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Nell'epoca dell'incertezza *Quali strategie per l'economia circolare e le materie prime seconde?*

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ASA – Alta Scuola per l'Ambiente

ETC CE – European Topic Centre Circular Economy and Resource Use - EEA

SEEDS - Sustainability Environmental Economics and Dynamics Studies



European Environment Agency
European Topic Centre
Circular economy and resource use



ETCs/EEA

ETC CE – European Topic Centre on Circular Economy and Resource Use, 2022-2026 <https://www.eionet.europa.eu/etcs/etc-ce>

- 13 partners, 3 Italy (SEEDS, IRCrES, ISPRA)



European Environment Agency



NORION CONSULT



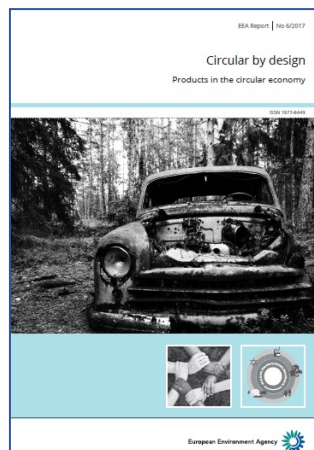
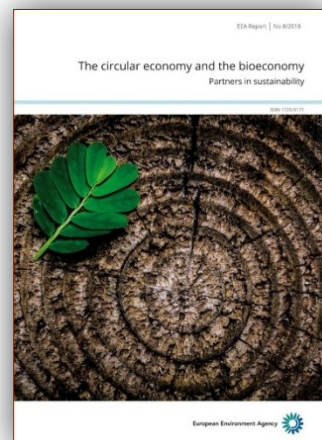
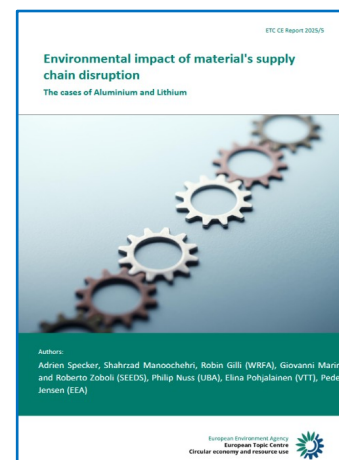
Umwelt Bundesamt

VTT



EEA/ETC reports on Circular Economy (2016, 2017, 2018, 2022, 2023, 2025)

- <http://www.eea.europa.eu/publications/circular-economy-in-europe>
- <https://www.eea.europa.eu/publications/circular-by-design>
- <https://www.eea.europa.eu/publications/circular-economy-and-bioeconomy>
- <https://www.eea.europa.eu/publications/investigating-europes-secondary-raw-material>
- <https://www.eionet.europa.eu/etcs/etc-ce/products/etc-ce-report-2024-3-environmental-impact-of-material-supply-chain-disruptions>
- <https://www.eionet.europa.eu/etcs/etc-ce/products/etc-ce-report-2025-5-environmental-impact-of-materials-supply-chain-disruption-the-cases-of-aluminium-and-lithium>



Banson Editorial & Communications



ISPRA Istituto Superiore per la Protezione e la Ricerca Ambientale

1. Policy framework europeo

EC 'Competitiveness Compass', January 2025



"The Compass builds on the [Mario Draghi's report on the future of European competitiveness](#)"

https://commission.europa.eu/topics/eu-competitiveness_en

1. Closing the innovation gap

- **EU Start-up and Scale-up Strategy**
- Adoption artificial intelligence (AI) and robotics, **"Apply AI" initiative**
- Simplifying rules and laws, **28th legal regime** for one set of rules across the EU
- **Action plans for advanced materials, quantum, biotech, robotics and space technologies**

2. A joint roadmap for decarbonisation and competitiveness

- **Clean Industrial Deal**
- Tailor-made **action plans for energy intensive sectors** (steel, metals, and chemicals)
- **Affordable Energy Action Plan**

3. Reducing dependencies and increasing resilience and security

- EU already the largest and fastest growing **network of trade agreements**, 76 countries
- A new range of **Clean Trade and Investment Partnerships** to secure supply of **raw materials**, clean energy, transport fuels, and **clean tech**
- Reviewing the **Public Procurement rules** towards a European preference



'ReArm Europe'/Readiness 2030' (March 2025)

https://ec.europa.eu/commission/presscorner/detail/en/statement_25_673

Budget 2028-2034: (MFF, July 2025): **Defense and space** expenditures are **to increase fivefold up to 131 billion**, with a major boost for cybersecurity, dual-use infrastructure and defense

Clean Industrial Deal, February 2025

COM(2025) 85 final



Affordable energy

Affordable Energy Action Plan:

- speed up the roll-out of clean energy, accelerating electrification
- complete the internal energy market with physical interconnections
- use energy more efficiently and cut dependence on imported fossil fuels

Boosting demand for clean products

- The Industrial Decarbonisation Accelerator Act introducing sustainability, resilience, and 'Made in Europe' criteria in public and private procurements
- Review the Public Procurement Framework in 2026 to introduce European preference criteria in public procurement for strategic sectors

Financing the clean transition

Mobilise over €100 billion to support EU-made clean manufacturing

- a new Clean Industrial Deal State Aid Framework
- strengthen the Innovation Fund and propose an Industrial Decarbonisation Bank, aiming for €100 billion in funding (revenues of the ETS and revision of InvestEU)
- dedicated call under Horizon Europe
- amend the InvestEU Regulation to increase the amount of financial guarantees to investments

