3

The Contribution of Local Government Organizations and Citizens to the Achievement of SDG 12: A Comparative Analysis of Greece, Italy, Serbia and Moldova

Angelos Papavasileiou[1], Olesea Plotnic[2], Isidora Milošević[3], Maria Menshikova[4], Agisilaos Economou[5] and Roido Mitoula[1]

[1]Department of Economics and Sustainable Development, Harokopio University of Athens, Greece
[2]Faculty of Law, Moldova State University, Republic of Moldova
[3]Technical Faculty in Bor, University of Belgrade, Serbia
[4]Department of Economics, Statistics and Business, Universitas Mercatorum, Italy
[5]National Technical University of Athens, Greece

Email: aggelos.papavassiliou@gmail.com; olesea.plotnic@usm.md; imilosevic@tfbor.bg.ac.rs; maria.menshikova@unimercatorum.it; oikonomouaghs@mail.ntua.gr; mitoula@hua.gr

Abstract

Sustainable Development Goal 12 commits states to responsible consumption and production by 2030, with waste management at its operational core. This chapter investigates how Greece, Italy, Serbia, and Moldova pursue SDG 12 through legislative architectures, infrastructure investments, local government practices, and citizen engagement. The four-country sample captures a gradient of European integration: a mature EU performer (Italy, 50.8% MSW

©The Editors and The Authors 2026.
This chapter has been made available under a Creative Commons Attribution-Non-Commercial 4.0 International License, CC-BY-NC 4.0.

recycling), a lagging EU member (Greece, 17.4%), an EU candidate (Serbia, ~8–10%), and an Eastern Partnership state (Moldova, <5%). Using comparative qualitative policy analysis supplemented by Eurostat, EEA, and national authority data, the study examines how each country translates the Waste Framework Directive and the Circular Economy Action Plans into national strategies and local practice, with particular attention to Local Government Organizations as the interface where policy meets citizen behaviour. Findings indicate that legislative alignment is broadly achievable but outcomes diverge dramatically. Three institutional variables are most strongly associated with performance: maturity of producer-responsibility infrastructure, depth of inter-municipal aggregation, and behavioural embedding over decades. Greece's experience demonstrates that finance is necessary but insufficient. The chapter identifies three implementation typologies and concludes with country-differentiated policy recommendations and an individual-action framework adaptable across heterogeneous European contexts.

3.1 Introduction

Waste is the residue of how societies produce and consume. Reducing it; managing what cannot be prevented is inseparable from the broader transition toward sustainability that Sustainable Development Goal 12 of the United Nations 2030 Agenda calls for. The world's 7+ billion people generate roughly 2 billion tonnes of municipal solid waste annually, projected to reach 3.4 billion tonnes within three decades on current trajectories (World Bank, 2018). Roughly half is not collected, treated, or safely disposed of. Among the most assertive policy actors in this domain stands the European Union, which has built — through the Circular Economy Action Plan (European Commission, 2015, 2020), Directives 2008/98/EC and the 2018 amendments, and Cohesion Policy — an architecture intended to drive Member States and accession partners toward circular models. Extensive though this architecture is, whether it works is another question — and the answer varies dramatically between countries.

This chapter examines that variation. Specifically, it asks how Greece, Italy, Serbia, and Moldova translate the common EU policy framework into national legislation, regional and local action, and citizen behaviour — and what the comparison reveals about the determinants of effective SDG 12 implementation.

Our country selection is deliberate. They occupy distinct positions on the spectrum of European integration and circular economy maturity. Italy, a founding EU member, ranks among Europe's best performers in packaging waste recycling (75.6% in 2023, against an EU average of 65.4%) and operates

a mature industrial recycling sector (Eurostat, 2024). Greece, an EU member since 1981, presents a paradox: extensive legislative alignment coexists with a municipal waste recycling rate of 17.4% — among the lowest in the Union (Eurostat, 2024; EEA, 2024). Serbia, an EU candidate since 2012, has made significant progress in harmonising the legislative framework with European standards in the field of waste management. At the same time, challenges remain in terms of consistent enforcement of regulations and infrastructure improvements, with municipal waste still largely disposed of through landfill (World Bank, 2023). Moldova, an Eastern Partnership country and EU candidate since 2022, is constructing its waste management system largely from scratch with sizeable EU and EBRD donor support, operating under its National Waste Management Programme 2023–2027 (Government of the Republic of Moldova, 2023).

Examining these four cases together yields insights single-country studies cannot. It tests what works at different stages of policy and infrastructure maturity, and what fails to transfer across contexts. It also examines Local Government Organizations (LGOs), which was the focus of our previous work on the Greek case (Papavasileiou et al., 2024), under markedly different administrative traditions. The chapter extends earlier comparative work (Cifuentes-Faura, 2025; Martínez-Jiménez et al., 2021) by widening the lens beyond the EU-27 to include both an accession country and an Eastern Partnership country. Challenges Serbia and Moldova face, and the lessons their trajectories offer, remain comparatively underexplored in the European waste policy literature.

The analysis moves from methodological framework and European policy architecture (Sections 3.2–3.3) through comparative legislative, infrastructure, and governance findings (Sections 3.4–3.7) to cross-country synthesis, country-differentiated recommendations, and conclusions (Sections 3.8–3.10). We deliberately narrow our focus to municipal solid waste, where LGOs and citizen action intersect most directly and where comparative data is most reliable; the trade-off is that we cannot claim to have analysed SDG 12 in its full breadth.

3.2 Theoretical Framework and Methodology

3.2.1 Approach

The study adopts a comparative qualitative policy analysis approach, supplemented by quantitative indicators from harmonised European statistical sources. Waste management is, at its core, a governance problem (Bondarouk

& Mastenbroek, 2018). Quantitative indicators — recycling rates, MSW per capita, landfill diversion percentages — are necessary but not sufficient. They tell us what is happening, not why; the why is what matters for transferable policy lessons (Schaffrin et al., 2015). Comparative policy analysis as developed by Heidenheimer et al. (1990) and refined for environmental contexts by Jordan and Adelle (2013) provides the methodological scaffolding: systematic comparison across a defined set of dimensions, holding the comparative framework constant while allowing each case to be examined on its own terms.

3.2.2 Analytical dimensions

We compare the four countries across five analytical dimensions in a most-different-systems design, deliberately chosen to capture the policy chain from European-level commitments to citizen behaviour (cf. Pires et al., 2019). The dimensions are five. First, legislative and strategic frameworks — transposition of EU directives, national waste management plans, regional and local planning instruments. Second, infrastructure and performance — quantitative indicators including MSW generation per capita, recycling rates under both old and new harmonised EU calculation rules, landfilling percentages, packaging waste performance, and infrastructure capacity. Third, Local Government Organizations — constitutional and statutory powers of local authorities, financial and human resource capacity, and relationships across governance levels. Fourth, citizen participation and behaviour — mechanisms for engagement, separate collection participation, awareness campaigns, behavioural instruments such as Pay-As-You-Throw (Reichenbach, 2008). Fifth, funding and investment mechanisms — EU Cohesion Policy allocations, Recovery and Resilience Facility resources, IPA funding, EU4Moldova and EBRD support, and Extended Producer Responsibility schemes.

3.2.3 Data sources and limitations

We rely on official, publicly available sources to ensure reproducibility. Primary sources, broadly speaking, include: national waste management plans, gazette publications of relevant legislation, Eurostat databases (env_wasmun, env_wasobl, sdg_12_50 series), EEA country profiles, World Bank assessments, and reports from international financial institutions (EBRD, AFD, EIB). Secondary sources include peer-reviewed comparative literature (Cifuentes-Faura, 2025; Martínez-Jiménez et al., 2021; Pires et al., 2019) and country-specific academic and grey literature. For Moldova, where Eurostat

coverage is largely limited, we draw on national statistical data, the National Waste Management Plan 2023–2027, UNDP and EBRD project documentation, and academic work from Moldovan and regional researchers (Plotnic, 2024a).

Three limitations should be acknowledged. First, data comparability is generally imperfect. The EU's harmonised waste calculation rules apply from 2025 going forward, but historical data was generated under different methodologies, and Serbia and Moldova report under their own. Where rates are quoted, we indicate the methodology. Second, the depth of analysis varies between cases — the evidence base is typically richer for Italy and Greece than for Serbia and Moldova, and we note this asymmetry rather than disguise it. Third, the study does not include primary fieldwork; it is a desk-based policy analysis. Field data would strengthen subsequent work but lay beyond the present scope. These limitations notwithstanding, the comparison yields conclusions sufficiently grounded to inform policy discussion at both national and EU level.

3.2.4 Categorisation Rubric for performance assessment

Several of our findings — most visibly the Figure 3.3 heatmap in Section 3.8 — categorise country performance against EU 2025/2030/2035 targets. To make these categorisations transparent and replicable, we apply a three-band rubric based on the percentage gap between current performance and the relevant target by its deadline. "On track" indicates that current performance is at or within roughly 10 percentage points of the target with a credible trajectory to close any remaining gap by the deadline; this corresponds, for instance, to Italy's 50.8% MSW recycling against the 55% 2025 target. "Lagging" indicates a gap of approximately 10 to 30 percentage points with implementation underway but uncertain to close; this corresponds, for instance, to Greece's packaging-waste recycling (~63%) against the 65% target, or Italy's bio-waste separate collection where coverage is regionally uneven. "Far behind" indicates a gap exceeding 30 percentage points or evidence of structural barriers (infrastructure, governance, fiscal capacity) that make timely closure unlikely; Greece's 17.4% MSW recycling against the 55% 2025 target falls in this category. "No data" applies to Serbia and Moldova on indicators where national reporting is incompatible with EU harmonised methodologies, in which case we report qualitative directional assessment rather than force a numeric comparison. The cutoff date for assessment is the latest data available at end-2025 / early-2026. We acknowledge that the rubric thresholds are themselves analytical judgments; readers preferring

tighter or looser thresholds can re-categorise the heatmap accordingly. The substantive ranking of countries — Italy strongest, Greece and Serbia mid, Moldova weakest — holds across plausible variations in the rubric.

3.2.5 Triangulation strategy and confidence ratings

Asymmetric data quality across the four cases requires explicit handling. For Italy and Greece, harmonised Eurostat indicators, EEA early-warning assessments, and national authority data (ISPRA, E.O.AN., HSWMA) are mutually corroborating. For Serbia, national SEPA reporting, World Bank situational analysis, and donor documentation (AFD, EBRD, Bankwatch) provide independent triangulation on most quantitative claims, although recycling-rate definitions diverge from EU methodology. For Moldova, the evidence base is thinner: we rely on national-statistics data, the National Programme 2023–2027 baseline, UNDP project documentation, and Plotnic's (2024a) legal analysis. To manage this asymmetry, we apply a three-source minimum where possible for any quantitative claim concerning Serbia or Moldova; where only one or two independent sources exist, we report the claim with explicit hedging ("approximately," "national-methodology figures suggest") rather than presenting precise numbers. Confidence in the comparative ranking — Italy > Greece ≈ Serbia > Moldova on aggregate performance — rests on convergent evidence across multiple sources, even where individual-indicator precision varies. Where structural conclusions (such as the three-variable analytical claim developed in Section 3.8) depend on country-specific evidence, we note in-text where evidentiary depth is shallow and treat the resulting interpretation as more provisional than for the EU-data cases.

