



APPENDIX

Waste Management





1 The Overall Waste Situation in Italy

The 2023 ISPRA Report on Urban Waste highlights that, in 2021, **national urban waste production** in Italy reached 495 kg of waste per inhabitant per year, performing slightly better than the European average.

Waste disposal in landfills in Italy is also just slightly better than the European average, standing at **21%**. However, this is not enough, as the top-performing countries, Belgium and Finland, do not use landfills at all, followed by Germany, the Netherlands, Denmark, and Sweden, where landfill use is minimal.

Finally, the **recycling rate for urban waste** - a key Eurostat indicator for measuring the progress of circular economy policies - was **51.9%** in 2021, leaving substantial room for improvement, especially when compared to Germany's **67%**.

2 Regulations and Investments in Italy

- **ARERA** has published the Strategic Framework, a document outlining the **strategic guidelines** that will direct **regulatory actions** for the period 2022-25. For waste management, it defines the objective as "Promoting the development of adequate infrastructure for waste cycle management";
- the **Ministry of Environment and Energy Security (MASE)**, through the National Waste Management Program (PNGR), aims to **improve the efficiency** and sustainability of waste management by strengthening infrastructure for separate collection, including modernizing or building new waste treatment facilities;
- the **National Recovery and Resilience Plan (PNRR)** has allocated **€2.6 billion** to the Waste sector, with specific investment lines to support the creation of new facilities and the modernization of existing plants. This aims to enhance and automate the urban waste separate collection network as well as the collection, logistics, and recycling of waste (WEEE, paper/cardboard, plastic waste, and textile fractions).

3 Challenges in Urban Waste Management

Regarding urban waste collection management (PNRR – M2C1 Investment 1.1), the objectives outlined by the MASE Decree include:

- investments aimed at bridging infrastructure gaps and improving waste management through **mechanized separate collection** and the establishment of additional waste treatment facilities. These improvements also seek to **reduce the number of European infringements** open against Italy and address significant regional disparities in separate collection rates;
- by 2025, **recycled waste must account for at least 55%** of total waste produced; this target rises to **60% by 2030** and **65% by 2035**. Additionally, these targets include a landfill restriction: by 2035, only **10% of total waste produced may be disposed of in landfills**;
- particular emphasis is also placed on the digitization and innovation of processes, specifically to enhance separate collection and digital monitoring.



Examples of the planned initiatives include, but are not limited to:

- **Smart structures:** roadside containers, underground recycling stations to optimize collection using controlled-access bins, where openings allow user identification. Volume sensors with alarms for predefined limits can be installed in containers and street bins;
- **Equipment to diversify separate collection streams:** additional waste streams to generate greater added value from the extended producer responsibility systems;
- **Hardware and software tools for IoT applications** in various management areas, such as pay-as-you-throw systems, geolocation, data transmission through georeferenced platforms, and fleet management models for vehicles. Automated systems for distributing consumables to users for separate collection;
- **Collection centers** as per DM 8/4/08 to optimize separate collection. These equipped, fenced, and monitored facilities allow users to dispose of items not compatible with regular collection circuits (e.g., bulky items, WEEE, hazardous materials);
- **Facilities for reusing discarded:** alongside collection centers, these facilities intercept and circulate reusable items through distribution points.





Our Approach

A Composable Platform for Waste Lifecycle Management

Achieving the goals and measures set at the national level requires a system capable of meeting various objectives:

- the ability to support the energy production process with a data-driven approach and incentive mechanisms for Community members;
- an overall governance of the consumer-prosumer ecosystem that provides feedback to stakeholders, highlighting outcomes in terms of service quality and operational efficiency.

To support the management of infrastructure impacted by PNRR investment lines in Heating, Water, Power & Gas, and Waste sectors, we at Engineering have developed the **Neta Open Platform**.

This is Engineering's answer for managing **digital ecosystems** with both company assets and established and emerging market technologies, focusing on delivering value based on our Clients' business needs across different market sectors.

What is it?