Circularity and access to materials

Critical raw materials

- a mechanism enabling European companies to come together and aggregate their demand for critical raw materials
- create an EU Critical Raw Material Centre to jointly purchase raw materials on behalf of interested companies

Adopt a Circular Economy Act in 2026 to accelerate the circular transition. The aim is to have 24% of materials circular by 2030

Acting on a global scale

The EU needs reliable global partners. In addition to ongoing and new trade agreements, the Commission will:

- launch the first Clean Trade and Investment Partnerships to diversify supply chains and forge mutually beneficial deals
- a range of trade defence and other instruments
- simplify and strengthen the Carbon Border Adjustment Mechanism

Skills and quality jobs

- Union of Skills that invests in workers, develops skills and creates quality jobs.
- Erasmus+ will reinforce a skilled and adaptable workforce, with up to €90 million in funding.

'Simplification' (Omnibus Packages)

- **Omnibus I on sustainability** I - COM(2025) 80, (2025)81, (2025)87
- [Omnibus II package on investment simplification](#). Commission proposal adopted on 26 February 2025.
- [Omnibus III on the common agricultural policy](#). Commission proposal adopted on 14 May 2026.
- [Omnibus IV package on small mid-caps, digitalisation and common specifications](#). Commission proposals adopted on 21 May 2025
- [Omnibus V on defence](#). Commission proposals adopted on 17 June 2025
- [Omnibus VI on chemicals](#). Commission proposals adopted on 8 July 2025
- [Omnibus VII on digital](#). Commission proposals adopted on 19 November 2025
- [Omnibus VIII on environmental legislation](#). Commission proposals adopted on 10 December 2025
- [Omnibus IX on automotive](#). Commission proposal adopted on 16 December 2025
- [Omnibus X on food and feed simplification package](#). Commission proposals adopted on 16 December 2025

First 'Omnibus' package Sustainability

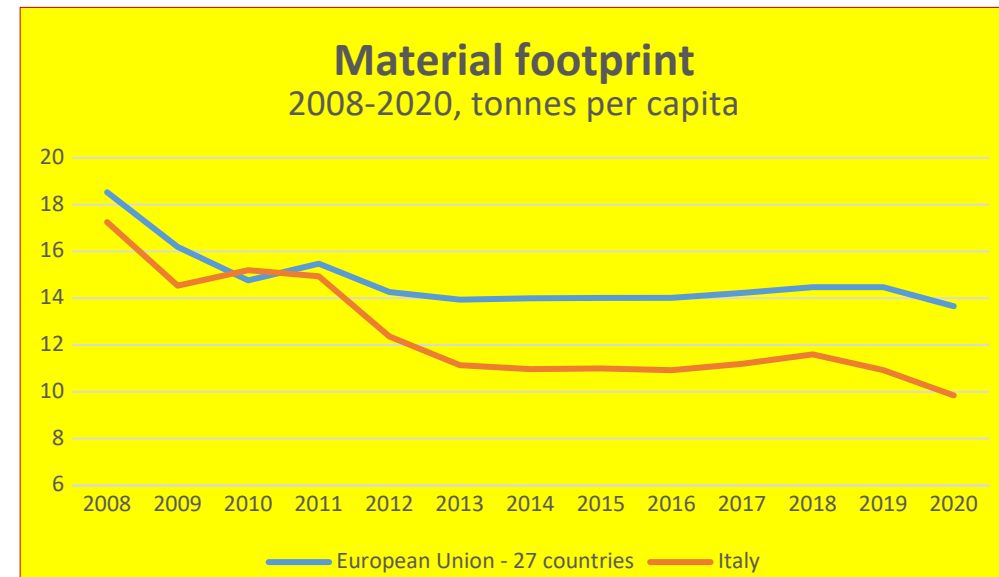
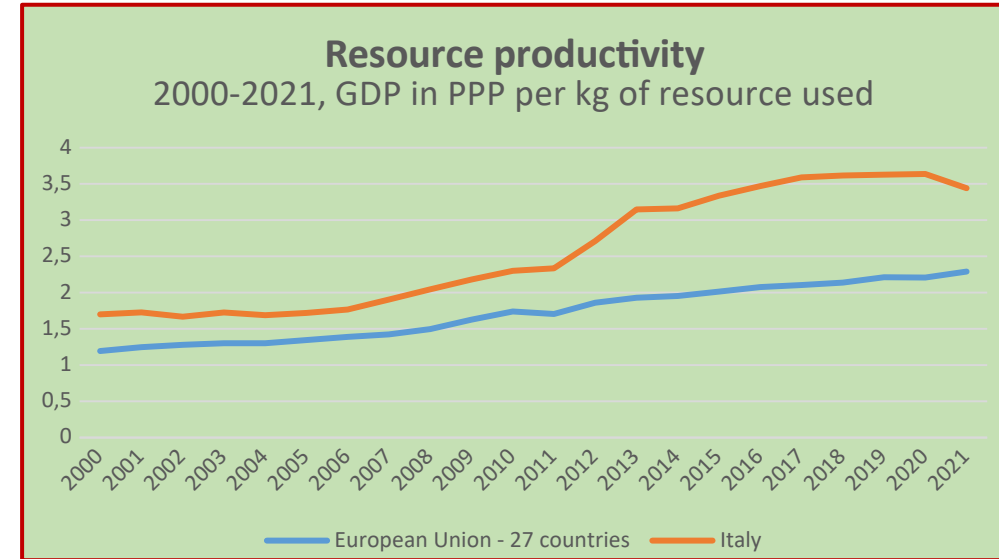
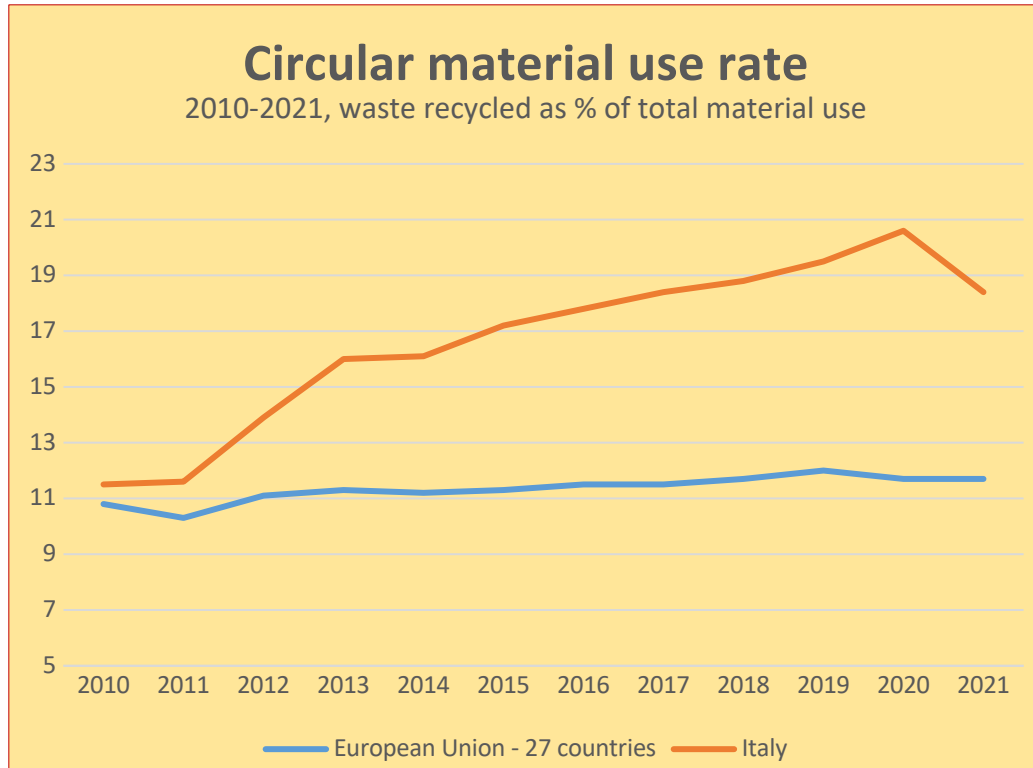
- Sustainable finance reporting (CSRD)
- Sustainability due diligence
- EU Taxonomy
- Carbon border adjustment mechanism