3.2.6 Conceptual framework and analytical propositions

The analysis is structured around three propositions developed inductively from the case literature reviewed in Sections 3.3 to 3.5 and tested narratively against the four cases in Sections 3.6 to 3.8. We state these explicitly here to make the analytical chain transparent. Proposition 1 (P1): SDG 12 performance is positively associated with the maturity of producer-responsibility infrastructure, where maturity is measured by years of operation, capitalisation, and coverage breadth (cf. Massarutto, 2014; Domenech & Bahn-Walkowiak, 2019). Proposition 2 (P2): SDG 12 performance is positively associated with the depth of inter-municipal aggregation, where depth is measured by the share of population covered by regional waste-management bodies and the operational capacity of those bodies (cf. Knill & Liefferink,

2007). Proposition 3 (P3): SDG 12 performance is positively associated with behavioural embedding — the duration over which separate-collection routines have been institutionally reinforced and culturally normalised in the population (cf. Reichenbach, 2008; Schaffrin et al., 2015).

These propositions sit within a multi-level governance frame (Knill & Liefferink, 2007; Hartley et al., 2020) and are not exclusive of alternative explanations. Falsification standards are explicit. P1 would be refuted if a country with mature, well-capitalised EPR infrastructure consistently underperformed on recycling and recovery indicators; P2 would be refuted if a country with strong regional waste-governance aggregation showed weak operational outcomes; P3 would be refuted if a country with multi-decade behavioural reinforcement showed low separate-collection participation. We also test against alternative single-variable explanations — finance access, statutory ambition, GDP per capita — in Section 3.8. The framework is therefore neither pure inductive description nor strict hypothetico-deductive testing; it is structured analytical reasoning with explicit propositions and explicit refutation conditions, appropriate to a four-case comparative qualitative design (Heidenheimer et al., 1990; Jordan & Adelle, 2013).

3.3 The European Policy Architecture for SDG 12

National variation in SDG 12 implementation makes sense only against the European framework that calibrates national systems (Domenech & Bahn-Walkowiak, 2019). Greece and Italy are bound by EU law as Member States. Serbia, as a candidate country, is engaged in legal approximation that is structuring its waste sector. Moldova, as an Eastern Partnership country and EU candidate since 2022, has aligned its 2023–2027 National Waste Management Programme with EU directives. The architecture maps across four interlocking layers: strategic policy framework (the Circular Economy Action Plans of 2015 and 2020); binding legal framework (the Waste Framework Directive and the 2018 amending package); financial framework (Cohesion Policy and the Recovery and Resilience Facility); and product-level regulation (Ecodesign for Sustainable Products and Right to Repair). Each layer creates obligations, opportunities, and constraints that show up differently in each of our cases (Calatayud-Vinent & Iglesias-Márquez, 2023).

3.3.1 Strategic frame: Circular economy action plans

Adopted in December 2015 (COM(2015) 614 final), the first Circular Economy Action Plan (CEAP) comprised 54 actions across production, consumption,

waste management, and secondary raw materials, with sector-specific attention to plastics, food waste, critical raw materials, construction and demolition, biomass, and bio-based products. By 2019 all 54 actions had been delivered or were in implementation (European Commission, 2019). A second and current plan — the New Circular Economy Action Plan, adopted in March 2020 (COM(2020) 98 final) as part of the European Green Deal — placed product design at the centre, on the rationale that up to 80% of a product's lifecycle environmental impact is determined at the design stage. Seven product value chains were prioritised: electronics and ICT; batteries and vehicles; packaging; plastics; textiles; construction and buildings; and food, water, and nutrients.

This regulatory tool-shift matters. A legal assessment by Calatayud-Vinent and Iglesias-Márquez (2023) finds that approximately 40% of measures in the first action plan and over 35% in the second address end-of-life management, and that these constitute almost all the regulatory changes with mandatory targets. Implication: the EU's circular economy agenda, despite the rhetoric of systemic transformation, remains heavily anchored in waste management rather than upstream redesign of production and consumption. National-level performance on SDG 12 is therefore closely correlated with national-level performance on waste indicators, because the binding obligations are concentrated there.

Operationally, the 2020 plan has produced extensive secondary legislation. The Ecodesign for Sustainable Products Regulation (Regulation (EU) 2024/1781) entered into force in July 2024, replacing the 2009 Ecodesign Directive and extending its scope from energy-related products to virtually all physical products placed on the EU market (European Commission, 2024a). The Directive empowering consumers for the green transition (Directive (EU) 2024/825), adopted March 2024, addresses greenwashing and improves point-of-sale information on durability and repairability. The Directive on the right to repair (Directive (EU) 2024/1799) entered into force in July 2024. Each affects waste streams indirectly by extending product lifespans and improving recyclability — though the impact timeline extends well beyond 2030, and implementation across the cases will be uneven (Hartley et al., 2020).

3.3.2 Binding Legal Frame: Waste Framework Directive and the 2018 Package

If the Action Plans set strategic direction, the binding legal frame is constructed around Directive 2008/98/EC, the Waste Framework Directive

(WFD), as deeply amended by Directive (EU) 2018/851. The WFD defines waste, hierarchises management options, establishes Extended Producer Responsibility as a general principle, and imposes recycling and recovery targets binding on Member States. At its conceptual centre sits the waste hierarchy (Article 4) — prevention, preparation for reuse, recycling, other recovery, disposal — which is binding in the sense that Member States must apply it as a priority order in legislation and policy (Pires et al., 2019). In practice, the hierarchy is more aspirational than prescriptive; several countries, Greece included, have struggled to move sizeable volumes of MSW up the hierarchy despite clear legal obligation (EEA, 2024).

The 2018 amendment package — Directives 2018/849, 2018/850, 2018/851, and 2018/852 — strengthened the WFD considerably. Key changes were five. A binding municipal waste preparation-for-reuse-and-recycling target of 55% by 2025, 60% by 2030, 65% by 2035 (Article 11(2)). A landfill cap of 10% of municipal waste by 2035 under the amended Landfill Directive (Directive (EU) 2018/850). Separate collection requirements for bio-waste from 31 December 2023 and textile waste from 1 January 2025. Tightened minimum requirements for EPR schemes (Article 8a). And a thoroughly revised methodology for calculating recycling rates from 2025, designed to eliminate the double-counting and definitional inconsistencies that had inflated reported rates in some Member States (EEA, 2025a). New calculation rules matter for cross-country comparisons: under the old methodology, rates were measured at facility input, inflating performance by including material later rejected during sorting. New rules measure at the point where waste actually enters the recycling operation in usable form. Italy's preliminary 2022 data under the new rules was 1–5 percentage points lower than under the old methodology — and Italy is broadly a relatively well-performing case (EEA, 2025a).

Specialised directives extend the binding frame. The Single-Use Plastics Directive (Directive (EU) 2019/904) imposed restrictions on specified single-use plastics from July 2021 and introduced separate collection targets for plastic beverage bottles (77% by 2025; 90% by 2029). The Packaging and Packaging Waste Regulation (Regulation (EU) 2025/40), replacing the previous directive, introduced reuse targets for transport packaging and beverage containers and restrictions on certain single-use formats. The proposed WFD revision of July 2023 would impose EPR on textile products and binding food waste reduction targets — 10% in processing and manufacturing, 30% per capita in retail and households, both compared with 2020 baselines, by end of 2030 (European Commission, 2023).

3.3.3 Financial frame and monitoring

Compliance requires investment. The 2021–2027 Multiannual Financial Framework allocates approximately EUR 392 billion to Cohesion Policy, of which EUR 12.5 billion is earmarked for circular economy and waste management — a 39% increase over the 2014–2020 envelope (European Commission, 2024b; Bankwatch, 2025). Of this, EUR 8.6 billion is direct EU funding. The 'do no significant harm' principle, derived from the Taxonomy Regulation and applied across the RRF and Cohesion Policy, restricts funding for landfill and incineration projects, channelling resources toward higher-tier waste management (Bankwatch, 2025). A specific instrument, the Cohesion Fund (EUR 42.6 billion at 2018 prices for 2021–2027), finances environment and transport in Member States with GNI per capita below 90% of the EU average (European Parliament, 2025). Greece is a beneficiary; Italy is not. The Recovery and Resilience Facility, established by Regulation (EU) 2021/241, introduced milestone-and-target disbursement with a 37% climate spending minimum. For accession countries, IPA III (Regulation (EU) 2021/1529) provides smaller-scale support; Moldova relies on EU4Environment, EU4Moldova, and EBRD blended finance (EBRD, 2024).

Eurostat's SDG 12 monitoring publication, now in its ninth edition (Eurostat, 2025), reports against 12 indicators. The Circular Material Use Rate — the share of secondary materials in total material use — stood at 11.8% in the EU-27 in 2023, well below the 2030 target of doubling from 2020 levels. Italy and Greece are subject to this indicator; Serbia and Moldova are not, although both report comparable national indicators. This asymmetry of reporting obligations is one reason like-for-like comparison across the four cases is methodologically challenging — and why we frame the analysis qualitatively in many places. Legal obligations on Greece and Italy are formally identical; differences in performance therefore cannot be attributed to differences in legal obligation. They must be sought in implementation capacity, financing decisions, institutional design, and citizen behaviour.

3.4 Results: Comparative Legislative Frameworks and Funding Mechanisms

National legislation is where European obligations meet local political economy (Knill & Liefferink, 2007). All four countries have, in their own ways, adopted the architectural elements of EU waste policy. Substance, however, differs. What changes (sometimes dramatically) is the depth of transposition, the speed of secondary legislation, and the financial machinery that turns paper

obligations into operational reality. Two caveats apply. Frameworks evolve quickly here. Snapshots that follow are accurate as of late 2025 / early 2026; we focus on framework laws and their direct circular-economy provisions, with sector-specific legislation touched on only where it bears on the comparison.

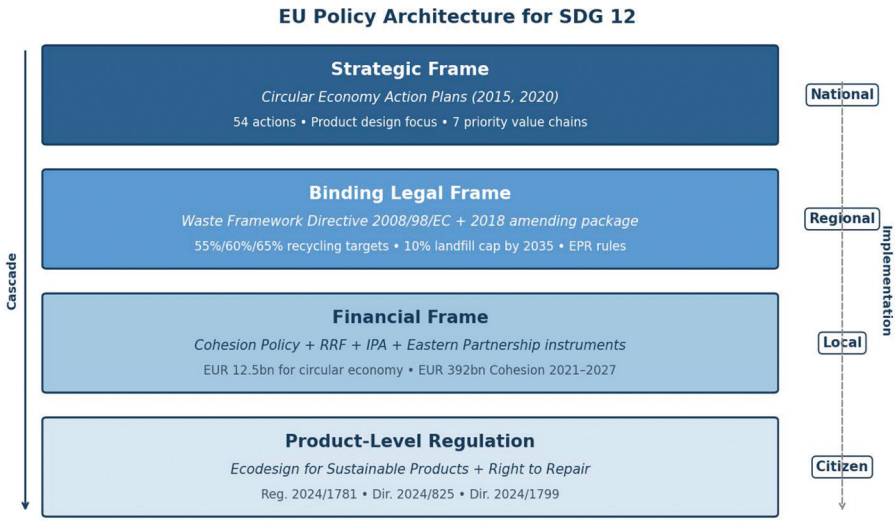

Figure 3.1 The EU policy architecture for SDG 12: four interlocking layers (strategic, legal, financial, product-level) cascading from European-level commitments to national, regional, local, and citizen-level implementation. Source: Authors' synthesis from European Commission (2015, 2020); Calatayud-Vinent and Iglesias-Márquez (2023); Bankwatch (2025).

3.4.1 Greece: Law 4819/2021 and its aftermath

Greek transposition is, on paper, the most recent and thorough of our EU sample. Law 4819/2021 (FEK A' 129, 23 July 2021), 'Integrated Framework for Waste Management', transposed Directives (EU) 2018/851 and 2018/852. This act is dense. Running to 173 articles across 11 parts, it replaced the fragmented patchwork of earlier instruments — most notably JMD 50910/727/2003 (Hellenic Republic, 2021). Substantive changes are considerable. A unified framework places prevention, reuse preparation, and recycling at the centre. Separate collection has been expanded to cover bio-waste, textiles, paper, plastics, metals, and glass. EPR fees are eco-modulated, rewarding recyclability and recycled content. The Hellenic Recycling Organisation (E.O.AN.) has been reorganised. And there is a commitment to reduce MSW landfilling to 10% by 2030 — five years ahead of the EU 2035

ceiling. Ambition is real. So is the gap, as Section 3.5 will show: the 10% target is not on track.

