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Opinion of the European Economic and Social Committee

From waste plants to resource plants

(own-initiative opinion)

(C/2025/107)

Rapporteur: **Anastasis YIAPANIS**

Co-rapporteur: **Michal PINTÉR**

Advisor	Mihai IVAŞCU (to the Gr. III rapporteur) Alexandra ŠARINOVÁ (to the Cat. 1 co-rapporteur)
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1. Conclusions and recommendations

1.1. Waste generation, driven by population growth, urbanisation, industrialisation and economic development, requires sustainable waste management practices to achieve the sustainable development goals (SDGs), focusing on minimising waste generation through prevention and increased reusability. Businesses, governments and citizens are seeking sustainable waste management solutions, requiring a shift from linear product-to-waste thinking to waste-to-resource approaches.

1.2. The EESC believes it is imperative to prioritise EU-level discussions on waste management and to implement a revised strategy to embrace pioneering projects aimed at enhancing recycling and resource recovery, while also diminishing the prevalence of dumpsites. The industry must be supported in implementing reliable and innovative technological solutions through targeted financial resources for research and development (R&D), pilot projects and the expansion of state-of-the-art technologies for resource plants.

1.3. Efficiently managing waste across borders and regulating it as a key raw material through appropriate standards under REACH and end-of-waste criteria will promote innovation and stimulate secondary materials markets. The EESC calls for EU-level oversight to address infringements and to streamline the product chain with future investments.

1.4. The Committee urges additional EU and national policies to enhance waste collection systems, to invest in advanced sorting technologies, to enforce existing regulations effectively, and to establish harmonised fines across Member States to combat illegal waste activities. Implementing a pollution fee while addressing recycling costs can bolster the economic rationale for recycling.

1.5. The EESC supports the widespread harmonisation of standards for recovered materials in order to ensure a level playing field for virgin and secondary materials across the entire Union and to prevent their fragmented regulation at individual national levels.

1.6. Several available technologies, such as waste-to-water plants, waste-to-hydrogen, incinerator bottom ash and fly ash use, waste-to-fuels technologies and wastewater treatment have the potential to shift current waste management paradigms towards a resource-oriented approach and foster industrial symbiosis. Support for innovative recovery technologies and functional markets for recovered materials is needed, as well as a regulatory environment that encourages a transition from disposing of unsustainable materials to generating high-quality secondary materials.

1.7. The EESC calls for increased financial incentives and support to develop and adopt innovative technologies (such as the Internet of Things (IoT), AI robots, pneumatic pipes, blockchain technology, chemical recycling, advanced material separation techniques, drones and satellite imaging), while respecting the waste hierarchy principle. The European Investment Bank's (EIB) dedicated financing for waste management should be expanded and streamlined to prioritise investments that support integrated resource recovery from waste.

1.8. In line with the EU Blue Deal priorities, the EESC strongly supports maximising nutrient recovery from wastewater, sewage sludge and other sources, through best-practice treatment, recycling and through resource recovery methods aimed at capturing valuable minerals.

1.9. The EESC recognises the need for dedicated upskilling and reskilling programmes for waste industry workers. The green and digital transformations are changing the nature and scope of waste industry jobs, requiring additional investments in human capital at all skill levels and of all functions. The EESC advocates for the continuous involvement of social partners in designing and implementing such programmes to facilitate a common understanding of sectoral challenges and solutions for workers.

1.10. Supporting the active engagement of local and regional governments in transitioning waste management to integrated resource recovery is crucial for advancing the circular economy. Municipal-level governance must be strengthened to develop the necessary competences, capabilities and capacity for new investments and regulatory frameworks that foster innovation in waste and resource management.

1.11. The EESC considers that information campaigns must be promoted and financed to inform EU citizens about waste prevention, producer responsibility and environmental protection. Educating the public about waste management, recycling and the circular economy will drive essential behavioural changes.

2. **General comments**

2.1. The UN Environment Programme ([1]) reports that the world generates 2,1 billion tonnes of municipal solid waste annually, with a projection that this will grow to 3,8 billion tonnes by 2050. Waste generation is an unavoidable result of population growth, urbanisation, industrialisation and economic development. The European Commission emphasises that 'half of total greenhouse gas emissions and more than 90 % of biodiversity loss and water stress come from resource extraction and processing ([2])'.