Circular Economy legislation framework - Last six years

(S. Paleari for ETC CE)

- EGDSF sets **10 strategic objectives** related to the 'CE and industry' policy area **to be reached in 2030**
- **2020 Circular Economy Action Plan** (CEAP; EC, 2020b): **double its Circular material use rate in the coming decade**
- By 2030: **total waste generation should be significantly reduced** (but a baseline still to be defined; EC, 2021b) and **per-capita food waste should be halved** (EC, 2020c). The latter objective **converted into (less ambitious) binding targets by the revised Waste Framework Directive** (Dir. EU/2025/1892)
- By 2030: **decrease by 50% the amount of residual (non-recycled) municipal waste** (no baseline has been defined; EC, 2021b) and **reduce by 50% plastic litter at sea and by 30% microplastics released into the environment** (compared to 2016; EC, 2021b). New legislative initiatives on microplastic (EU, 2023h and Regulation (EU) 2025/2365)
- **Strategy for sustainable and circular textiles** (EC, 2022b), by 2030: textiles should be long-lived, recyclable, and free of hazardous substances; reuse and repair services for textiles should be widely available; the incineration and landfilling of textiles should be minimised. Revised Waste Framework Directive (Dir. EU/2025/1892), introduces **Extended Producer Responsibility for textile waste**
- Most CE legislation regulates **waste management**. New legislative initiatives to address also the **other phases of the value chain** (such as Ecodesign Regulation; Directive on empowering consumers for the green transition; Directive on the repair of good; proposed Green Claims Directive; Regulation (EU) 2024/1781; Directive (EU) 2024/825; Directive (EU) 2024/1799; EC, 2023e -COM/2023/166)
- Several directives that focus on **specific waste streams** (such as packaging waste, waste batteries, and end-of-life vehicles) revised and transformed into comprehensive regulations setting for the **whole related value chains** (Regulation (EU) 2025 /40; EU, 2023f)
- **Competitiveness Compass** (COM(2025)30) and '**Clean Industrial Deal**' (COM(2025) 85): increasing the **Circular material use rate** from current **11.8% to 24%** by 2030.
- Scheduled the adoption of a **new Circular Economy Act (Q3 2026)**