Law 4819/2021 has not stood still. Law 4843/2021 (FEK A' 193, 20 October 2021) added a 'clarification' part. Law 4936/2022 (FEK A' 105, 27 May 2022) amended administrative penalties and FoDSA participation in alternative packaging waste management (E.O.AN., 2024). Subsequent amendments through 2023 and 2024 have refined inspections, EPR fee structures, and LGO separate collection obligations. The accompanying NWMP 2020–2030 (Council of Ministers Act 39/31.8.2020, FEK A' 185) sets the EU-aligned targets — 55% MSW recycling by 2025, 60% by 2030, landfilling below 10% by 2030 — operationalised through Pay-As-You-Throw, source separation, MRF upgrading, and public-awareness campaigns (Hellenic Ministry of Environment and Energy, 2020). Below the national plan, each Region prepares a Regional Waste Management Plan (PESDA), and each primary-level municipality a Local Waste Management Plan (LWMP), under Article 228 of Law 4555/2018.

Greece is in a relatively privileged funding position. As a Cohesion Fund beneficiary, it has access to financing for waste infrastructure that Italy does not. The 2021–2027 MFF allocates Greece approximately EUR 21.1 billion in ERDF and Cohesion Fund resources combined, with sizeable fractions earmarked for environmental investments under Policy Objective 2 (European Commission, 2024c). Add the Greek NRRP — EUR 30.5 billion in grants and loans, with explicit waste-sector commitments including new MRFs, biowaste treatment plants, and landfill modernisation (Greek Ministry of Finance, 2021). On paper, the financial pipeline is substantial. The performance gap, then, cannot be explained by underfunding.

3.4.2 Italy: The Codice dell'Ambiente and Legislative Decree 116/2020

Italy's architecture is older, denser, and more sophisticated than Greece's. At its core stands Legislative Decree 152/2006, the Codice dell'Ambiente (Environmental Code), adopted 3 April 2006 and published in Gazzetta Ufficiale No. 88. The Code consolidated multiple prior environmental laws — including the foundational 1997 'Ronchi Decree' (Legislative Decree 22/1997) that first introduced the polluter-pays principle and separate-collection obligations — into a single coherent instrument. Part IV (Articles 177 to 266) addresses waste management. Within it, the architecture is detailed. Article 179 anchors the hierarchy as the priority order. Articles 183 and 184bis define waste and by-products. Article 184ter transposes the EU

end-of-waste concept. Article 188 codifies the duty of care. Article 205 sets separate-collection objectives at the level of the Ottimale Territoriale (OTA) or, where no OTA is established, at municipal level — with a 20% addition to the landfill tax as financial penalty for OTAs that miss targets (EEA, 2024).

Italy transposed the 2018 EU package through Legislative Decree 116/2020 of 3 September 2020, implementing both Directive 2018/851 and Directive 2018/852. Three changes were consequential. First, EPR was strengthened with new registration, labelling, and eco-modulated CONAI environmental contributions. Second, the duty of care was reinforced. Third, new digital traceability requirements arrived. The Single-Use Plastics Directive was transposed through Legislative Decree 196/2021 — a transposition that drew criticism at EU level for delayed bans and exemptions for biodegradable and compostable plastics that diverge from the harmonised approach (ISPRA, 2025; Italian Ministry of Environment and Energy Security, 2025). A distinctive Italian feature is the role of producer-responsibility consortia. CONAI (established 1997) coordinates the packaging EPR through six material-specific sub-consortia: COREPLA for plastics, COMIECO for paper, CIAL for aluminium, CoReVe for glass, RICREA for steel, Rilegno for wood. For batteries (COBAT), tyres, used oils, and other streams, similar consortium structures operate. This producer-responsibility infrastructure, accumulated over nearly three decades, partly explains Italy's strong packaging-waste performance: the institutional plumbing was already in place when the 2018 package raised targets (Massarutto, 2014).

Italian framework legislation continues to evolve. RENTRi (National Electronic Register for Waste Traceability) became operational on 13 February 2025 for large producers, replacing paper-based waste tracking with a fully digital system. Such a shift is consequential. Legislative Decree 125 of 6 September 2024 transposed the EU Corporate Sustainability Reporting Directive. The Code's most recent consolidated version incorporates amendments through Law 18 March 2025, No. 40 (Italian Ministry of Environment and Energy Security, 2025). On funding, Italy is not a Cohesion Fund beneficiary but received the largest national RRF allocation — EUR 191.5 billion in grants and loans, of which EUR 59.4 billion targeted the green transition (PNRR Mission 2). Within Mission 2, specific budget lines covered new bio-waste treatment plants, mechanical-biological treatment facilities, separate-collection infrastructure, and digital transformation (Italian Ministry of Economy and Finance, 2021). Implementation has not been smooth. Italian RRF disbursement has documented delays (European Court of Auditors, 2024). But the green-transition envelope provided investment in waste infrastructure that prior Cohesion Policy cycles had not delivered at comparable scale.

3.4.3 Serbia: From the 2009 framework to the 2025 reform

Serbia illustrates the dynamics of EU accession-driven legal reform (Stanisavljević et al., 2018). Adopted in 2009, the country's first comprehensive Law on Waste Management (Official Gazette of the Republic of Serbia No. 36/2009) was accompanied by a parallel Law on Packaging and Packaging Waste (also OG 36/2009). The 2009 framework was conceptually aligned with the pre-2018 EU acquis: waste hierarchy, EPR for packaging and other streams, institutional architecture for collection, transport, disposal. Subsequent amendments in 2010 (88/2010), 2016 (14/2016), 2018 (95/2018), and most importantly 2023 (35/2023) progressively aligned the framework with the post-2018 EU package, particularly Directive 2018/851. The 2023 amendments added provisions on the revised waste hierarchy, strengthened EPR, and introduced new bio-waste separate collection obligations (Serbia, Government. 2024).

That reform reached a turning point in 2025. Serbia's National Assembly adopted a new Law on Waste Management published in Official Gazette No. 109/2025, entering into force in late 2025 and replacing the 2009 framework in its entirety (Serbian Ministry of Environmental Protection, 2025). This break is real. The new Law retains the hierarchy concept while elaborating in considerably greater detail on specific stages of waste handling. One change stands out. Definition of 'material recovery' has been sharpened: it explicitly includes preparation for reuse, recycling, and backfilling, while expressly excluding incineration and other forms of energy recovery — a deliberate alignment with the EU's recycling-rate calculation methodology under the new harmonised rules. EPR obligations on producers are tightened. Permitting procedures are clarified. The data-reporting framework is strengthened. Above the framework legislation sits the Waste Management Programme 2022–2031 (Official Gazette No. 137/2022) and an associated Action Plan for 2026–2030, plus the Circular Economy Development Programme 2026–2030 (Serbian Government, 2022). The Green Agenda for Serbia 2024–2033, aligned with the Sofia Declaration, has been in preparation; as of early 2026, final adoption was pending.

Serbia's funding situation is structurally distinct from Member States. As an IPA III beneficiary, Serbia accesses EU pre-accession funding for environmental projects; the IPA III 2021–2027 envelope totals EUR 1.46 billion across all sectors (European Commission, 2024d). Beyond IPA, the country has accessed EBRD, EIB, AFD, and bilateral support. AFD has been particularly active, supporting a national solid waste programme covering up to eight sub-projects across approximately one third of Serbian municipalities (AFD,

2023). The financing model differs fundamentally from Greek or Italian arrangements: it relies more heavily on concessional lending and donor coordination, less on grant-based co-financing — affecting what is built, how fast, and at what cost to public finances.

3.4.4 Moldova: The 2016 foundation and the 2023–2027 National plan

Moldova is the most distinctive case in our sample. As neither an EU Member State nor part of the IPA framework until recently, the country's alignment with the WFD is shaped by the 2014 Association Agreement (Law No. 112 of 2 July 2014) and the broader Eastern Partnership architecture. Law No. 209 of 29 July 2016 on Waste transposes Directive 2008/98/EC into Moldovan law (Government of the Republic of Moldova, 2016), setting the standard EU framework: hierarchy, EPR principle, separate collection, definitions, permitting and reporting. Originally, this 2016 Law was accompanied by a Waste Management Strategy 2013–2027 (Government Decision 248/2013) that pre-dated the framework law itself — an unusual sequencing that became increasingly problematic as the Strategy's operational targets diverged from the legal framework. A 2019 amendment (Law No. 22 of 11 March 2019) excluded the cross-reference, formally severing the legal nexus. By 2024, the 2013–2027 Strategy was effectively obsolete (Plotnic, 2024a).

Its replacement is the National Waste Management Programme 2023–2027, approved by Government Decree No. 972 on 6 December 2023 and entering into force on 6 March 2024 (Government of the Republic of Moldova (2023)). The Programme targets a 30% reduction in landfilled waste by 2027, identifying infrastructure priorities including seven solid waste landfills, 34 transfer stations, and two mechanical-biological treatment plants in Chișinău and Bălți (UNDP, 2024). Three operational mechanisms anchor the SDG strategy: source separation, biodegradable waste composting, and EPR implementation. Sector-specific Government Decisions transpose particular EU directives: GD 212/2018 (WEEE), GD 561/2020 (packaging), GD 586/2020 (batteries), GD 610/2022 (used tyres), GD 731/2022 (used oils), GD 93/2023 (end-of-life vehicles). The structure mirrors the EU sectoral acquis, but local implementation capacity (addressed in Section 3.6) is limited. Funding comes from a relatively diverse but structurally smaller pool: EU4Environment and EU4Moldova programmes, EBRD blended financing with E5P co-financing, UNDP support via EU4Climate, and bilateral contributions from Sweden, Germany, and Romania. The arithmetic of available finance remains modest by Greek or Italian standards.

3.4.5 Comparative synthesis

The cross-country legislative picture yields three findings that are clear enough to carry analytical weight. First, legislative alignment with the EU framework is broadly a solved problem across the four cases (Domenech & Bahn-Walkowiak, 2019). Greece, Italy, and Serbia have each transposed Directive 2018/851 in their respective legal traditions; Moldova has aligned Law 209/2016 with Directive 2008/98/EC and is progressively aligning secondary legislation. Frameworks differ in maturity, density of secondary instruments, and digital traceability integration — but the basic shape is recognisable across all four. As Mazzanti, M., & Zoboli, R. (2006) note, the WFD has become an extraordinarily effective convergence instrument at the legal level. Where it has been markedly less effective is in producing convergent outcomes (Domenech & Bahn-Walkowiak, 2019).

The pace of recent reform also deserves attention. Each country has undertaken far-reaching legislative work in the 2021–2025 window: Greece's Law 4819/2021 with subsequent amendments; Italy's Decree 116/2020, Decree 196/2021, and ongoing updates; Serbia's 2023 amendments and 2025 framework reform; Moldova's 2023 Programme with sectoral decisions. The pace is, if anything, accelerating — driven by the 2018 EU package, the 2020 Action Plan, green-transition politics, and accession or association pressures. For practitioners this is exhausting; for analysts it complicates comparison; for citizens it raises the question of whether the regulatory edifice can settle long enough to be operationalised. The risk of legal hyperactivity outpacing administrative capacity is real (Bondarouk & Mastenbroek, 2018).