2.2. Integrating sustainable waste management practices is crucial for achieving SDGs and promoting a more sustainable future. The most effective path involves minimising waste generation at the source, starting with prevention and an enhanced emphasis on reusability. In a truly circular system, waste is just a mix of resources that have not yet been properly sorted or treated (but can be). However, once all virgin raw material reserves are depleted, waste will become their only source.

2.3. Waste can broadly be defined as the unintended outcome of consumption and production; however, waste is as different as its sources, and can be classified in various ways (by material, product type, source, hazard level, etc.). The primary focus of this EESC opinion is on municipal solid waste referring to – waste generated by households, retail, small businesses, public services and similar entities. This excludes non-municipal waste, such as construction, industry, agricultural or medical waste.

([1]) *Global Waste Management Outlook 2024* (unep.org).
([2]) Eur-lex – *A new Circular Economy Action Plan*.

2.4. Ensuring access to raw materials while avoiding excessive dependence on third countries has emerged as a significant environmental and geopolitical challenge for the EU. Recovering energy and materials from waste helps curb the need to extract fossil fuels and raw materials, and minimises the associated greenhouse gas emissions from extraction, while supporting energy and raw material security in the EU.

2.5. 'EU waste management is based on a five-step "waste hierarchy", which was established and made legally binding by the Waste Framework Directive ([3]) and requires EU companies to apply the best waste management techniques ([4])'. Landfilling is the 'last resort' (disposal operation), followed by waste-to-energy (WtE) processes (incineration). Mass landfilling has the potential to destroy valuable materials and nutrients that could be recovered, but many EU Member States are heavily depending on it. At a time when businesses, governments and citizens are looking for sustainable solutions to waste management, the linear product-to-waste paradigm must shift towards waste-to-resource thinking.

3. **Treating waste as a resource**

3.1. While the EESC appreciates the efforts of current EU waste legislation, it emphasises the need to prioritise EU-level discussions on waste legislation and management. These discussions should cover updated strategies, innovative technologies and management techniques, promoting circularity principles and removing regulatory barriers to developing a circular system. Such discussions should align with the EU's objectives in the Packaging and Packaging Waste Regulation, the Waste Framework Directive, the Urban Wastewater Treatment Directive, and the Waste Shipment Regulation. It is recommended that recovery targets be set for materials like phosphorus, nitrogen, metals, etc., and that the waste-as-a-resource logic be applied in all new and revised EU legislation to avoid placing unnecessary regulatory or economic penalties on the use of raw materials recovered from waste. Within the Critical Raw Materials Act, a much stronger and broader focus on recycling is encouraged.

3.2. Effective waste management technologies must be implemented to enhance recycling and recovery, while decreasing the prevalence of dumpsites. The EU must support industry to deploy its latest technological solutions, aiming for large-scale roll-out and implementation. Appropriate and targeted financial support for R&D, pilot projects and for scaling up innovative technologies for resource plants will decrease their costs. The EIB's dedicated financing stream for waste management should be increased and streamlined to focus on investments that contribute to the transition to the circular economy and to integrated resource recovery from waste. The distribution of financial support should take into account territorial aspects.

3.3. Performance metrics and standardised indicators need to be developed to improve waste management procedures, covering a broad range of dimensions, going beyond purely economic or environmental aspects, and integrating social factors.

3.4. The Committee has asked that 'the EU … support its waste treatment and processing industry by preparing secondary raw materials to be recycled in production processes and amend existing waste legislation so as to prioritise recycling and the circularity of critical and strategic RM [raw materials] with the highest technical and economic potential for recycling ([5])'. In addressing the cost of recycling, introducing a cost for polluting can help establish a market case for recycling.

([3]) Eur-lex Consolidated text – Directive 2008/98/EC.

([4]) The foundation of EU waste management is the five-step "waste hierarchy", established in the Waste Framework Directive. It establishes an order of preference for managing and disposing of waste.

([5]) Opinion of the European Economic and Social Committee on "Proposal for a Regulation of the European Parliament and of the Council establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1724 and (EU) 2019/1020" [COM(2023) 160 final — 2023/0079 (COD)] and on "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions — A secure and sustainable supply of critical raw materials in support of the twin transition" (COM(2023) 165 final) (OJ C 349, 29.9.2023, p. 142).