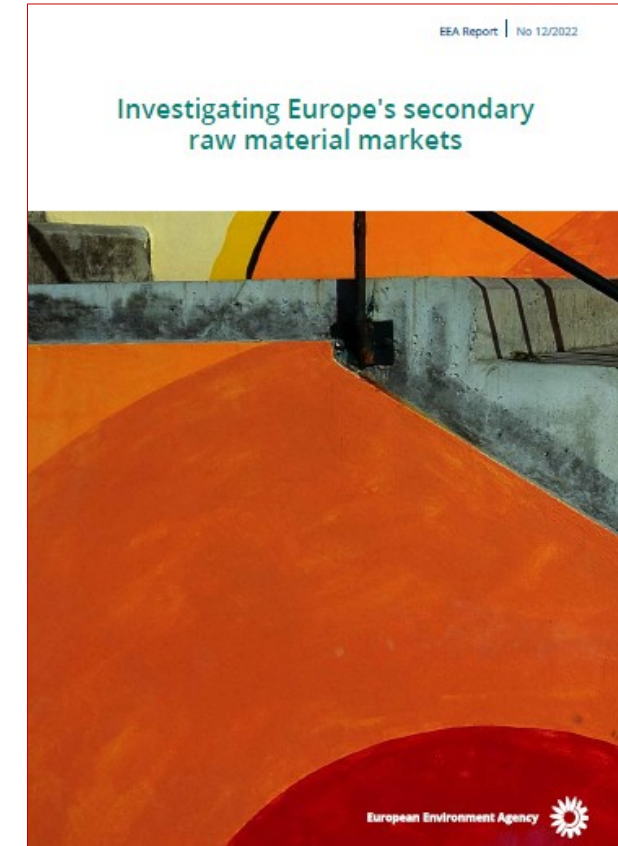
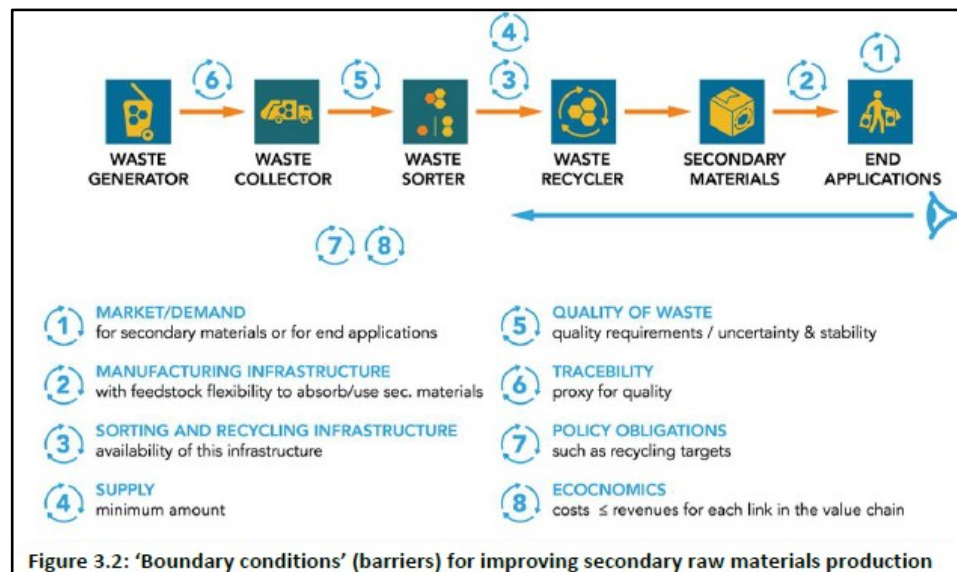
Selected CE indicators for Italy



2. Mercati dei materiali secondari

Waste as commodity

- ‘Secondary Raw Materials’ as commodities with their own markets
- Value chain approach
- Different types of **barriers** identified **by phase** of the SRM value chain (‘Product design and making’; ‘SRM supply chain’ - waste availability, waste collection /sorting/preparation, recycling - and SRM demand)
- **Policy orientation: more to do on the demand side**



Market assessment (new measurement project launched by EEA in 2025)

Table 2.1. Maturity degree of selected SRMs

Keys	GREEN LIGHT= criterion verified	YELLOW LIGHT = criterion partly verified				RED LIGHT = criterion not verified		
	Aluminium	Paper	Wood	Glass	Plastics	Biowaste	C&DW	Textiles
High share of supply/demand with respect to total market	YES	YES	Depending on the specific material	YES	High supply, low demand	High supply, low demand	High supply, low demand	High supply, low demand
Enough stable/increasing supply/demand balance	YES	YES	YES	YES	Increasing supply > demand	Increasing supply > demand	Increasing supply > demand	Increasing supply > demand
Open international trade and high tradability	YES	YES	YES	YES, but high transport cost	YES but as waste	Regional markets	Regional markets	YES but as waste
High industrial capacity based on secondary material inputs	YES	YES	YES	YES	Depending on country	Depending on country	Depending on country	Depending on country
Non-policy-driven supply/demand	YES but policies relevant	YES but policies relevant	YES but policies relevant	YES but policies relevant	Policy driven supply as waste	Policy driven supply as waste	Policy driven supply as waste	Policy driven supply as waste
Included in compliance schemes for packaging waste or EPR schemes	YES	YES	YES	YES	YES	NO	NO	Some countries
No competition from energy use	YES	Competition from RES	High competition from E-RES and H-RES	YES	High competition	Competition from biogas / biomethane	YES	YES
Reference international or national prices	YES	YES	YES	YES	YES	NO	NO	NO
'Organised markets' for trading (e.g. futures, etc.)	YES	YES	NO	NO	NO	NO	NO	NO
Sufficient information to both demand and supply actors	YES	YES	YES	YES	YES	NO	NO	NO
Product specifications are standardised	YES	YES	YES	YES	YES	YES	YES/NO	NO
Weak regulatory barriers to use as input	YES	YES	YES	YES	NO	Barriers in some countries	Barriers in some countries	NO

Source: own elaboration on Section 2.2 and background ETC/WMGE reports 2020 and 2021 (unpublished).