Urban Waste Management Platform (UWMP)

UWMP is Engineering's vertical solution for managing waste infrastructure and services impacted by various PNRR investment lines.

Our platform is built on the principle that optimal management requires a governance system to support and guide the entire digital ecosystem.

The Urban Waste Management Platform is centered on the offerings of the Engineering Group but also integrates solutions from other partners.

Among Engineering's solutions is the **Neta Waste** module of the Neta Open Suite, which enables the billing of the pay-as-you-throw waste management tariff, in addition to managing the estimated tariff. This module integrates processes across CRM, material delivery, waste collection, and on-demand services.

Measurement criteria are applied to influence public behavior, encouraging responsibility and more mindful waste practices.

Effective separate collection requires a unified, reliable data management system shared across company departments, covering information such as:

- distributed collection materials;
- detailed records of collected and disposed waste;
- linking of measurements to specific supplies for billing, including allocation in the case of shared containers or aggregated user accounts;
- monitoring compliance and detecting violations.

Certified collection data forms the basis of the billing system, allowing the calculation of pay-as-you-throw tariffs for all waste fractions, considering that multiple collection systems often coexist in the same urban area. This approach ensures:

- process and activity automation;
- improved back-office efficiency, such as eliminating data reprocessing and reducing data entry tasks;

- increased resources for monitoring and supervising;
- effective service monitoring;
- enhanced transparency, thus improving citizens' perceived service quality.

With a **data-driven approach** and an integration architecture leveraging data, the platform establishes a **Governance** level, a **Decision Support System** that use data and AI to provide a single access point for monitoring key metrics in terms of:

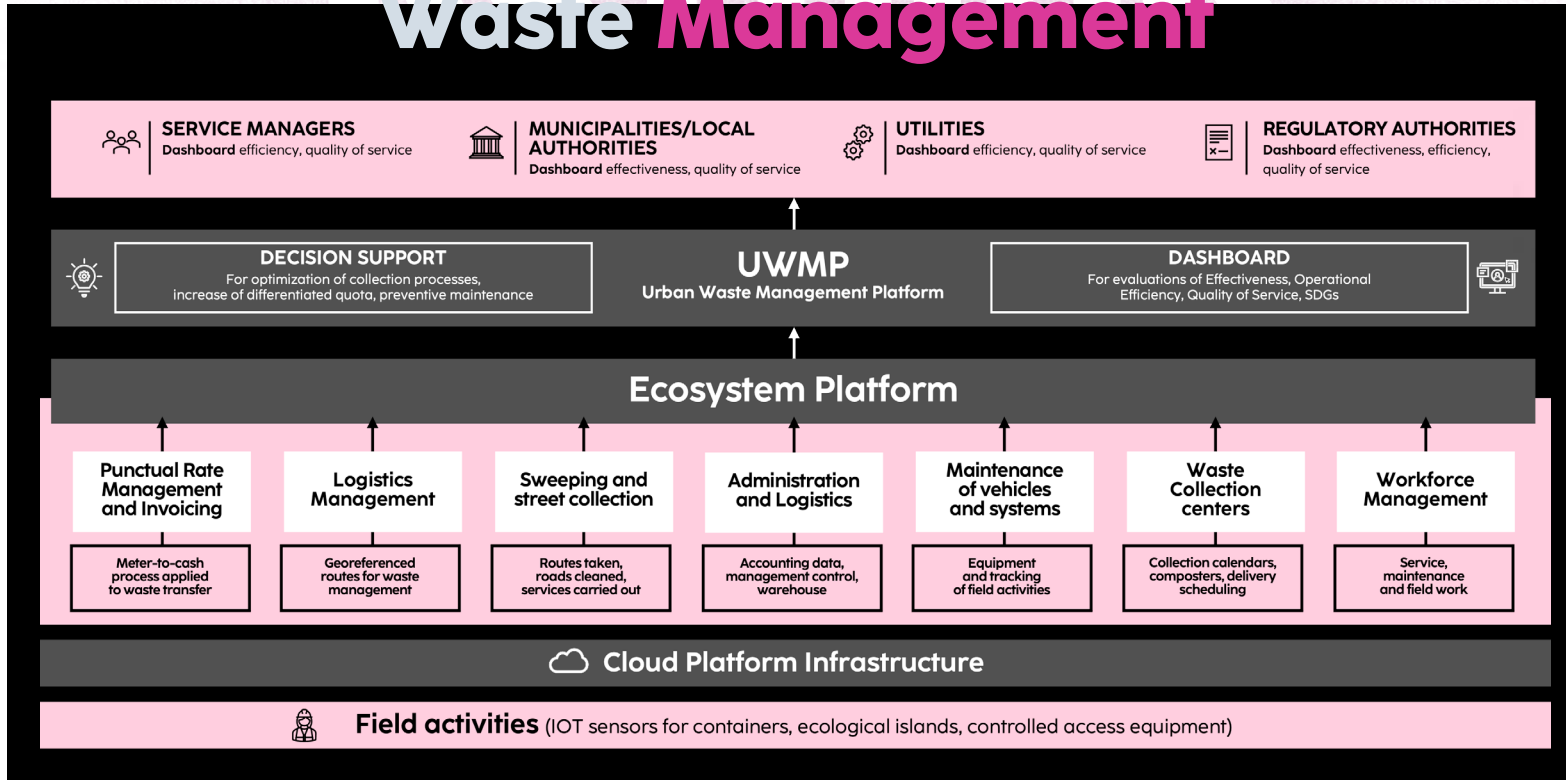
- **Operational Efficiency:** reducing travel distances based on actual bin-emptying needs, and real-time monitoring of vehicles and personnel;
- **Effectiveness:** measuring progress toward business goals, like reducing environmental impact, increasing transparency and minimizing waste volumes;
- **Service Quality:** enhancing service quality through measurable collection metrics, reliable service, and effective communication for managing changes like schedule adjustments.