4. **Shift from conventional waste management to integrated comprehensive resource management**

4.1. The EESC calls for enhancing the operation and effectiveness of landfills by implementing new infrastructure, treatments and technological tools. Europe needs separation techniques that are more efficient, and to promote the use of WtE and integrated resource recovery plants over landfills, as these enable solid waste to be processed to generate electricity and other output materials.

4.2. Fostering collaborations with research centres while developing cutting-edge technologies can advance WtE innovation, thereby enhancing resource efficiency by reducing landfill waste and preserving raw materials. The EESC emphasises that WtE planning should adhere to the waste hierarchy principle, taking into account life-cycle considerations, and is calling for a policy and financial support (e.g. through recognition of WtE in the EU Taxonomy Delegated Acts) to establish a business and environmental case for WtE technologies that incorporate material recovery processes, such as bottom ash processing and metal extraction, to help recover secondary raw materials and nutrients and reduce hazardous waste and landfilling.

4.3. Future waste legislation at both EU and Member State level should recognise the systemic contribution of resource plants, provide support for recovering resources from waste, and classify installations such as resource recovery plants or wastewater treatment plants as resource hubs that provide not only heat, electricity or water, but also captured carbon, nutrients, recovered metals and organic materials as an alternative to virgin materials. Waste should be considered and regulated as a key raw material, including by setting appropriate REACH standards and end-of-waste criteria and efficiently managing cross-border waste shipments. Granting end-of-waste status to new and innovative materials will promote innovation and stimulate the secondary materials markets. Control at EU level is important, as waste management infringements often occur where oversight is weakest.

4.4. Member States must strive to absorb EU funds to the maximum extent possible and guide investment towards a circular economy. The EESC is calling for additional EU and national policies that focus on improving waste separation and collection systems and, complementarily, investment in advanced sorting technologies to maximise recycling rates. Source separation is one of the most important operations at the beginning of the waste management chain and is the decisive effort to ensure quality recycling, while involving direct consumer participation. Furthermore, enforcing existing waste management regulations must be accompanied by new measures to ensure compliance and minimise illegal waste activities. A harmonised level of fines must be applied in this regard in all Member States.

4.5. Among the available technologies for future integrated resource recovery facilities, several have the potential to shift current waste management towards a resource-oriented approach. This includes **waste-to-water plants** and integrated waste-to-water systems that use energy from waste to operate seawater desalination plants. **Waste-to-hydrogen** technology uses electricity generated via incineration processes to produce locally sourced renewable and low-carbon hydrogen. Both **incinerator bottom ash and fly ash** – residues from incineration – hold potential as sources of secondary raw materials. It is essential to incentivise the recovery of metals, minerals, aggregates, potassium, sodium and calcium in salt form at EU level via appropriate legislation and by removing regulatory barriers that currently encourage backfilling. In addition, various **waste-to-fuels technologies** (biogas, methane, syngas, e-fuels, etc.) could divert significant amounts of municipal solid waste from landfills. Regarding **wastewater treatment**, integrating **phosphorus recovery** into sustainable sludge management also requires an appropriate regulatory framework.

4.6. EU Member States currently manage the recovered materials mentioned above at national level, without European regulation or legislative coverage. This hampers their circular reuse and full valuation. Several policy actions will be needed to promote resource recovery from these substances, along with predictable and stable standards and policies to ensure the cost-effectiveness of these technologies. Support for innovative recovery technologies and functional markets for recovered materials is needed to ensure a level playing field. The regulatory environment must encourage a transition from disposing of unsustainable materials to generating high-quality secondary materials. Well-designed and flexible chemical authorisation and permitting are needed to maintain the quality of input materials for further processing.

4.7. Several regulatory obstacles need to be removed to implement the waste-to-resource shift and achieve a fully circular economy. The EESC recommends revising EU legislation that prohibits the use of recycled raw materials and recovered nutrients in various sectors, including agriculture / organic farming, animal rearing, aquaculture, etc., in close consultation with industry. Regulation should prioritise product quality over origin, and market conditions must be adjusted to level the playing field between recycled and virgin materials.