- **Key point: A supply/production bias in waste/recycling policies**
- **Product design/making and demand for SRMs are key to close the loop**

Table 4.1 Ideas for policy measures to improve SRM markets

Product manufacture and design	Supply of SRM	Demand for SRM
<ul style="list-style-type: none"> • Eco-modulated extended producer responsibility fees • Design for environment measures • Restrictions on substances inhibiting recycling • Green public procurement 	<ul style="list-style-type: none"> • Recycling targets • Waste export restrictions • Harmonising collection schemes • Promoting material recovery over energy recovery • Standardising SRMs • End of waste criteria 	<ul style="list-style-type: none"> • Recycled content requirements • Ecolabel/product passports • Tax on primary raw materials • VAT reduction on SRMs

3. Materie prime critiche (e riciclo)


DG GROW, European Commission, Study on the Critical Raw Materials for the EU 2023 – Final Report

<https://screen.eu/results/>

**UNDERSTANDING
THE METHODOLOGY BEHIND THE
EU LIST OF CRITICAL RAW MATERIALS**

Luis A. TERCERO ESPINOZA (Fraunhofer ISI)

This working paper aims to unravel the methodology for the determination of Critical Raw Materials for the EU first at a very high level – allowing for a quick and general understanding of the approach – and then in more depth, examining the data and equ... is placed on the chain "intention" (what it) → "effect" (how this affects the scorin

SCRREEN 



<https://op.europa.eu/en/publication-detail/-/publication/57318397-fdd4-11ed-a05c-01aa75ed71a1>

Figure 1: Overall structure of the criticality methodology²²

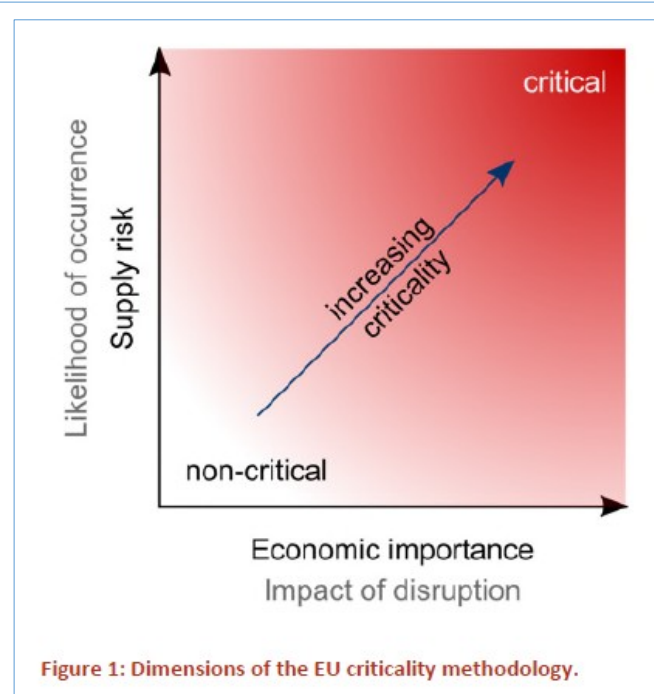
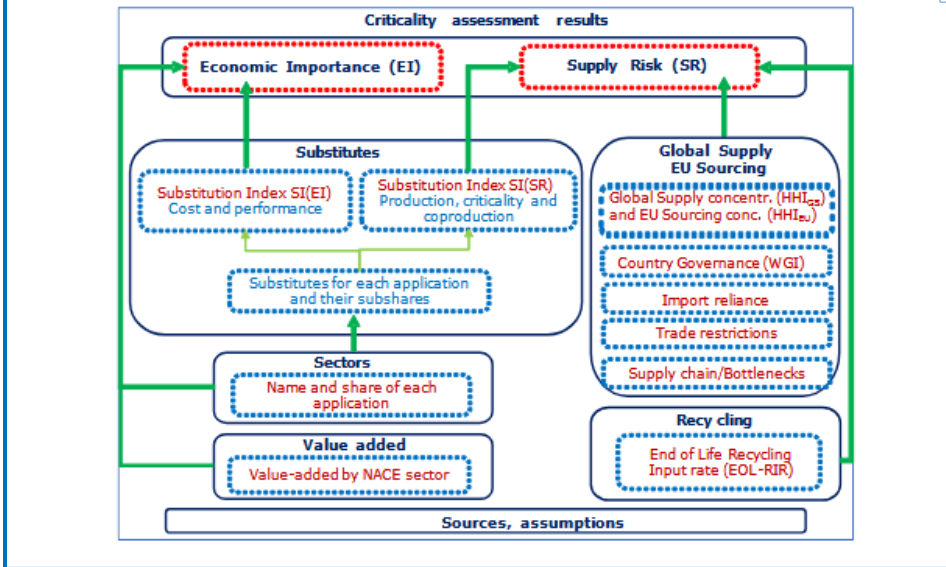
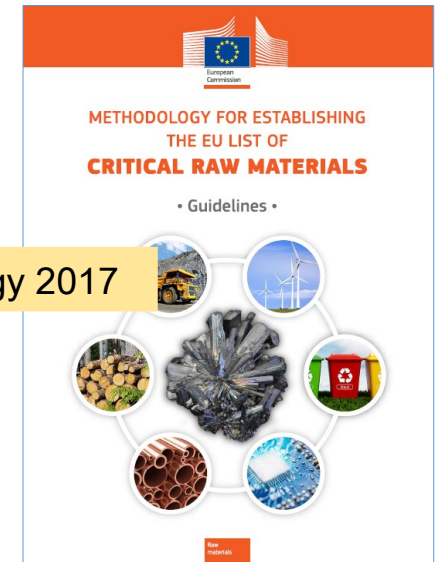