ReThink Waste Management

ReThink Waste Management





What does it do?

Managing the pay-as-you-throw tariff (PAYT)

The **Neta Waste** module allows you to manage:

- **dedicated records** for all types of materials used in waste collection and disposal;
- activation and transfer processes integrated with the delivery of collection materials (in-person pickup, collection vouchers, home delivery);
- **CRM** processes for container maintenance, emptying disputes, delivery, retrieval, and replacement of containers;
- acquisition and reconciliation of **emptied containers** and waste deposits, including management of unreconciled measurements and orphan containers;
- accurate **pay-as-you-throw** billing.



Governance e Decision Support System

In addition to the crucial, well-documented acquisition of waste deposit data for pay-as-you-throw tariff application, UWMP's ecosystem approach can **gather field data through IoT devices** (e.g., roadside containers, controlled-access recycling stations, equipment for diversified collection).

It is also capable of acquiring **information from other systems** managing digital ecosystem business processes, such as:

- **vehicles logistics management:** tracking routes used to handle deposits from georeferenced containers on a map, aiding in planning collection rounds;
- **street sweeping and roadside collection management:** information on completed routes, streets cleaned per route, completed services, emptied containers, and data on illegal dumps

and ad hoc disposals;

- **administration and logistics management:** administrative data in general and analytical accounting for management control, and logistics data (procurement and warehousing) relevant to enriching the M2C process;
- **vehicles and facilities maintenance:** equipment management and tracking of field activities, with cost tracking, usage statistics, and maintenance monitoring;
- **collection centers management:** information on schedules, collection from containers (including smart bins), composting stations, transfer stations, and planning of deliveries to collection centers.

The ecosystemic approach of UWMP is also able to **enhance the information assets** by integrating data and supporting the governance level with a cohesive set of

dashboards to aid stakeholders in achieving objectives of:

- **effectiveness:** minimizing environmental impact (reducing emissions, increasing waste sorting), promoting sustainability (establishing practices that foster sustainability across the entire value chain), and evaluating performance and business KPIs through near real-time dashboards;
- **efficiency:** optimizing resources (logistics for collection routes, vehicles, and personnel) to reduce travel times, fuel consumption, and staff time & materials, while ensuring efficient maintenance to reduce breakdowns and inefficiencies across the entire process;
- **service quality:** ensuring punctuality and reliability of services, raising awareness about waste sorting, implementing a "pay for what you consume" model, and maintaining cleanliness and upkeep of urban areas to respond more effectively to reported issues.