Third, funding architectures diverge sharply along the EU-member / candidate / Eastern-Partnership axis, with consequential effects (Bankwatch, 2025). Greece accesses Cohesion Fund support; Italy received the largest single RRF allocation. Serbia operates within IPA III plus EBRD/AFD lending. Moldova depends on EU4Environment, EU4Moldova, and donor-coordinated blended finance. These differences shape the project pipeline, available technical assistance, funding conditionalities, and the time required to move from plan to operational facility (Martínez-Jiménez et al., 2021). Greece's experience — generally abundant funding, weak conversion to performance — offers a sobering counterpoint to the assumption that finance is the binding constraint. For Serbia and Moldova, in different ways, finance is genuinely binding. For Greece, in most years, it is not. Table 3.1 summarises the legislative and funding frameworks.

Table 3.1 Legislative and funding frameworks for waste management: Greece, Italy, Serbia, Moldova.

Dimension	Greece	Italy	Serbia	Moldova
Framework law	Law 4819/2021 (FEK A' 129)	Legislative Decree 152/2006 (Codice dell'Ambiente), Part IV	Law on Waste Management OG 109/2025 (replaces 36/2009)	Law No. 209/2016 on Waste
Transposition of 2018/851	Direct in Law 4819/2021	Legislative Decree 116/2020	Amendments OG 35/2023; consolidated in OG 109/2025	Progressive via sectoral GDs (2018–2023)
National plan / programme	NWMP 2020–2030 (FEK A' 185/2020)	National Programme for Waste Management (PNGR)	Waste Management Programme 2022–2031 (OG 137/2022)	National Programme 2023–2027 (GD 972/2023)
MSW recycling target	55% by 2025; 60% by 2030; 65% by 2035	55% by 2025; 60% by 2030; 65% by 2035	Aligned with EU targets via 2025 Law	30% landfill reduction by 2027
Landfill ceiling target	≤10% MSW by 2030	≤10% MSW by 2035 (EU target)	Aligned with EU 2035 target	30% reduction by 2027 (relative)
EPR architecture	E.O.AN. + alternative management schemes	CONAI + 6 material consortia (since 1997)	Seven collective schemes (packaging EPR since 2009)	Established for packaging, WEEE, batteries, tyres, vehicles
Primary EU funding	ERDF + Cohesion Fund + RRF (~EUR 30.5bn)	ERDF + RRF (EUR 191.5bn total)	IPA III (EUR 1.46bn 2021–2027 all sectors)	EU4Environment, EU4Moldova, bilateral
Other major IFI support	EIB	EIB	EBRD, EIB, AFD	EBRD, E5P, World Bank

Source: Authors' compilation from national legislation, European Commission, EEA, World Bank, EBRD, and AFD documentation. As of early 2026.

3.5 Results: Infrastructure and Quantitative Performance

Numbers expose what statutes conceal. Whatever the elegance of national waste laws, what travels to landfill rather than to recycling determines whether SDG 12 is being met. Three indicators carry most of the comparative weight: municipal solid waste (MSW) generation per capita; recycling rate (with old and new EU methodologies clearly distinguished); and the share of MSW landfilled. Behind these numbers sit infrastructure stocks: material recovery facilities, mechanical-biological treatment (MBT) plants, anaerobic digestion and composting capacity, sanitary landfills, and waste-to-energy incinerators. On every dimension, the four countries differ.

3.5.1 Greece: Compliance on paper, performance on hold

Greek MSW generation, at 524 kg per capita in 2023, sits modestly above the EU-27 mean of 511 kg (Eurostat, 2024). Composition is fairly typical Mediterranean: high organics share (around 40%), sizeable paper and cardboard, growing plastics. Performance is the difficulty. Under the old recycling methodology, Greek MSW recycling stood at 21.0% in 2022; under the new harmonised rules applying from 2025, EEA's preliminary estimate is 17.4% — among the lowest in the Union and far short of the 55% binding target for 2025 (EEA, 2025b). Landfilling remains dominant. Approximately 78% of Greek MSW reaches landfill, against an EU-27 average of 23.5% (Eurostat, 2024). The 2030 national target of 10% landfilling, set five years ahead of the EU 2035 ceiling, is on no plausible trajectory to be met.

Infrastructure capacity tells part of the story. As of 2024, Greece operated 29 Material Recovery Facilities (MRFs) covering roughly 87% of the population, 5 mechanical-biological treatment (MBT) plants, and zero waste-to-energy incinerators (HSWMA, 2024; Hellenic Recycling Organisation, 2024). This MRF network is technically functional but produces high reject rates — typically 30–40% of input material is rejected as unsuitable for recycling, partly because source separation upstream is patchy. Biowaste separate collection, mandatory under Law 4819/2021, has been rolled out in only about 35% of municipalities by end-2024 (E.O.AN., 2024). Per capita recycling stood at roughly 90 kg in 2022, against an EU-27 average of 263 kg (Eurostat, 2024). Greece is largely recycling roughly one-third of what comparable EU economies recycle per inhabitant — despite spending considerable structural-fund resources on the system.

3.5.2 Italy: Mature system, strong outcomes, regional heterogeneity

Italian performance is among the EU's strongest. MSW generation in 2023 stood at 504 kg per capita, slightly below the EU-27 average (Eurostat, 2024). Under the new harmonised methodology, recycling reached 50.8% in 2023 — only 4.2 percentage points below the 2025 binding target (ISPRA, 2024). Packaging waste recycling stood at 75.6%, well above the EU average of 65.4% and ahead of all 2030 EU packaging targets (Eurostat, 2024). Landfilling sits at approximately 18%, on track to meet the 10% ceiling by 2035. Behind these averages lies marked regional heterogeneity. Northern regions (Trentino-Alto Adige, Veneto, Lombardy) routinely exceed 70% separate collection; southern regions (Sicily, Calabria) struggle below 50% (ISPRA, 2024). The national average reflects not uniform success but the weight of Italy's industrial north.

Italian infrastructure is mature and dense. As of 2023, Italy operated 658 sorting and recovery plants, 343 composting and anaerobic digestion plants, 41 MBT plants, and 37 waste-to-energy incinerators with energy recovery (ISPRA, 2024). The waste-to-energy fleet, concentrated in the north, processes approximately 5.4 million tonnes of MSW annually — a route Greece has politically chosen not to pursue. Italy's system also benefits from long-running CONAI infrastructure: as Section 3.4 noted, the producer-responsibility consortium framework dating from 1997 means that collection, sorting, and recycling for packaging streams operates under tested institutional arrangements rather than improvised ones (Massarutto, 2014). RRF investment under PNRR Mission 2 is now adding capacity at the margins, particularly in southern composting and MBT, narrowing the north-south gap (ISPRA, 2024).

3.5.3 Serbia: The implementation gap

Serbian data should be read with caution. Serbia's national statistics methodology has historically diverged from Eurostat conventions, and reported recycling rates have been challenged on definitional grounds. With that qualification, the picture is sobering. MSW generation in 2022 stood at approximately 386 kg per capita — below the EU-27 average, reflecting lower household consumption rather than waste-prevention policy (SEPA, 2023). Recycling rates are reported at around 16% by national authorities, though independent assessments place actual material recovery closer to 8–10% (World Bank, 2023). Landfilling, including a sizeable share at non-sanitary

disposal sites, accounts for approximately 79% of MSW (SEPA, 2023; World Bank, 2023). Serbia has roughly eight regulated sanitary landfills covering about 20–25% of the population, with the remainder served by 162 mostly non-compliant municipal disposal sites (Stanisavljević et al., 2018).

The infrastructure deficit is therefore the binding constraint. AFD-supported regional waste programmes have begun closing some of the most polluting non-sanitary landfills and replacing them with sanitary regional facilities; eight regional projects covering roughly one-third of Serbian municipalities are in various stages of design or construction (AFD, 2023). EPR coverage exists for packaging, WEEE, batteries, tyres, vehicles, and oils — seven collective schemes operate under the framework legacy from 2009 — but compliance, particularly for non-packaging streams, remains uneven (Bankwatch, 2025). A 2025 Law on Waste Management is intended to address this. Whether implementation can move faster than the recent trajectory is the open question.

3.5.4 Moldova: Building from limited foundations

Moldova's situation is structurally different. MSW generation is lower than EU peers — roughly 340 kg per capita according to national statistics, though urban-rural variation is large and rural collection coverage is frequently incomplete (National Bureau of Statistics of Moldova, 2024). Recycling rates remain low: under the National Programme 2023–2027 baseline, formal recycling stood at less than 5% of MSW, with disposal (much of it at unregulated sites) accounting for the dominant share. Approximately 95% of generated waste reaches landfill or open dump, making Moldova's landfilling intensity the highest among the four cases (UNDP, 2024).

Infrastructure foundations are at an early stage. Modern sanitary landfilling capacity is largely concentrated around Chișinău and a handful of larger cities. The National Programme 2023–2027 plans seven new sanitary landfills, 34 transfer stations, and two MBT facilities serving Chișinău and Bălți — a build-out programme financed through EBRD blended finance with E5P co-financing, EU4Environment grants, World Bank lending, and bilateral support from Sweden, Germany, and Romania (UNDP, 2024; EBRD, 2024). Source separation is in pilot phase in selected urban districts; biodegradable waste composting operates at small scale. EPR schemes for packaging, WEEE, batteries, tyres, oils, and end-of-life vehicles exist on paper through Government Decisions, but operational implementation is partial. Infrastructure trajectory matters more than the current snapshot. Whether the 2027 milestones — 30% landfill reduction, sanitary landfill coverage of

Table 3.2 Quantitative waste-management performance indicators, latest available data (2022–2023).

Indicator	Greece	Italy	Serbia	Moldova
MSW generation (kg/capita, 2023)	524	504	~386 (2022)	~340
MSW recycling rate, new EU methodology	17.4%	50.8%	~8–10%	<5%
MSW landfilled (% of generated)	~78%	~18%	~79%	~95%
Packaging waste recycling rate (2023)	~63%	75.6%	Limited data	Limited data
Material Recovery Facilities	29	658 sorting plants	Limited	Pilot scale
MBT plants	5	41	Few	2 planned (Chișinău, Bălți)
Waste-to-energy incinerators	0	37	0 major	0
Sanitary landfill coverage	Largely complete	Complete	~20–25%	Partial (urban centers)

Sources: Eurostat (env_wasmun, env_waspac, 2024 release); EEA (2025b); ISPRA (2024); SEPA (2023); World Bank (2023); UNDP (2024); national authority data. Recycling rates for Serbia and Moldova use national methodologies; figures are not directly comparable to EU harmonised rates.

major urban centres, MBT operational in Chișinău and Bălți — are met will determine whether Moldova converges with EU patterns or remains structurally behind (Plotnic, 2024a).

3.5.5 Cross-country comparison

Table 3.2 collects the headline indicators on a comparable basis. The comparison points to three findings that hold across the data. First, MSW generation per capita is broadly correlated with national income; Italy and Greece generate more, Serbia and Moldova less, but the spread among EU members is wide and reflects consumption patterns more than policy ambition. Second, recycling performance correlates poorly with statutory ambition: all four countries have aligned legal frameworks, yet outcomes range from Italy's 50.8% to Moldova's near-5%. Third, landfilling intensity tracks infrastructure maturity rather than legal commitment. Italy's 18% reflects three decades of CONAI-led capacity building; Greece's 78% reflects a slow build-out despite available finance; Serbia's 79% reflects implementation lag; Moldova's 95%

reflects a system being built almost from scratch. Each case is at a different point on the same trajectory — and the policy levers that work at one stage may not transfer to another.