Figure 1: Dimensions of the EU criticality methodology.



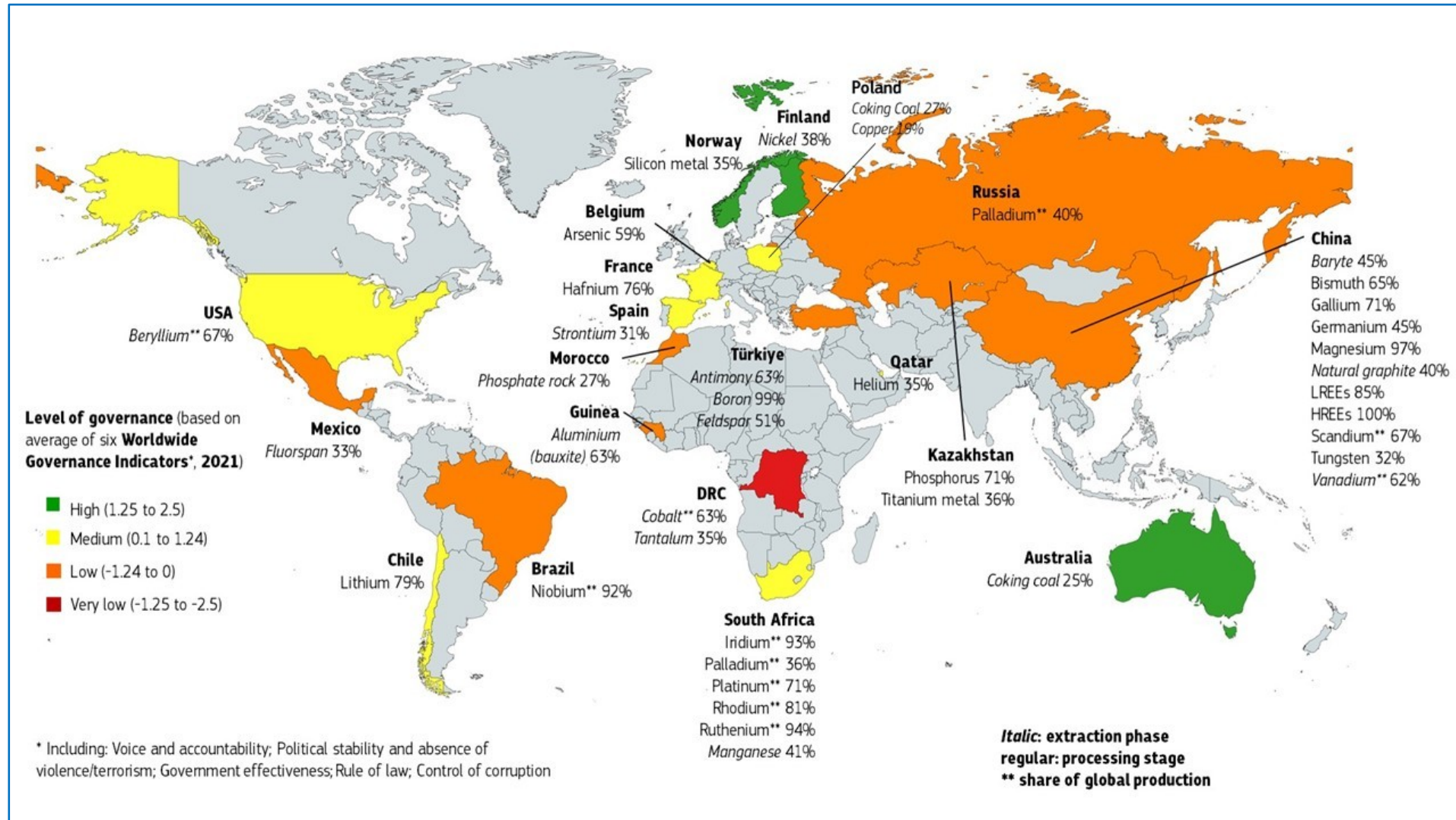
Methodology 2017

<https://op.europa.eu/en/publication-detail/-/publication/2d43b7e2-66ac-11e7-b2f2-01aa75ed71a1>

- “The proposal of the CRM Act Regulation contains the list of Strategic Raw Materials (SRMs) and the list of CRMs. The Regulation proposes to automatically add SRMs selected based on a new methodology (Annex 1 of the Regulation) on the CRMs list, **defined by the established CRM methodology** (Annex 2 of the Regulation). The **CRM methodology was developed by the European Commission in cooperation with the Ad hoc Working Group on Defining Critical Raw Materials (AHWG) in 2017.**
- The methodology is based on the two main criteria of **Economic Importance (EI) and Supply Risk (SR)**. The thresholds remain at $SR \geq 1.0$ and $EI \geq 2.8$ rounded to one decimal.