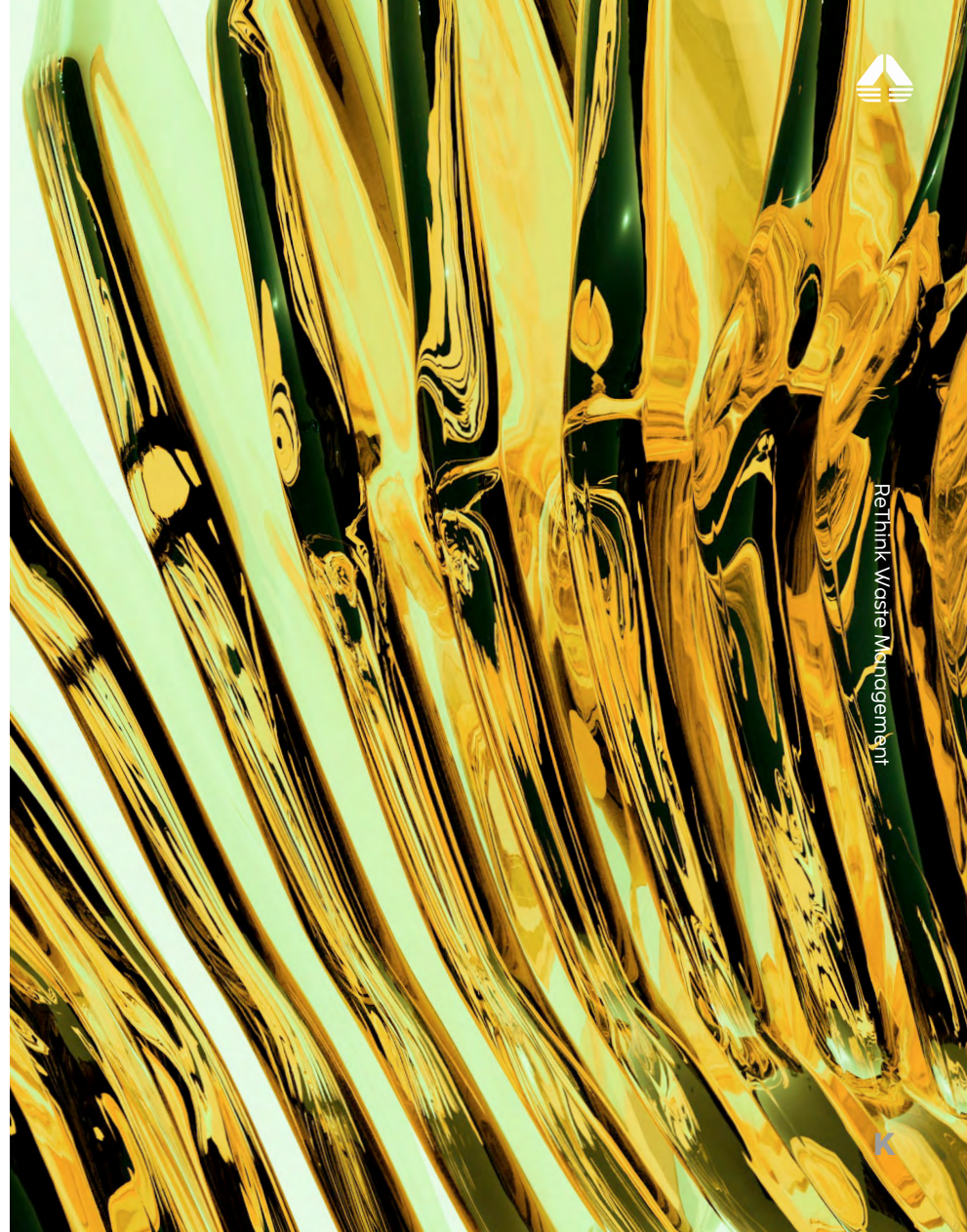
What value for stakeholders?

