energy Specialist (Waste to Energy), Energy Sector Group, Sustainable Development and Climate Change Division, Asian Development Bank

1. **Wide range of factors** that need to be considered in waste management planning (e.g. waste volume, type, quality, facility capacity, material and energy recovery rates, capital expenses, operation expenses, waste collection fees, subsidies, environmental pollutants, etc.).
2. **Need to measure** environmental, financial, economic, and social performance indicators so that decision-makers can choose which waste management system is best suited for their region.
3. **Lack of technical expertise** among policy makers and planners in developing countries in Asia to design complex waste management systems and holistically compare each option against a common baseline.

ADB Waste Analytical Resource Planning Scenarios Tool

1. Developed a Microsoft Excel-based tool (Beta product) that measures the environmental, financial, economic, and social performance of waste management systems and produces a Sankey diagram.
2. The tool allows decision makers to compare waste management systems with a common baseline
3. The tool is not meant to replace a full feasibility study. Rather, it provides policy makers and planner a means of taking a first-cut look at a variety of what-if scenarios for managing waste at different scales.
4. The tool applies knowledge captured in ADB publications regarding holistic responses to waste management challenges which include:

Sankey diagram



Funded by the Australia ASEAN Smart Cities Program from the Australian Department of Foreign Affairs and Trade

ADB WARPS Tool Performance Indicators

Financial indicators

- Capital expenses (year zero)
- Annual operation expenses
- Annual revenue
- Annual profit/loss

Economic indicators

- Company economic benefits (USD/year)
- Individual economic benefits (USD/year)
- Employment creation (Number of jobs)
- Corporate income tax (USD/year)
- Individual income tax (USD/year)
- Carbon tax (USD/year)
- Pollution tax (USD/year)
- Government tax revenue (USD/year)

Environmental indicators

- Greenhouse gas emissions
- Nitrous oxide emissions
- Sulfur oxides emissions
- Particulate matter
- Unintentional persistent organic pollutants (uPOPs):