Major EU suppliers of CRMs (2023) and their quality of governance

JRC - <https://rmis.jrc.ec.europa.eu/eu-critical-raw-materials>



Critical Raw Materials Act (CRMA), COM(2023)160, and Regulation 2024/1252, 11 April 2024

Respond to the **supply disruption risk in critical raw materials** mainly by **boosting their domestic production, refining, and recycling**

A list of **'strategic' and 'critical' raw materials** for the manufacturing of green, digital and defence technologies

Benchmarks by 2030 for domestic capacities

- at least 10% of the EU's annual consumption for **extraction**
- at least 40% of the EU's annual consumption for **processing**
- at least 25% of the EU's annual consumption for **recycling**
- **no more than 65%** of the EU's annual consumption from a single third country

Secure and resilient supply chains

- Streamlining **permitting procedures** for CRM projects
- Selected **strategic projects** will benefit from support for **access to finance** and **shorter permitting timeframes** (27 months for extraction permits and 15 months for processing and recycling permits)
- EU countries will have to develop national programmes for exploring **geological resources**



Improving sustainability and circularity of critical raw materials

- EU countries: improve **collection of critical raw material-rich waste and ensure its recycling**
- EU countries and private operators: investigate the **potential** for recovery of critical raw materials from **extractive waste**

Diversifying the Union's imports of raw materials

- using **trade agreements** to secure and **diversify** trade in critical raw materials
- expanding the EU's network of strategic partnerships with a value chain approach and strong sustainability dimension
- using the **Global Gateway** to deploy projects along the raw materials value chain
- to set up an **EU export credit facility** to low the risk of investment abroad
- tackling **unfair trade practices** related to raw materials and increasing enforcement

To ensure overall coordination, the act proposes a **European Critical Raw Materials Board**, composed of EU countries and the Commission

Responses

- Geo-diversification of suppliers
- Domestic supply (mining + manufacturing)
- Recycling and material efficiency
- Innovation/substitution

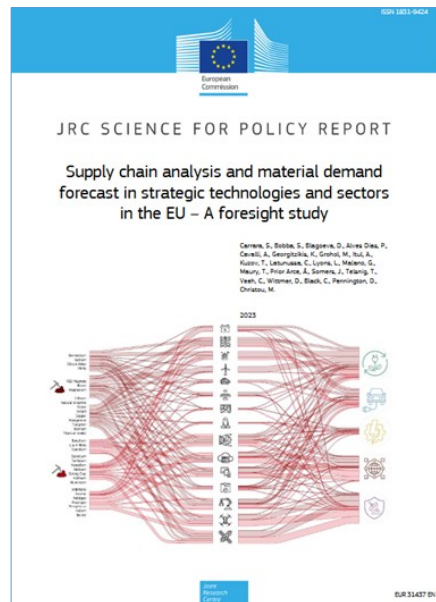


Figure 114. Overview of actions to increase the resilience of supply chains

Possible actions to increase resilience of supply chains



Source: JRC analysis.

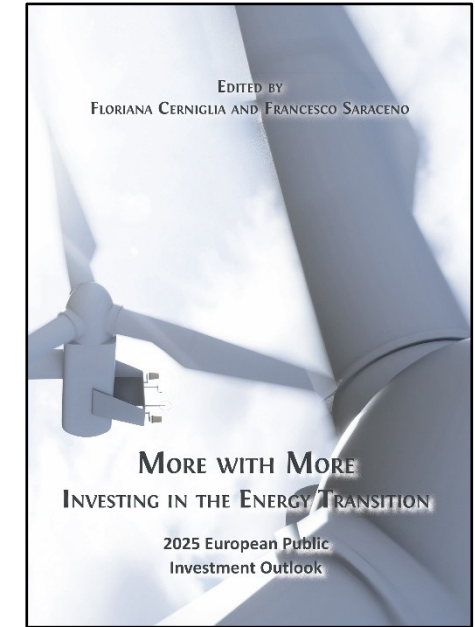
Responses

Reaction strategies

1. Geographical diversification of suppliers
2. Creation of domestic industrial value chains, up to domestic mining
3. **Boosting domestic recycling**
4. Leveraging innovation (material saving and substitution, efficient use)

While keeping into consideration:

- Environmental pressures
- Realism of feasibility (short, medium, long term)



Circular Economy and material efficiency in Europe: Policy failures and 'Strategic autonomy'

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Società Chimica Italiana
XXVIII National Congress
MILAN, 26 - 30 August 2024