Various stakeholders benefit from the waste management activities and the outcomes achieved through governance over renewable energy-related initiatives:

- **Municipal Administrations:** responsible for public hygiene, TARI fees, and enhancing service quality and reliability, through transparent communication, effective credit management, and sustainable development;
- **Service Providers:** oversee the supply chain management of the waste lifecycle or the Integrated Waste Service;
- **Center Managers:** hold responsibility over the infrastructures involved in waste management processes (e.g., recycling islands, collection centers, fleet managers);
- **Control Operators:** entities tasked with verifying proper waste disposal and conducting inspections/audits (e.g., municipal police, ecological control officers);
- **Communities, Institutions, and Local Areas:** citizens, associations, and local entities actively engaged in preserving the territory, fostering value creation, and encouraging collaboration, while promoting innovation and ensuring sustainable development through efficient and responsible waste management practices;
- **Regulatory Bodies:** ARERA (Italian Regulatory Authority for Energy, Networks, and Environment) oversees tariff and operational regulations;
- **Government Bodies:** Territorial Competent Entities (TCEs) typically encompass provincial or, in some cases, regional areas, although in Lombardy, each municipality acts as a TCE due to regional governance choices;
- **Future Generations:** schools, universities, and research centers involved in raising awareness about resource efficiency and the social, economic, and environmental sustainability of waste management actions;
- **Service Users (Citizens and Businesses):** essential participants in waste sorting, primary beneficiaries of the collection service, and crucial contributors to promoting sustainable and efficient waste management practices.

The **main benefits** are:

- **Data-Driven Decision Making:** achieved through the analysis of historical data, enabling a predictive approach;
- **Operational Efficiency:** enables optimized routes, dynamic planning by waste volume, and preventive vehicle maintenance;
- **Management Effectiveness:** aims to successfully meet recovery and recycling targets;
- **Informed Management:** effective control and monitoring provide essential tools for optimizing urban waste collection activities;
- **Sustainability and Environmental Impact:** reduction of emissions through optimized routes and preventive maintenance management, and improved waste sorting;
- **Effective Communication and Awareness:** the Decision Support System drives education on green practices through campaigns for citizens and stakeholders.





Why choose us?

The UWMP solution guarantees:

- **End-to-End Coverage** of all operational processes necessary for optimizing waste collection activities, with a focus on IT services;
- **Agile and Timely Response** utilizing a "near real-time" approach to enable rapid, highly effective* action in critical areas, including street cleaning, waste collection, container emptying, and proactive vehicle and equipment maintenance, ensuring optimized service delivery;
- **Process Optimization and Improvements** such as optimized collection routes and enhanced fleet management;
- **Dynamic and Flexible Planning**, allowing services to adapt to actual needs;
- **Proactive and Preventive Management** of emergencies and incidents;
- **Improved Service Quality Perception** by users (citizens), identifying areas for improvement based on analysis of historical data;
- **Data-Based Decision Support**, enhancing the ability to make informed, conscious decisions;
- **Support for Environmental Sustainability** through specific indicators that measure KPIs aligned with the UN's 17 Sustainable Development Goals (SDGs).



Appendices



ReThink Waste Management

Specifically, the solution enables progress towards:

SDG 11: "Make cities and human settlements inclusive, safe, resilient, and sustainable" - Sustainable Cities and Communities:

- percentage of sorted waste in relation to total waste;
- efficiency of collection routes, measurable by CO2 savings.

SDG 12: "Ensure sustainable consumption and production patterns" - Responsible Consumption and Production:

- waste generated per capita;

- percentage of recycled waste in relation to total waste produced.

SDG 13: "Take urgent action to combat climate change and its impacts" - Climate Action:

- reduction of greenhouse gas emissions through operational efficiency in waste management.



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