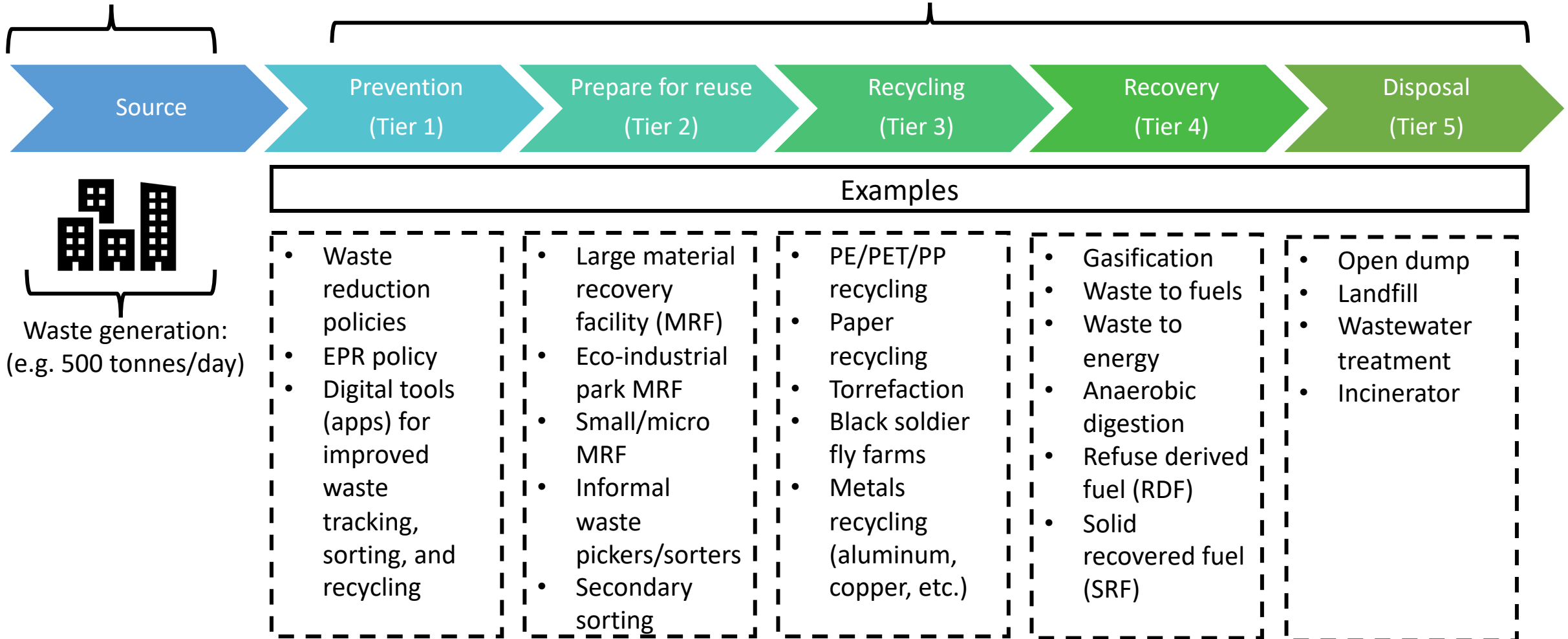
Social indicators

- Access to waste collection services
- Employment opportunities for women
- Formal versus informal employment
- Disability adjusted life years (DALYs)

Waste Management System Processes

Activities that change the volume and composition of waste generated

Tiers in Waste Management Hierarchy



Demonstration of Tool (Beta version)

Asian Development Bank Waste Analytical Resource Planning Scenarios Tool (ADB WARPS Tool)

Introduction and Background

Enabling a circular economy requires strategic planning of waste management systems. Such systems should provide environmental, economic, and social benefits, but can be very complex due to the various types of waste streams and options for managing waste at different stages. The Asian Development Bank has developed this excel-based tool to compare potential waste management systems and measure their environment, financial, economic, and social performance. The tool provides users with a means of taking a first-cut look at a variety of what-if scenarios for managing waste at different scales.

Purpose of Tool

ASSIST
policy makers plan out pathways for managing different types of wastes.

EXPLORE
the effects of prices and policies on waste management systems.

QUANTIFY
environmental, economic, financial, and social performance to inform what aspects a future full feasibility study could focus on.

Tool Structure and User Guide

Step 1: Create waste profile	→
Step 2: Select agents to design system	→
Step 3: Set policy and price conditions	→
Step 4: View results	→

Color Coding

Values that users can vary.

Values that should be kept fixed.