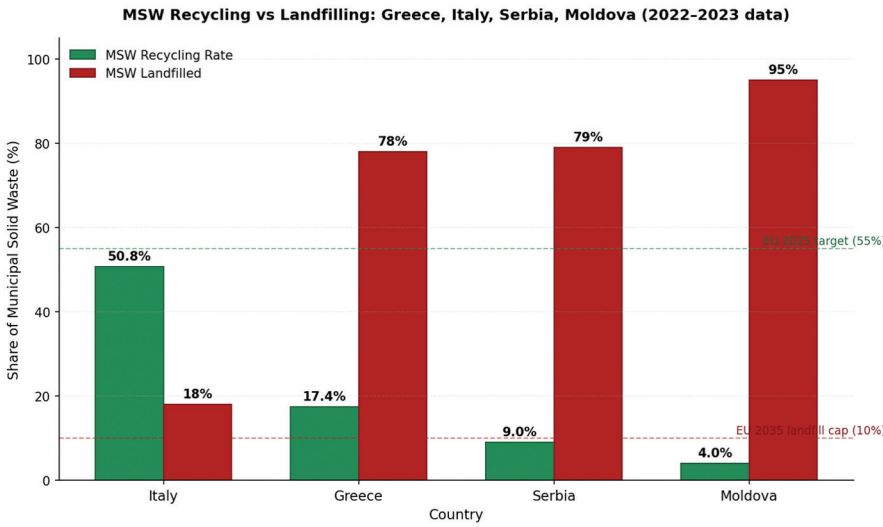

Figure 3.2 Municipal Solid Waste recycling versus landfilling shares across Greece, Italy, Serbia, and Moldova (latest available data, 2022–2023). Reference lines indicate the EU 2025 recycling target (55%) and 2035 landfill ceiling (10%). Sources: Eurostat (2024), EEA (2025b), ISPRA (2024), World Bank (2023), UNDP (2024).

3.6 Results: Local Government Organizations and Implementation Capacity

Statutes are written at national level. Waste, however, is collected at the curb. Local Government Organizations (LGOs) — municipalities, regions, and the inter-municipal bodies that pool their resources — are where SDG 12 either succeeds or fails as an operational matter (Mitoula et al., 2024). Across our four countries, LGOs operate under markedly different administrative traditions, fiscal capacities, and statutory mandates. The variation matters because it explains, in part, why identical EU obligations produce divergent outcomes.

3.6.1 Greece: Municipalities under pressure

Greek waste management is decentralised in name, fragmented in practice. Article 102 of the Constitution and Law 3852/2010 (Kallikratis Programme)

place primary responsibility for collection, transport, and disposal on the 332 primary-level municipalities. A second tier of regional authorities (FoDSAs — Regional Solidarity Waste Management Bodies) handles inter-municipal infrastructure such as MBT plants and sanitary landfills. The Kallikratis reform consolidated 1,034 pre-2010 municipalities into 325 (now 332), reducing fragmentation but leaving many municipalities below the population threshold at which separate collection becomes economically viable (Hellenic Ministry of Interior, 2024). Local Waste Management Plans (LWMPs), mandated under Article 228 of Law 4555/2018, must align with regional PESDA plans and the national NWMP — a three-tier vertical hierarchy that is, on paper, coherent.

In practice, Greek municipalities face severe capacity constraints. Average per-capita municipal revenue is among the lowest in the EU; the Central Autonomous Funds transfer, intended to fund local services including waste management, has been periodically reduced in real terms since 2010 (Council of Europe, 2022). Cleaning fees on property tax bills (Δημοτικά Τέλη Καθαριότητας) generate uneven revenue across regions, with wealthier municipalities collecting more per resident than poorer ones — a regressive feature that compounds territorial disparities. Technical staff are scarce; many municipalities operate without a dedicated environmental engineer or waste planner. The result is a system where formal compliance with statutory planning is routinely high, while operational performance — measured by separate-collection rates, MRF reject rates, biowaste programme rollout — lags far behind plan ambitions (E.O.AN., 2024).

3.6.2 Italy: Capable Local Government, strong inter-municipal tradition

Italian LGOs operate within a different institutional logic. The country has 7,901 comuni, ranging from large urban centers to villages of fewer than 100 inhabitants (ISTAT, 2024). Legislative Decree 152/2006 organises waste management at the level of the Ottimale Territoriale (OTA) (typically corresponding to a province or sub-regional area) under which inter-municipal bodies plan and procure services. The OTA logic enables small municipalities to pool resources without losing identity. Comparative experience suggests this model has been broadly effective, though regional implementation has been uneven (Massarutto, 2014).

Italian municipal capacity is generally stronger than in Greece, with formal qualifications and continuity of staff at higher levels. Local taxation arrangements, particularly the TARI (Tariffa Rifiuti) — a waste-specific user

charge replacing earlier property-tax mechanisms — generate dedicated revenue for waste services. Critical to the Italian model is the role of in-house and mixed public-private operators (utilities such as A2A, Hera, Iren, and Acea) that aggregate scale and technical capacity beyond what individual comuni could mobilise (Hartley et al., 2020). These utilities, often listed and partially privatised, bring access to capital markets and managerial expertise that smaller LGOs alone could not maintain (Zamfir et al., 2025). The northern regions, where this model is most developed, account for the bulk of Italian recycling performance.

3.6.3 Serbia: Limited municipal capacity, regional consolidation underway

Serbia has 145 municipalities (opštine) and 29 cities (gradovi), administered under the 2007 Law on Local Self-Government (Official Gazette No. 129/2007). Constitutional Article 188 grants municipalities original competences in environmental protection and communal services including waste collection. Implementation has been hampered by limited fiscal capacity, with most municipalities relying heavily on transfers from the central budget; own-source revenues are generally insufficient to fund modern waste infrastructure (OECD/SIGMA. (2023)). Regional waste management (sanitary landfilling, transfer stations, MBT) operates through inter-municipal regional centers, of which roughly 26 have been planned, though only about half are fully operational (Stanisavljević et al., 2018).

The 2025 Law on Waste Management (OG 109/2025) tightens municipal obligations on EPR coordination, separate collection, and reporting (Serbian Ministry of Environmental Protection, 2025; Milošević et al., 2025a). Whether municipalities have the technical capacity to meet these tightened obligations is the binding question. AFD-supported regional projects, ongoing across roughly one-third of the country, have included municipal capacity-building components alongside infrastructure investment (AFD, 2023). The trajectory is positive but slow. Serbia's recycling performance is unlikely to converge with EU averages within the decade.

3.6.4 Moldova: Building capacity from a low base

Moldova's territorial organisation is the most fragmented in our sample. Approximately 898 first-level local public administrations (LPAs) (primarily small rural communes) operate alongside 35 districts (raioane) and the autonomous territorial unit of Gagauzia (National Bureau of Statistics of Moldova,

2024). Most LPAs have populations below 5,000, making independent waste-service provision economically impossible. Law No. 209/2016 on Waste, supplemented by the 2003 Law on Local Public Administration, allocates collection responsibility to LPAs but but enables — indeed requires — inter-municipal cooperation for treatment and disposal infrastructure. The 2023–2027 National Programme operationalises this through eight planned waste management regions, each centerd on a sanitary landfill and a network of transfer stations (Government of the Republic of Moldova, 2023; UNDP, 2024).

Capacity is the binding constraint at every level. Most rural LPAs operate without dedicated waste staff; many lack functioning collection vehicles. EU4Environment, EU4Moldova, EBRD, and bilateral donors are funding both infrastructure and the institutional architecture that must operate it — a parallel build-out that takes time. Recent legal analysis argues that the misalignment between fragmented LPA structure and the regional infrastructure logic of the National Programme remains the central governance challenge for Moldovan waste management (Plotnic, 2024a).

3.6.5 Cross-country synthesis

Comparison across the four cases surfaces three patterns that cut across administrative traditions. First, the structural gap between national waste policy and local implementation is universal but expresses itself differently in each context. Italy bridges the gap through OTA-level inter-municipal organisation and capable utilities; Greece's three-tier system is formally coherent but undermined by municipal fiscal weakness; Serbia is mid-transition; Moldova is at the start of the journey. Second, fiscal capacity correlates more strongly with operational performance than statutory authority does. Third, scale matters. Where average municipality size is small and regional aggregation is weak (Greece, Moldova), implementation is uneven. Where regional aggregation is strong (Italy's OTAs, Serbia's regional centers where they operate), outcomes improve. The lesson for SDG 12 implementation is that decentralisation without capacity-building is, in practice, decentralisation without delivery. Table 3.3 summarises the comparative governance and capacity picture across the four cases.

3.7 Results: Citizen Participation and Behavioural Mechanisms

Waste systems work only if citizens cooperate. Source separation, biowaste composting, repair, and reuse all depend on routine household behaviour.

Table 3.3 Evidence matrix: country performance across five analytical dimensions. Confidence ratings: HIGH (3+ independent sources, harmonised data); MEDIUM (2 sources, some methodological heterogeneity); LOW (1 source, national methodology, interpret with caution).

Dimension	Greece (HIGH conf.)	Italy (HIGH conf.)	Serbia (MEDIUM conf.)	Moldova (LOW conf.)
Legislative framework	Transposed (Law 4819/2021); frequent amendments; ambitious targets	Mature (D.Lgs. 152/2006 + Decree 116/2020); digital traceability (RENTRi)	New framework (OG 109/2025); prior law 36/2009 amended multiple times	Transposed (Law 209/2016); sectoral GDs aligned with EU acquis
MSW recycling rate	17.4% (new EU methodology); far below 55% target	50.8%; close to 55% target; packaging 75.6%	~8–10% (national method); ~79% landfill	<5% (national figures); ~95% landfill
EPR maturity (P1)	Weak–moderate: E.O.AN. reorganised; eco-modulation partial	Strong: CONAI since 1997; 6 material consortia; eco-modulated fees	Moderate: 7 collective schemes since 2009; compliance uneven	Weak: sectoral EPR schemes exist on paper; operational implementation partial
Inter-municipal aggregation (P2)	FoDSAs exist but politically contested; coverage partial	OTA system strong in north; weaker in south; large utilities scale-up	~13 of 26 planned regional centers operational	8 regions planned; infrastructure build-out underway via EBRD/UNDP
Behavioural embedding (P3)	High declared willingness; low routine practice; PAYT pilots only	Strong in north (>75% sep. collection); moderate-weak in south	Infrastructure-limited; participation where bins provided	Pilot-phase only; urban-rural divide significant
Key primary sources	Eurostat, EEA, E.O.AN. (2024), HSWMA (2024), Council of Europe (2022)	Eurostat, EEA, ISPRA (2024, 2025), Italian MoEF (2021), Normattiva	SEPA (2023), World Bank (2023), Bankwatch (2025), AFD (2023)	NBS Moldova (2024), UNDP (2024), EBRD (2024), Plotnic (2024a)

Source: Authors' synthesis. P1 = EPR maturity; P2 = inter-municipal aggregation; P3 = behavioural embedding. Where sources diverged, harmonised Eurostat and EEA data were prioritised for EU member states; national authority data were used for Serbia and Moldova where harmonised EU datasets were unavailable or methodologically non-comparable. Confidence ratings are assigned at country-case level (not per-indicator): HIGH = 3+ independent institutional sources with harmonised methodology; MEDIUM = 2 sources with partial methodological heterogeneity; LOW = 1 source or national methodology incomparable with EU harmonised data. 'National method' data (Serbia, Moldova) not directly comparable to EU harmonised recycling rates. All figures as of latest available data, end-2025 / early-2026.

The most ambitious infrastructure produces poor outcomes if material arrives at the MRF mixed and contaminated. Citizen engagement is therefore not a soft adjunct to waste policy but its operational core (Schaffrin et al., 2015; Reichenbach, 2008). Across our four countries, citizen participation mechanisms differ in design, in funding, and (most consequentially) in cultural context.