4.8. In line with the EU Blue Deal ([6]), the EESC strongly advocates the optimal recovery of nutrients from wastewater, sewage sludge and other sources through best-practice treatment, recycling and recovery methods to capture nitrogen, phosphorus and potassium. Recovery would help reduce imports into the EU of these materials, while employing advanced technology to remove heavy metals and microplastics, thus preventing soil build-up and contamination. Prioritising phosphorus and other material recovery technologies is essential for facilitating a shift to a fully circular water economy and wastewater/sludge management. A dedicated strategy for sustainable resource recovery from wastewater should be drafted, with targeted actions at both EU and Member State levels, to encourage wastewater treatment plant operators to take up these additional tasks and ensure the high quality of inflowing wastewater for recovery.

Other innovative solutions

4.9. In Europe, numerous emerging waste management technologies use the **Internet of Things (IoT)** to enhance the efficiency of waste collection. IoT sensors can be integrated into waste bins to monitor fill levels in real time, optimising waste collection routes and schedules. **AI robots** can be programmed to distinguish between various materials swiftly and precisely, with recycling centres already integrating this technology to improve efficiency and accuracy in recycling facilities. **Pneumatic pipes** can be laid beneath public waste receptacles to transport waste directly to processing centres, eliminating the need for traditional trash collection. **Blockchain technology** can be used to track and trace waste throughout its lifecycle, ensuring transparency and accountability in waste management processes. **Chemical recycling** and **advanced material separation techniques** can improve the quality and efficiency of recycling processes. **Drones** and **satellite imaging** can be used for aerial monitoring of waste sites, illegal dumping activities, and landfill management, improving surveillance and enforcement efforts.

4.10. The EESC calls for increased financial incentives and support for these technologies and practices in waste management, while respecting waste hierarchy. The Committee has already stated that doing so requires 'the adoption of policies for building new recycling facilities and for technologically upgrading the existing ones, including through the national recovery and resilience plans ([7])'.

5. Human capital and awareness raising

5.1. Workers in the waste industry will need up-skilling and re-skilling to adapt to new technologies. Adequate investments in human capital infrastructure must be ensured, with social partners fully involved. The shift to a more circular waste industry is expected to create more jobs, as advanced resource recovery processes are typically more labour-intensive than landfilling or incineration. Estimates suggest that an extra 50 000 jobs could be created in waste management alone, should the green economy be fully implemented ([8]). Additionally, the skill level of waste management workers is expected to increase, encompassing a broader range of digital skills, specialised knowledge in product/output and process engineering.

5.2. The re-evaluation of the EU's approach to waste management will directly influence the need for additional worker education and training. This includes enhancing workers' awareness of sustainability principles and innovative technologies, and an increased focus on health and safety principles. Robust social dialogue in the sector can facilitate a common understanding of these requirements and provide solutions accepted by all key stakeholders. Continued engagement with the social partners and other relevant stakeholders at cross-industry, national and EU levels should be supported and facilitated.

5.3. Local and regional governments are key drivers of waste-to-resource management initiatives, championing sustainable development and the circular economy. They manage infrastructure, enforce regulations, handle waste collection and disposal and raise public awareness. Their active engagement in transitioning waste management to fully integrated resource recovery is crucial for advancing the circular economy and implementing innovative projects. Supporting municipal-level governance is crucial for empowering local authorities to develop competences, capabilities and capacity to implement new investments and a regulatory framework that encourages innovation in waste and resource management.

([6]) EESC calls for an EU Blue Deal.

([7]) Opinion of the European Economic and Social Committee on "Sustainable recycling, use of secondary raw materials and just transition in the European ferrous and nonferrous metal industry" (own-initiative opinion) (OJ C 140, 21.4.2023, p. 1–7).

([8]) Friends of the Earth, 2010, *More jobs, less waste: Potential for job creation through higher rates of recycling in the UK and EU*.

5.4. The EESC believes information campaigns must be promoted and financed to raise awareness among EU citizens about waste prevention and reduction, producer responsibility and environmental protection. The EU population plays a massive role in shifting towards circularity, making their involvement in such campaigns vital. Furthermore, data protection must be prioritised to ensure that the EU waste management sector complies with regulations, enhances operational efficiency and maintains the trust of the public and other stakeholders.

5.5. The Committee advocates programmes and information campaigns that promote reusing, recycling and recovering materials to reduce dependence on landfills and incineration without energy recovery. Educating the public about the importance of waste management, recycling and the circular economy will foster a much-needed behavioural change.

Brussels, 23 October 2024.

The President
of the European Economic and Social Committee
Oliver RÖPKE