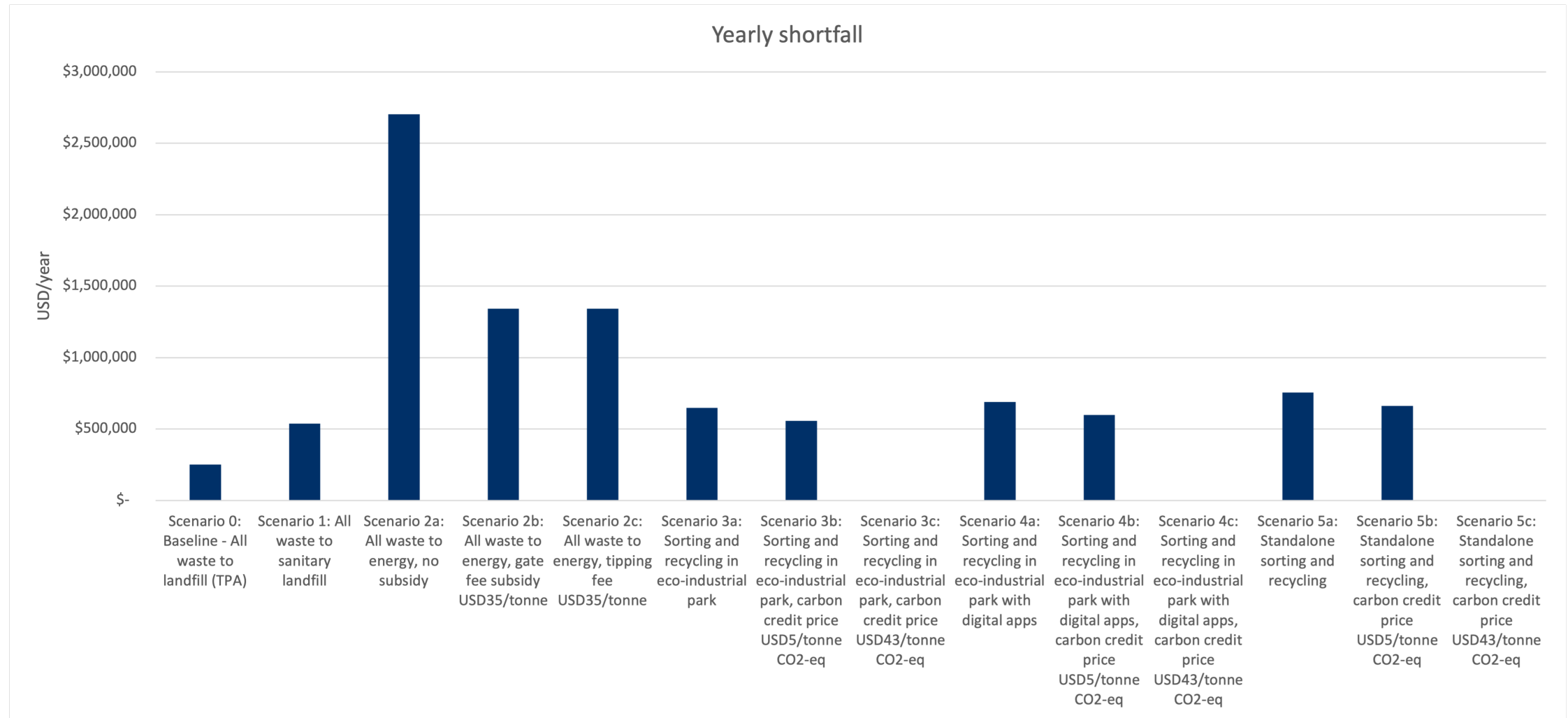
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Case Study Scenarios