3.7.1 Greece: Patchy engagement despite formal mandates

Greek citizens face a separate-collection system that is inconsistent across municipalities and chronically under-communicated. Law 4819/2021 mandates municipal awareness campaigns, but funding and execution vary enormously. National-level surveys conducted by the Hellenic Recycling Organisation indicate that while declared willingness to recycle is high — typically above 70% — practical participation in source separation rarely exceeds 40% in well-served urban areas and falls below 20% in rural districts (E.O.AN., 2024). Pay-As-You-Throw (PAYT) schemes have been piloted in only a handful of municipalities (Elefsina, Vari-Voula-Vouliagmeni, Ioannina). National rollout is far behind plan. Civil society engagement on waste issues exists but is concentrated in a few NGO networks (Ecological Recycling Society, Mediterranean SOS) rather than embedded in municipal programmes. The cultural perception of waste services as a public good provided 'top down' by municipalities, rather than as a shared civic responsibility, persists.

3.7.2 Italy: Behavioural embedding through decades of practice

Italy's citizen participation is the strongest in our sample, the product of three decades of consistent practice. Northern regions in particular have institutionalised separate-collection routines through tariff structures (TARI variants with PAYT components in many cities), school-level environmental education curricula, and high-visibility municipal communication. Trentino-Alto Adige reaches separate-collection rates above 75% (ISPRA, 2024); Brescia, Treviso, and other northern provinces routinely exceed 80%. Behavioural change at this scale is generational. Mazzanti & Zoboli (2006) note that Italian citizens born after the 1997 Ronchi Decree have grown up with separate collection as a normal feature of household life, in much the same way that Northern Europeans consider it routine. Reuse markets and adaptive reuse infrastructure also play a meaningful supporting role (Mitoula et al., 2017). Southern regions lag, partly because the institutional framework

arrived later and the behavioural reinforcement is shorter; closing this gap is the central operational challenge for Italian SDG 12 performance.

3.7.3 Serbia: Awareness without infrastructure

Serbian citizens often demonstrate awareness of recycling without practical means to act on it. Public surveys consistently show concern about pollution and willingness to participate in separate collection where the infrastructure is provided (UNDP Serbia, 2023). Implementation, however, lags. Where separate collection bins exist — typically in central Belgrade, Novi Sad, and a few other major cities — participation is moderate to high. Most municipalities, however, lack systematic separate collection altogether. Citizen-level engagement under these conditions is necessarily limited; the relevant policy lever is infrastructure provision rather than behavioural campaigns. EPR-funded packaging collection points are slowly expanding but remain inadequate to national needs (Bankwatch, 2025).

3.7.4 Moldova: Pilot-phase engagement

Moldovan citizen participation operates almost entirely at pilot scale. Source-separation programmes exist in selected Chișinău neighbourhoods and a handful of donor-supported pilot communes. UNDP and EU4Environment have funded behavioural-change campaigns alongside infrastructure investment, recognising that the two must develop in parallel (UNDP, 2024). Civil society engagement is led by a small number of environmental NGOs (notably Ecological Counselling Center Cahul, EcoVisio). The behavioural challenge in Moldova is not resistance — surveys show consistent public support for environmental improvement — but the absence of routine infrastructure that makes participation possible (Plotnic, 2024a).

3.7.5 Comparative implications

Citizen behaviour is a function of opportunity, information, and habit — in roughly that order. Where infrastructure exists, information is provided, and routine forms over time, participation rates approach the ceiling that demographics allow. Where any of the three is missing, participation falters. The Italian case shows what is achievable with multi-decade consistency. The Greek case shows that information without infrastructure produces frustration, not behaviour change. The Serbian and Moldovan cases show that absent infrastructure makes behavioural campaigns largely symbolic.

For SDG 12 implementation, the sequence matters: build the infrastructure, communicate consistently, and allow time for habits to form. Skipping steps tends to fail.

3.8 Discussion and Cross-Country Synthesis

The comparative analysis surfaces a central paradox. Legal frameworks across the four cases are broadly aligned. Financing is available to all — admittedly at very different scales. Citizens in each country express high declared support for sustainability objectives. Yet outcomes differ substantially across the four cases (Cifuentes-Faura, 2025). Greece's 17.4% recycling rate sits sits at barely a third of Italy's 50.8%; Moldova's near-zero recycling sits several percentage points below Serbia's 8–10%. The convergence at the level of statute coexists with sharp divergence at the level of performance (Domenech & Bahn-Walkowiak, 2019). Understanding why is the central contribution comparative analysis can make to SDG 12 scholarship.

3.8.1 Factors associated with stronger performance

Three variables emerge as systematically associated with stronger performance, drawing on the patterns developed across Sections 3.4 to 3.7. First, the maturity of producer-responsibility infrastructure. Italy's CONAI consortium predates the 2018 EU package by two decades; Serbia's collective EPR schemes have been operational since 2009 but with patchy coverage; Greek E.O.AN. has been repeatedly reorganised; Moldovan EPR is largely on paper. The pattern is unambiguous: long-running, well-capitalised EPR institutions outperform recently established or under-resourced ones (Knill & Liefferink, 2007; Massarutto, 2014). Regional aggregation among municipalities is the second variable. Italian OTAs, Serbian regional centers where they operate, and Moldovan planned regional structures show that scale aggregation is necessary for modern waste management. Greek FoDSAs, while structurally similar, have been politically contested and operationally underperforming (Council of Europe, 2022). Third, the depth of behavioural embedding. Italy's three decades of consistent practice produces behavioural defaults that lower-income economies cannot replicate quickly.

What does NOT appear to drive performance (at least not on its own) is access to finance. Greece is the cautionary case. The country has accessed sizeable Cohesion Policy funding across multiple programming periods, and its NRRP allocations for waste are sizeable. Yet performance remains the worst in our EU sample. The lesson is that finance is necessary but not

sufficient; absorptive capacity, project pipeline maturity, and implementation governance matter at least as much (Bankwatch, 2025).

Other variables also differ across the four cases and could plausibly explain part of the variance: GDP per capita ranges roughly from USD 5,700 (Moldova) to USD 36,000 (Italy); urbanisation rates vary from approximately 43% (Moldova) to 71% (Italy); population density differs by an order of magnitude across the four countries; and waste-stream composition reflects climate, dietary, and consumption-pattern differences. We considered whether the EPR / aggregation / behaviour triad merely correlates with these structural variables rather than independently driving performance. Two observations argue against the structural-confounding interpretation (cf. Milošević et al., 2025b). First, Greece (comparable to Italy on GDP per capita and urbanisation) performs dramatically worse, indicating that structural variables alone do not determine outcomes. Second, the within-country variance in Italy (north 75%+ separate collection, south below 50%) holds GDP, density, and climate broadly constant while EPR maturity and the depth of municipal aggregation vary, again favouring the institutional-causal account over the structural one. We do not claim to have ruled out structural variables comprehensively; a fuller treatment would require quantitative analysis beyond the present scope. We claim, more modestly, that structural variables cannot account for the variance pattern observed and that the institutional triad we identify offers a plausible and policy-relevant explanation.

3.8.2 Lessons that may transfer

Some lessons are likely to transfer across contexts. Well-capitalised, operationally independent EPR institutions appear to deliver outcomes wherever deployed (Massarutto, 2014). Inter-municipal aggregation produces operational efficiency at any scale. Predictable, dedicated funding (as in Italian TARI) outperforms variable property-tax derivatives (as in Greek cleaning fees). Source-separation infrastructure must precede behavioural campaigns, not follow them. These lessons are not country-specific.

Other lessons are highly context-dependent. Italian success rests on specific institutional features — strong regional government, capable utilities, deep civil society — that cannot be transplanted wholesale to Moldova. Serbia's IPA-financed regional projects work in part because of accession conditionality that does not apply to Moldova. Greek struggles reflect specific Greek dysfunctions in municipal finance and project management that other countries do not share. The honest analytical conclusion is that EU

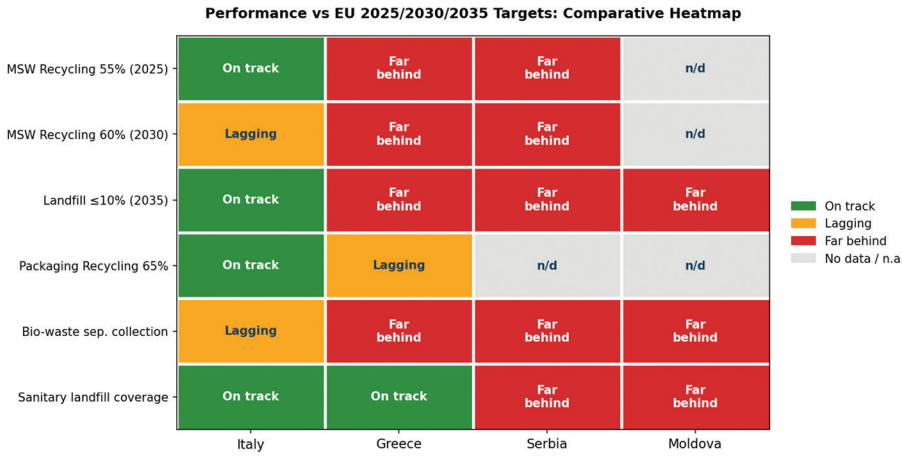

Figure 3.3 Comparative performance heatmap: country positions against six binding EU 2025/2030/2035 targets. Italy is broadly on track for most targets but lags on bio-waste collection. Greece misses most targets despite full legislative alignment and abundant funding. Serbia and Moldova show systematic deficits, with the binding constraint being infrastructure rather than statutory framework. Sources: Authors' assessment based on Eurostat (2024), EEA (2025b), ISPRA (2024), Bankwatch (2025), UNDP (2024).

policy convergence has limits: legal alignment is achievable, infrastructure transfer is conditional, and behavioural change is largely endogenous.

3.8.3 Toward a performance typology

Figure 3.3 summarises the comparative position of the four countries against the binding 2025 and 2030 EU targets. The heatmap visualisation highlights that performance gaps are not uniform: Italy is broadly on track for most targets but lags on bio-waste separate collection; Greece misses most targets (EEA, 2025b); Serbia and Moldova, operating on national methodologies, are not directly comparable but both show sizeable implementation deficits (Bankwatch, 2025; UNDP, 2024). The typology that emerges has three categories. Mature performers (Italy) need targeted closure of remaining gaps, particularly between northern and southern regions (ISPRA, 2024). Lagging members (Greece) need fundamental reform of municipal capacity and project delivery; the binding constraint is governance, not finance. Catching-up systems (Serbia, Moldova) need infrastructure, financing, and time — in roughly equal measure. Each category demands a different policy response (Hartley et al., 2020). Section 3.9 develops these recommendations.

3.8.4 Robustness check: Propositions against cases

We now test the three propositions of Section 3.2.6 explicitly against the four cases. Proposition 1 — EPR maturity drives outcomes — is supported by Italy (CONAI since 1997, six material consortia, strong outcomes), corroborated by the Italian within-country pattern (north stronger CONAI integration, north stronger outcomes), and the negative case Moldova (EPR partly on paper, weak outcomes). The proposition fits Greece imperfectly: E.O.AN. has been operational since 2011 and has experienced repeated reorganisations, suggesting that mere statutory existence is insufficient; institutional stability and capitalisation are the operative variables, as Massarutto (2014) anticipated. P1 holds, with refinement. Proposition 2 — inter-municipal aggregation drives outcomes — is supported strongly by Italy's OTA system and the contrast between Italian regions where regional waste governance is consolidated versus those where it remains fragmented. Greece's FoDSAs, structurally similar to Italian regional bodies but politically contested, show that aggregation requires governance stability to deliver (Council of Europe, 2022). Serbia's regional waste management centers, where operational, support P2; where they remain at planning stage, they cannot. Moldova's eight planned regions test P2 prospectively. P2 holds, conditional on governance quality. Proposition 3 — behavioural embedding drives outcomes — is supported by Italy (three-decade reinforcement, generational normalisation), unsupported in Moldova (insufficient institutional history to test), and partly supported in Greece, where stated willingness to participate is high but routine practice is weak — pointing toward the infrastructure–information–habit sequence we develop in Section 3.7.