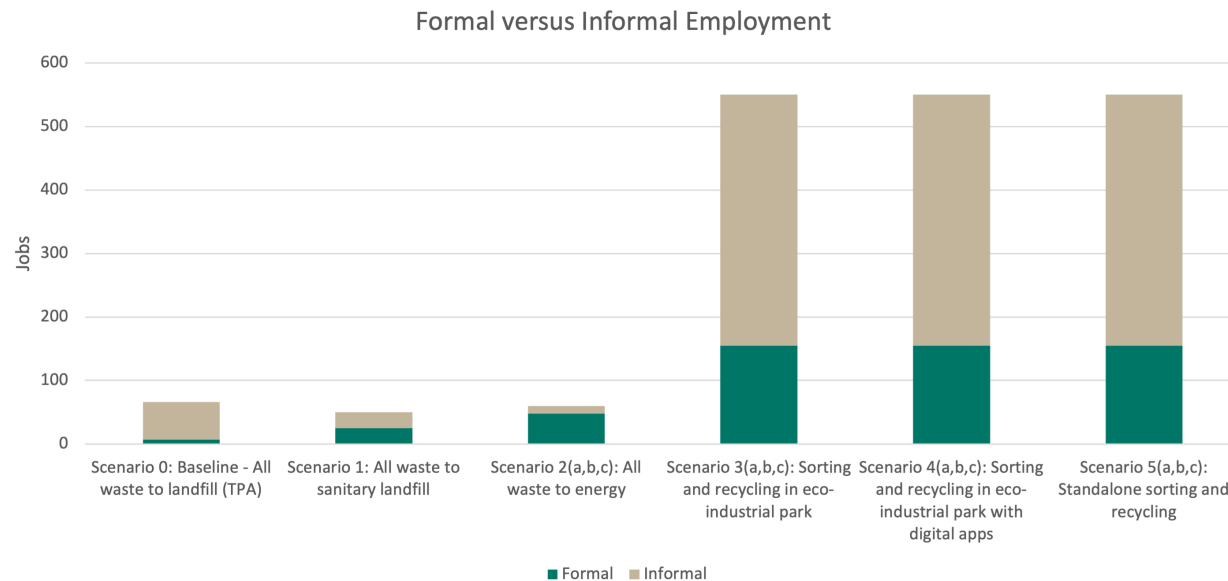
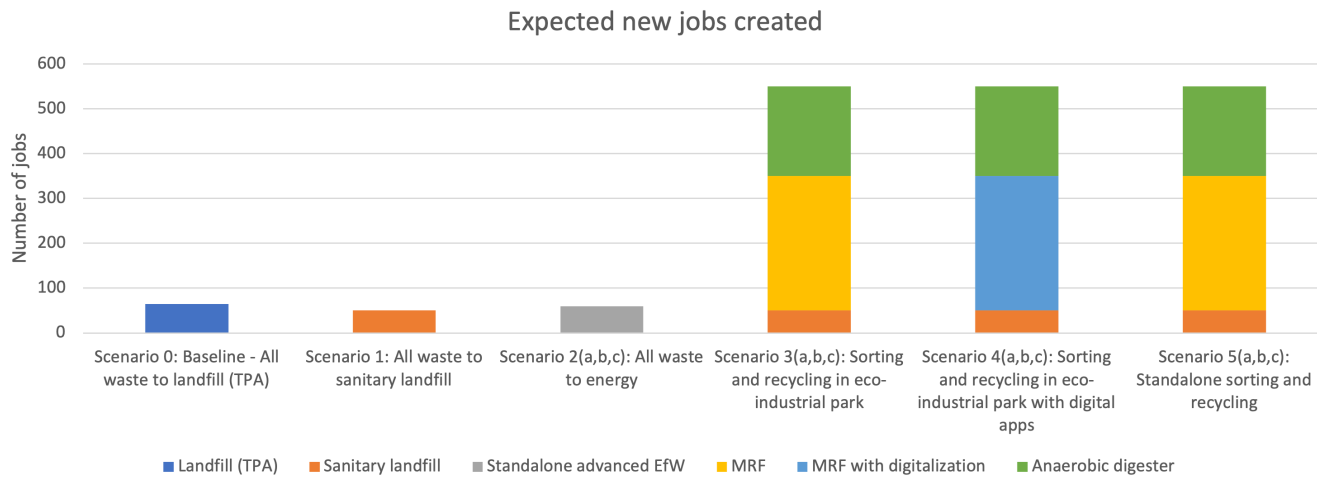
- Carried out a case study to test the tool and demonstrate its capabilities
- The case study measures the impacts to the economy (subsidy requirements, jobs created) and the environment (emissions of greenhouse gases (GHGs), nitrogen oxides (NOx), sulfur oxides (SOx), particulate matter, and unintentionally produced persistent organic pollutants (uPOPs)), as well as the social benefits different waste management scenarios.
- Each scenario was designed to test out different types of waste management systems that could be considered and how certain policies could affect their performance.
- Each scenario is unique based on the technologies deployed, policies, and financial support.

Scenario 0:	Scenario 1:	Scenario 2:	Scenario 3:	Scenario 4:	Scenario 5:
Baseline – All waste to non-sanitary landfill	All waste to sanitary landfill	All waste to energy	Sorting and recycling in eco-industrial park	Sorting and recycling in eco-industrial park with digital apps	Standalone sorting and recycling
Represents the existing system used to manage waste	Creation of a new sanitary landfill	Waste to energy facility that generates electricity that is sold back to the grid	Sorting & recycling facilities, non-recoverable waste being sent to a sanitary landfill	Same as scenario 3, but includes digital apps that improve segregation of waste at the source	Same as scenario 3, but not in an eco-industrial park

High-level Results of Case Study (1/3)

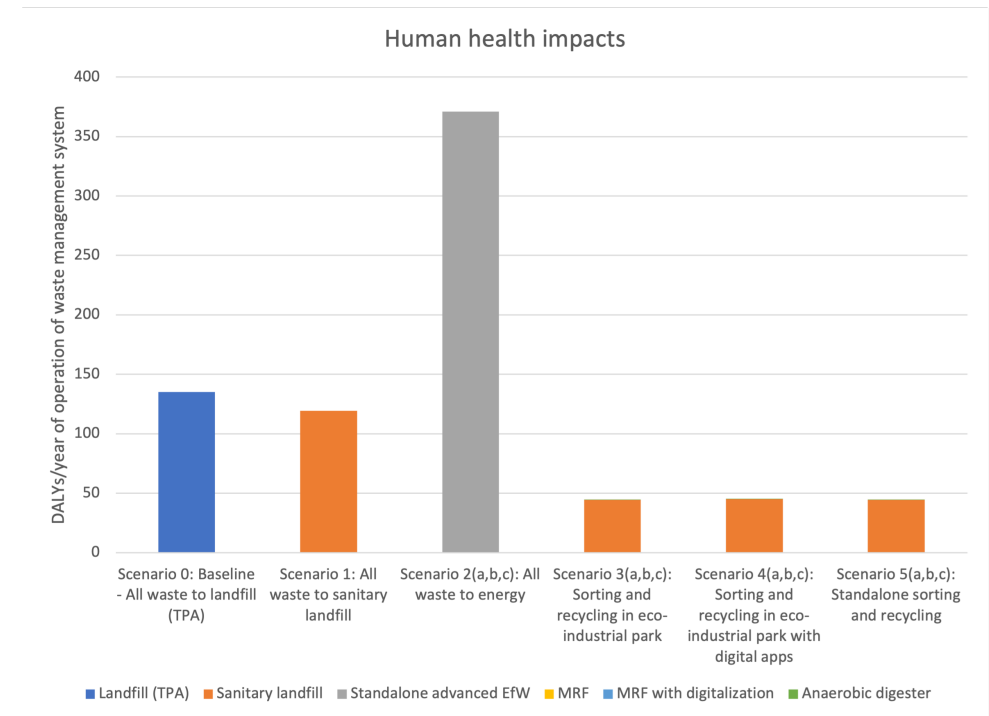
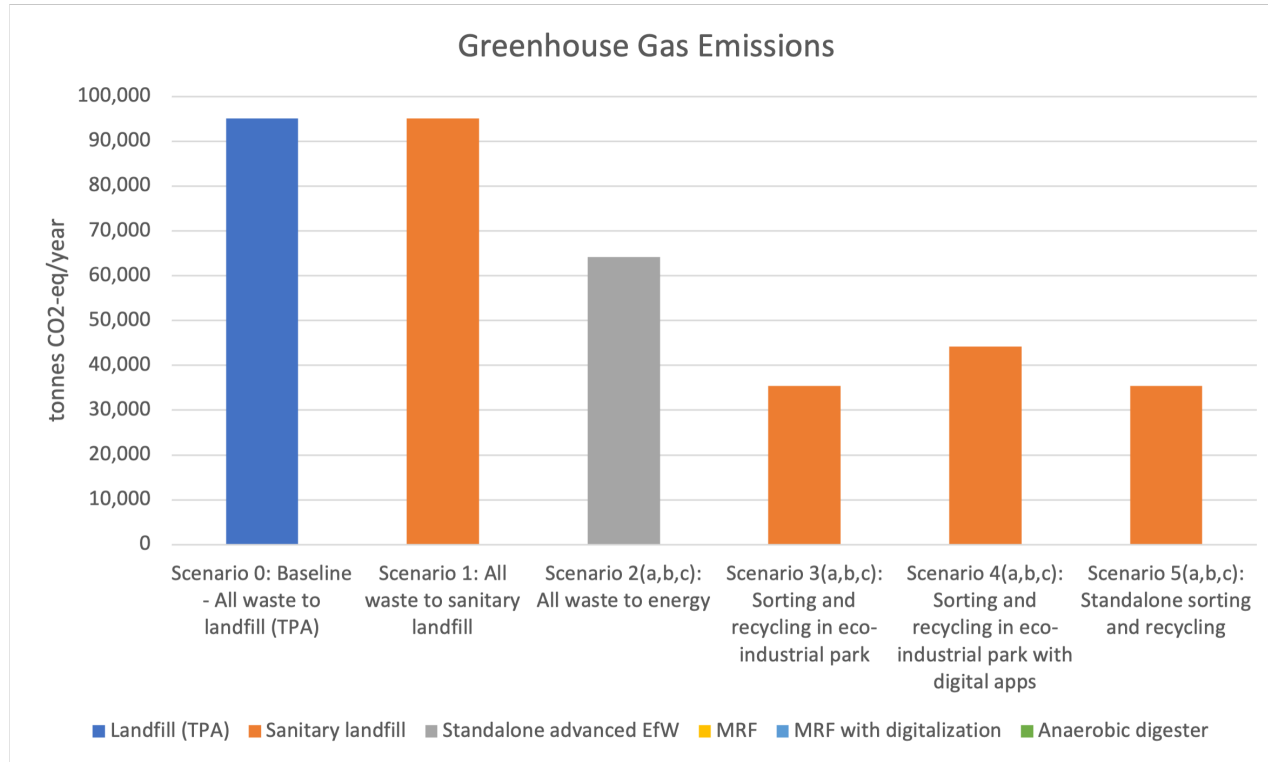