Two cases warrant explicit caution. The within-Italy variance — north strong, south weak — is consistent with all three propositions but also with the GDP and density-related structural variables we discussed earlier in this section. We cannot fully separate institutional from structural causes within Italy on the present evidence base. Greece is the most analytically interesting case: it has formal institutions (E.O.AN., FoDSAs) and substantial finance, yet performance is poor. The combination of weak P1 (institutional instability), weak P2 (politically contested aggregation), and weak P3 (information without infrastructure preventing habit formation) jointly explains the Greek outcome better than any single variable. This is the kind of multi-factor convergence that comparative qualitative analysis is designed to surface. We do not claim the three propositions exhaust the causal field — alternative or complementary frameworks (advocacy coalitions, multi-level governance dynamics, EU compliance literature) could yield further insights. We claim,

more modestly, that the three-proposition framework is consistent with the four cases, identifies plausible policy levers, and survives the alternative-explanation tests of Section 3.8.1.

3.9 Policy Recommendations and Individual Actions

Comparative analysis is most valuable when it produces actionable recommendations, differentiated by context. The four countries occupy different positions on the SDG 12 trajectory, and uniform recommendations would be inappropriate. This section therefore proposes country-differentiated policy recommendations and a framework for individual action that the original conference paper had developed for the Greek case (Papavasileiou et al., 2024) but which deserves recasting across the four-country comparison.

Each country-specific recommendation below is derived from a specific finding established in Sections 3.4 to 3.8. We make the analytical warrant explicit: Recommendation R follows from Finding F because evidence E from cases C supports the diagnosis. For Greece, the binding finding is institutional instability and weak municipal capacity (Sections 3.6.1 and 3.8.4); recommendations therefore target these institutional levers, not finance. For Italy, the binding finding is regional heterogeneity within an otherwise mature system (Sections 3.5.2 and 3.7.2); recommendations target gap-closing investment, not system rebuild. For Serbia, the binding finding is implementation lag against a recently strengthened framework (Sections 3.4.3, 3.5.3, 3.6.3); recommendations target infrastructure roll-out and EPR strengthening. For Moldova, the binding finding is the build-from-scratch challenge under fragmented LPA structure (Sections 3.4.4, 3.5.4, 3.6.4); recommendations target the National Programme execution and the cross-municipal pooling that small LPAs require. Transferability across cases is constrained: not every Italian lesson transfers to Moldova, and we acknowledge these limits where they apply.

3.9.1 Country-differentiated policy recommendations

For Greece, the binding constraint is municipal capacity and project delivery, not legal framework or finance (Council of Europe, 2022; E.O.AN., 2024). Three recommendations follow. First, dedicated technical assistance to small and medium-sized municipalities should be expanded substantially — through E.O.AN., regional governments, or a new dedicated unit — to ensure that statutory obligations on biowaste collection, PAYT pilots, and LWMP implementation become operational realities rather than paper plans. Second,

FoDSAs should be reformed to clarify governance, establish predictable funding, and depoliticise operational decisions. Third, the cleaning fee mechanism (Δημοτικά Τέλη) should be reformed to include explicit PAYT components, mirroring Italian TARI rather than continuing as a flat property-tax surcharge (Reichenbach, 2008).

For Italy, the policy frontier has shifted from establishing the system to closing remaining gaps. The north-south performance differential is the central operational challenge (ISPRA, 2024). Recommendations focus on accelerating southern infrastructure investment under PNRR Mission 2, strengthening municipal capacity in Sicily, Calabria, and Campania, and using RENTRi digital traceability to enforce uniform compliance across regions. Italy's circular economy agenda is also moving upstream — toward design-for-recycling, EPR for textiles, and reuse infrastructure — and this trajectory should be accelerated through dedicated CONAI investments (Hartley et al., 2020; Zamfir et al., 2025).

For Serbia, the implementation phase of the 2025 Law on Waste Management is the immediate priority. Three recommendations follow. First, the network of regional waste management centers should be completed, with eight to ten additional centers operational by 2030 to extend sanitary landfill coverage from the current 20–25% toward universal coverage. Second, the EPR architecture established in 2009 should be strengthened with dedicated regulatory oversight to ensure compliance, particularly for non-packaging waste streams (Bankwatch, 2025). Third, IPA III funding combined with EBRD/AFD lending should be channelled toward both infrastructure and the municipal capacity-building that must accompany it.

For Moldova, the National Programme 2023–2027 milestones are the binding test (Moldovan Government, 2023). Recommendations center on protecting the donor-funded infrastructure pipeline from political volatility, completing the seven planned sanitary landfills and 34 transfer stations on schedule, operationalising MBT plants in Chișinău and Bălți, and using the inter-municipal cooperation framework to overcome the fragmentation challenge inherent in 898 small LPAs (UNDP, 2024). Donor coordination — between EU instruments, EBRD, World Bank, and bilateral programmes — must continue to avoid the parallel-financing fragmentation that has slowed implementation in some Western Balkans contexts (Plotnic, 2024a).

3.9.2 Individual action framework

Beyond government and institutions, individual citizens can — through their daily choices — accelerate or impede SDG 12 outcomes (Reichenbach,

2008). The conference paper that anchors this work proposed ten action areas for Greek citizens (Papavasileiou et al., 2024). We adapt that framework here for cross-country application, with two methodological caveats. First, the original framework was developed inductively from the Greek context and reflects the institutional and infrastructural assumptions of an EU-member state with mature urban services. Second, transferability across our four cases is therefore conditional rather than automatic: some actions (such as second-hand and reuse-market participation) presuppose urban infrastructure and consumer markets that are present in Italy and most of Greece but partial in Serbia and limited in rural Moldova. We position the framework relative to comparable individual-action listings in the European waste policy literature (Hartley et al., 2020) and note that our ten actions broadly correspond to the citizen-level priorities those analyses identify, with two distinctive features: explicit linkage to LGO infrastructure provision (so that individual actions are not framed as substitutes for institutional capacity) and explicit accommodation of cross-context applicability through the priority weighting we develop in the following paragraph.

The action areas are: (i) source separation participation where infrastructure exists; (ii) home composting of biodegradable waste, especially valuable in countries where municipal biowaste collection is incomplete; (iii) waste auditing — measuring household waste over a representative period to identify reduction opportunities; (iv) sustainable purchasing, prioritising products with minimal packaging, recyclable materials, and end-of-life take-back; (v) reduction of single-use plastics and disposables, particularly in food service contexts; (vi) participation in second-hand and reuse markets — clothing, electronics, furniture — which directly extend product lifespans; (vii) support for local farmers through short food chains, reducing transport-associated waste; (viii) elimination of plastic bag use, replaced by reusable alternatives; (ix) reduction of bottled water consumption where tap water is safe; (x) reduction of paper use in domestic and professional contexts.

These actions matter more in some contexts than others, and not every action transfers cleanly across our four cases. In Italy, where infrastructure is strong, sustainable purchasing and reuse markets carry more relative weight than in Moldova, where source separation participation when bins arrive is the priority action (Mitoula et al., 2017). In Greece, where infrastructure is patchy, home composting can fill a gap that municipal biowaste collection has not yet reached. In Serbia, where infrastructure is mid-development, individual support for emerging EPR-funded collection systems accelerates institutional consolidation. Some actions transfer poorly: organised second-hand markets (action vi) presume the urban-consumer infrastructure

that is largely absent in rural Moldova, where reuse practices remain informal and non-monetised; the action remains valid in principle but operates under different sociological logic. The framework is universal in its conceptual structure; its application is local, and the priority weighting must follow the institutional and behavioural conditions of each context.

3.10 Conclusion

This chapter has compared SDG 12 implementation across Greece, Italy, Serbia, and Moldova — a sample following a most-different-systems design, spanning a long-standing EU member with mature performance, an EU member struggling to convert legal compliance into outcomes, an EU candidate, and an Eastern Partnership country. The four-country comparison highlights cross-case patterns that are less visible in single-country studies. Legal alignment with EU frameworks appears broadly achievable, but the four cases show that outcome convergence remains limited. Italy's mature performance shows what three decades of consistent EPR development, capable inter-municipal organisation, and behavioural embedding can deliver. Greece illustrates the difficulty of converting abundant funding and recent legislative reform into operational outcomes when municipal capacity is weak. Serbia's 2025 framework reform represents a meaningful step but faces the same implementation gap, with a different binding constraint — infrastructure, not governance. Moldova's 2023–2027 National Programme (Plotnic, 2024b) is at the start of a build-out that will determine whether the country converges with EU patterns or remains structurally behind. The comparison yields implications for SDG 12 scholarship and policy that are worth stating plainly. First, comparative analysis across different stages of European integration is more useful than comparison among similar cases; the variance reveals what convergence and divergence look like under common policy frameworks (Domenech & Bahn-Walkowiak, 2019). Second, finance is necessary but not sufficient — the Greek experience demonstrates that absorptive capacity, governance, and project pipeline maturity matter at least as much (Cifuentes-Faura, 2025; Bankwatch, 2025). Third, EPR institutional architecture, regional aggregation among municipalities, and citizen behavioural embedding are the three variables most strongly associated with performance. Strengthening these is where comparative learning has most to offer. Future research should extend the comparison through primary fieldwork at municipal level, particularly in Serbia and Moldova where comparable quantitative data is incomplete. The textile waste stream — recently added to mandatory separate-collection requirements — deserves dedicated comparative analysis. And the transition

from waste management toward upstream circular economy redesign, foreshadowed in the 2020 Action Plan and implemented through the Ecodesign Regulation and Right to Repair Directive, will reshape the comparative picture in ways the present analysis can only sketch. On current evidence, the waste-management dimensions of SDG 12 are unlikely to be fully achieved by 2030 across the four cases. Whether progress accelerates sharply enough to make 2035 targets meaningful is the question that frames the next phase of European waste policy.

Author Contributions

Conceptualization, A.P., O.P., I.M., M.M., A.E., and R.M.; Methodology, A.P. and A.E.; Data curation, A.P. (Greece), O.P. (Moldova), I.M. (Serbia), M.M. (Italy); Formal analysis, A.P., A.E., O.P., I.M., and M.M.; Investigation, A.P., O.P., I.M., and M.M.; Writing — original draft preparation, A.P.; Writing — review and editing, A.P., O.P., I.M., M.M., A.E., and R.M.; Visualization, A.P.; Supervision, R.M.; Project administration, A.P. All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

The data supporting the findings of this study are available from publicly accessible institutional sources: Eurostat databases (env_wasmun, env_waspac, sdg_12_50 series), accessible at https://ec.europa.eu/eurostat/data/database; European Environment Agency country profiles, accessible at https://www.eea.europa.eu; national authority reports as cited in the References section. No new empirical datasets were generated by the authors. All secondary data sources are cited in full in the References. All figures in this chapter were produced using Python 3 with the Matplotlib library (version 3.x), based on the publicly available data sources cited in the References. No AI image-generation tools were used to create any figure.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this manuscript, the authors used Claude (Anthropic) for language refinement, readability improvement, structural consistency checking, and pre-submission editorial review. The tool was used to improve the presentation of the research rather than to generate substantive research content. All primary research decisions, analytical judgments,

development of the comparative framework, formulation of the propositions tested in Section 3.2.6, interpretation of findings, and policy conclusions are entirely those of the authors. The authors reviewed and edited all AI-assisted output and take full responsibility for the content, accuracy, completeness, and integrity of the final manuscript. AI tools were not used as authors and are not listed as authors.

References

AFD (Agence Française de Développement). (2023). Supporting the national solid waste programme in Serbia. AFD Project Documentation, AFD Belgrade Office. Available at: https://www.afd.fr/sites/default/files/pdfs/supporting-national-solid-waste-program-serbia-13563-en.pdf (accessed May 2026).

Bankwatch Network. (2025). Waste management and the circular economy in central and eastern Europe: An analysis of EU cohesion policy funding. CEE Bankwatch Network, Prague. Available at: https://bankwatch.org/publication/waste-management-and-the-circular-economy-in-central-and-eastern-europe-an-analysis-of-eu-cohesion-policy-funding (accessed May 2026).

Bondarouk, E., & Mastenbroek, E. (2018). Reconsidering EU compliance: Implementation performance in the field of environmental policy. Environmental Policy and Governance, 28(1), 15–27.

Calatayud-Vinent, A., & Iglesias-Márquez, D. (2023). The European Union's Circular Economy Action Plans: A legal assessment of regulatory tools and instruments. Review of European, Comparative and International Environmental Law, 32(2), 187–203.

Cifuentes-Faura, J. (2025). Building an index based on key SDG 12 indicators to promote the transition to a circular economy. Finance Research Letters, 82, 107610. https://doi.org/10.1016/j.frl.2025.107610

Council of Europe. (2022). Local government finance in Greece: A monitoring report. Congress of Local and Regional Authorities, Strasbourg.

Domenech, T., & Bahn-Walkowiak, B. (2019). Transition towards a resource-efficient circular economy in Europe: Policy lessons from the EU and the Member States. Ecological Economics, 155, 7–19.

EBRD (European Bank for Reconstruction and Development). (2024). Moldova solid waste management: Strategic environmental assessment. EBRD, London.

EEA (European Environment Agency). (2024). Early warning assessment related to the 2025 targets for municipal waste and packaging waste.

EEA, Copenhagen. Available at: https://www.eea.europa.eu/en/analysis/publications/many-eu-member-states (accessed May 2026).

EEA (European Environment Agency). (2025a). Italy profile on municipal and packaging waste management — 2025. EEA, Copenhagen. Available at: https://www.eea.europa.eu/en/topics/in-depth/waste-and-recycling/municipal-and-packaging-waste-management-country-profiles-2025/it-municipal-waste-factsheet.pdf (accessed May 2026).

EEA (European Environment Agency). (2025b). Greece profile on municipal and packaging waste management — 2025. EEA, Copenhagen. Available at: https://www.eea.europa.eu/en/topics/in-depth/waste-and-recycling/municipal-and-packaging-waste-management-country-profiles-2025/gr-municipal-waste-factsheet.pdf (accessed May 2026).

E.O.AN. (Hellenic Recycling Organisation). (2024). Annual report on packaging and other waste management 2023. E.O.AN., Athens.

European Commission. (2015). Closing the loop — An EU action plan for the circular economy. COM(2015) 614 final, Brussels.

European Commission. (2019). Report on the implementation of the Circular Economy Action Plan. COM(2019) 190 final, Brussels.

European Commission. (2020). A new circular economy action plan: For a cleaner and more competitive Europe. COM(2020) 98 final, Brussels.

European Commission. (2023). Proposal for a Directive amending Directive 2008/98/EC on waste. COM(2023) 420 final, Brussels.

European Commission. (2024a). Regulation (EU) 2024/1781 of the European Parliament and of the Council of 13 June 2024 establishing a framework for the setting of ecodesign requirements for sustainable products. Official Journal of the European Union, L 2024/1781.

European Commission. (2024b). Cohesion Policy 2021–2027: Multiannual Financial Framework. DG Regional and Urban Policy, Brussels.

European Commission. (2024c). Greece partnership agreement 2021–2027. DG Regional and Urban Policy, Brussels.

European Commission. (2024d). IPA III: Pre-accession assistance programming 2021–2027. DG Neighbourhood and Enlargement Negotiations, Brussels.

European Court of Auditors. (2024). Special Report: Italian Recovery and Resilience Plan implementation. ECA, Luxembourg.

European Parliament. (2025). Cohesion Fund 2021–2027: Briefing for the BUDG Committee. EPRS, Brussels.

Eurostat. (2024). Municipal waste statistics: 2023 data release. Eurostat database env_wasmun and env_waspac, Luxembourg.

Eurostat. (2025). Sustainable development in the European Union — Monitoring report on progress towards the SDGs in an EU context (9th edition). Publications Office of the European Union, Luxembourg.

Government of the Republic of Moldova. (2016). Law No. 209 of 29 July 2016 on Waste. Official Monitor No. 459–471, Chișinău.

Government of the Republic of Serbia. (2022). Waste Management Programme 2022–2031. Official Gazette of the Republic of Serbia No. 137/2022, Belgrade.

Hartley, K., van Santen, R., & Kirchherr, J. (2020). Policies for transitioning towards a circular economy: Expectations from the European Union (EU). Resources, Conservation and Recycling, 155, 104634.

Heidenheimer, A. J., Heclo, H., & Adams, C. T. (1990). Comparative public policy: The politics of social choice in America, Europe, and Japan (3rd ed.). St. Martin's Press, New York.

Hellenic Ministry of Environment and Energy. (2020). National Waste Management Plan 2020–2030. Official Gazette of the Hellenic Republic FEK A' 185, Athens.

Hellenic Ministry of Interior. (2024). Local government statistical bulletin. Athens.

Hellenic Recycling Organisation. (2024). Material Recovery Facility infrastructure inventory 2024. E.O.AN., Athens.

Hellenic Republic. (2021). Law 4819/2021: Integrated framework for waste management. Official Gazette of the Hellenic Republic FEK A' 129, Athens.

HSWMA (Hellenic Solid Waste Management Association). (2024). Annual review of MSW infrastructure in Greece. Athens.

ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale). (2024). Municipal Waste Report — Edition 2024 (Rapporto Rifiuti Urbani, Edizione 2024). National Waste and Circular Economy Center, ISPRA, Rome. Available at: https://www.isprambiente.gov.it/en/publications/reports/municipal-waste-report-edition-2024 (accessed May 2026).

ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale). (2025). Municipal Waste Report — Edition 2025 (Rapporto Rifiuti Urbani, Edizione 2025): data updated to 2024. National Waste and Circular Economy Center, ISPRA, Rome. Available at: https://www.isprambiente.gov.it/en/publications/reports/municipal-waste-report-edition-2025 (accessed May 2026).

ISTAT (Istituto Nazionale di Statistica). (2024). Annuario statistico italiano 2024. ISTAT, Rome.

Italian Ministry of Economy and Finance. (2021). Piano Nazionale di Ripresa e Resilienza (PNRR). Rome.

Italian Ministry of Environment and Energy Security. (2025). D.Lgs. 152/2006 — Norme in materia ambientale (Codice dell'Ambiente), as amended through Law 18 March 2025 No. 40. Normattiva, Rome. Available at: https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2006-04-03;152 (accessed May 2026).

Jordan, A., & Adelle, C. (Eds.). (2013). Environmental policy in the EU: Actors, institutions and processes (3rd ed.). Routledge, London.

Knill, C., & Liefferink, D. (2007). Environmental politics in the European Union: Policy-making, implementation and patterns of multi-level governance. Manchester University Press, Manchester.

Martínez-Jiménez, V., Jiménez-Aguirre, R., & Martínez-Olvera, C. (2021). The circular economy and the European Union: A review of indicators, instruments, and obstacles. Sustainability, 13(8), 4275. https://doi.org/10.3390/su13084275

Massarutto, A. (2014). The long and winding road to resource efficiency — An interdisciplinary perspective on extended producer responsibility. Resources, Conservation and Recycling, 85, 11–21.

Mazzanti, M., & Zoboli, R. (2006). Economic instruments and induced innovation: The European policies on end-of-life vehicles. Ecological Economics, 58(2), 318–337. https://doi.org/10.1016/j.ecolecon.2005.07.024

Milošević, I., Plotnic, O., Buzdugan, A., Stanković, Z., & Tick, A. (2025a). Circular economy as a strategic imperative for fostering sustainability and consumer engagement. Sustainable Development, Culture, Traditions Journal, 16(A), Special Issue ECO4ALL.

Milošević, I. M., Plotnic, O., Dumančić, K., & Bojkovska, K. (2025b). The role of legislation and consumer perception in shaping circular economy behaviour. Serbian Journal of Management, 20(2), 349–365.

Mitoula, R., Economou, A., & Karametou, P. (2024). Contribution of urban regeneration to sustainable development: The case of Piraeus. Sustainable Development, Culture, Traditions Journal, 16(2), 45–62.

Mitoula, R., Theodoropoulou, E., & Karali, B. (2017). Sustainable development in the City of Volos through reuse of industrial buildings. International Journal of Energy and Environment, 8(4), 369–376.

Moldovan Government. (2023). National Waste Management Programme 2023–2027. Government Decree No. 972 of 6 December 2023, Chișinău.

National Bureau of Statistics of Moldova. (2024). Statistical yearbook of the Republic of Moldova 2024. Chișinău.

OECD/SIGMA. (2023). Multi-level governance in the six Western Balkan economies. SIGMA Paper No. 62, GOV/SIGMA(2023)1, OECD Publishing, Paris. Available at: https://one.oecd.org/document/GOV/SIGMA%282023%291/en/pdf (accessed May 2026).

Papavasileiou, A., Economou, A., & Mitoula, R. (2024). The contribution of Local Government Organizations and citizens to the achievement of the 12th SDG in Greece. Conference Paper, Open Air Cities International Conference.

Pires, A., Martinho, G., Rodrigues, S., & Gomes, M. I. (2019). Sustainable solid waste collection and management. Springer International Publishing, Cham.

Plotnic, O. (2024a). Legal adaptation strategies for unforeseen events in the circular economy through the integration of resilience and material reuse. European Financial Resilience and Regulation, 256–270.

Plotnic, O. (2024b). Advancing circular economy: Integrating consumers and institutions towards sustainability. EURINT, Editura Universității Alexandru Ioan Cuza din Iași, 65–83.

Reichenbach, J. (2008). Status and prospects of pay-as-you-throw in Europe — A review of pilot research and implementation studies. Waste Management, 28(12), 2809–2814.

Schaffrin, A., Sewerin, S., & Seubert, S. (2015). Toward a comparative measure of climate policy output. Policy Studies Journal, 43(2), 257–282.

SEPA (Serbian Environmental Protection Agency). (2023). Annual report on the state of the environment in the Republic of Serbia 2022. SEPA, Belgrade.

Serbian Government. (2024). Annual report on environmental protection 2023. Ministry of Environmental Protection, Belgrade.

Serbian Ministry of Environmental Protection. (2025). Law on Waste Management. Official Gazette of the Republic of Serbia No. 109/2025. Belgrade. [Enacted October 2025.]

Stanisavljević, N., Brunner, P. H., & Vučinić, A. A. (2018). Municipal solid waste management in Serbia: Current state and future challenges. Detritus, 1, 162–170.

UNDP (United Nations Development Programme). (2024). UNDP Moldova development results report 2023–2024. UNDP Moldova, Chișinău. Available at: https://www.undp.org/moldova/publications/undp-moldovas-development-results-report-2023-2024 (accessed May 2026).

UNDP Serbia. (2023). Public attitudes survey on environmental issues. UNDP Belgrade.

World Bank. (2018). What a waste 2.0: A global snapshot of solid waste management to 2050. World Bank Group, Washington DC.

World Bank. (2023). Municipal waste management in Serbia: Situational analysis. World Bank Group, Washington DC. Available at: https://openknowledge.worldbank.org/entities/publication/81540fa6-3bd3-4a3a-ac3d-cb87dde773c8 (accessed May 2026).

Zamfir, N., Plotnic, O., Tofan, M., Milošević, I., & Menshikova, M. (2025). Regulatory framework for innovation and advancing climate neutrality through circular economy sandboxes. Strategic Planning for Energy and the Environment, 44(04), 793–818. https://doi.org/10.13052/spee1048-5236.4447