High-level Results of Case Study (2/3)



- In terms of social benefits, the sorting and recycling scenarios (scenario groups 3, 4, 5) showed the best performance.
- Formal versus informal employment: Scenario groups 3, 4, and 5 had the highest share of formal employment because the MRF and anaerobic digester in each scenario can provide 300 and 200 jobs respectively and at least 10% of the jobs at the MRF are expected to be formal roles and 50% of the jobs at the anaerobic digester are expected to be formal.
- The current landfill (TPA) had the highest share of informal jobs because only 10% of the current jobs are formal.

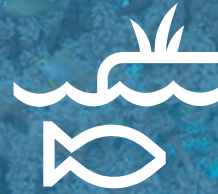
High-level Results of Case Study (3/3)



- The sorting and recycling scenarios (scenario groups 3, 4, 5) had the lowest GHG emissions because the MRF and anaerobic digester do not emit GHGs.
- The waste to energy system (scenario group 2) had the highest human health impacts due to a combination of having the highest emissions of particulate matter and NO_x.
- The sorting and recycling scenarios had the lowest impacts to human health because they had lower emissions of pollutants already.

Summary of ADB WARPS Tool (Beta version)

- 1. Simple interface for users with limited waste technical expertise:** Users can enter a waste profile, select the type of technology they want to use to deal with the waste streams, and modify policy and price conditions. The tool automates calculation of waste flows between different processes and generates economic and environmental results that can be used by decision-makers such as policy makers and planners.
- 2. Multi-level analysis:** The results sheet presents the total system-level environmental, financial, economic, and social performance results and breaks down the results according to the type of agents (e.g. sorting, recycling, waste-to-energy) selected. This allows the user to see how much each agent contributes to the performance of the entire waste management system.
- 3. Advanced software not required:** The tool functions fully on Microsoft Excel, which is common office software that is easily accessible. To use the tool, all the user needs to do is download the Excel spreadsheet file.



Waste, Energy & Ocean Nexus

Thank You for Your Kind Attention

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ADB Project Officer: Stephen Peters (speters@adb.org)