Ex. Lithium: domestic potential in mining and recycling

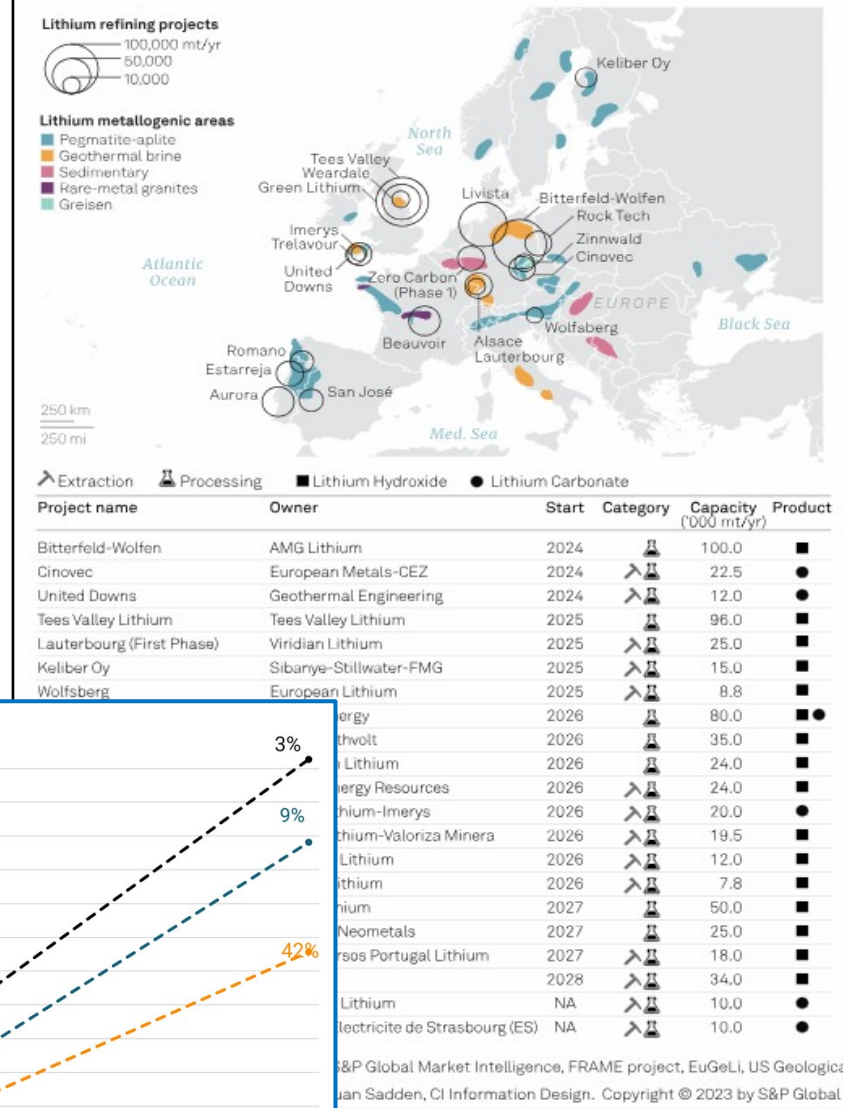
Rush to lithium domestic mining

- **Mine output:** More than 10 new European lithium mining projects have been announced, in Austria, Czech Republic, Germany, Finland, Portugal, Spain, Serbia, with a total project pipeline of **130 kt by 2030**
- **Refining capacity** announcements, independent of domestic mining plans. Total potential **refining capacity** might reach 155 kt by 2030, which is **25 kt more than mining capacity**
- **However**, most of them still have relatively **high levels of uncertainty** due to differing factors: **community opposition, untested production processes, economic challenges**

<https://eurometaux.eu/media/rqocjybv/metals-for-clean-energy-final.pdf>

..... and uncertainties on recycling

- **Lithium supply from secondary sources can arrive to cover 9% of estimated consumption in 2040** <https://rmis.jrc.ec.europa.eu/analysis-of-supply-chain-challenges-49b749>
- **“By 2050, secondary supply has the potential to provide over 75% of Europe’s lithium demand, assuming a domestic battery recycling industry is established fitted for lithium recovery. Quantities of recycled lithium will remain low until after 2040, when end-of-life batteries start becoming available in higher volumes”** <https://eurometaux.eu/media/rqocjybv/metals-for-clean-energy-final.pdf>



Ex. Lithium

ETC CE 2025, Case study Lithium

<https://www.eionet.europa.eu/etcs/etc-ce/products/etc-ce-report-2025-5-environmental-impact-of-materials-supply-chain-disruption-the-cases-of-aluminium-and-lithium>



- **Short term scenario (2024-2026):** Shifting to alternative lithium suppliers is challenging in the short term, as **Australia**, the largest producer, refines much of its spodumene in **China**, posing potential geopolitical risks. Changing supply from **Chile**, already the largest supplier, may also be difficult, while **Portugal's** lithium production remains small relative to EU demand. **Environmental impacts** of producing lithium in China and Australia seem higher than in Chile or Portugal.
- **Medium term scenario (2026-2030):** Currently, the **recycling rate of lithium is negligible**. However, by 2030, it is estimated that secondary sources could meet **5% to 8%** of the EU battery value chain's lithium demand. In the medium term, **ramping up recycling could help mitigate supply shortages and reduce environmental impacts**. However, **recycling technologies need further development and understanding when lithium will become available from in-use stock is crucial for preparing future recycling streams**. Tools such as **product passports and dynamic material flow models will be critical for forecasting and preparing future recycling streams**.

- **Long-term scenario (2030-2040):** In the long term, **lithium mining** could expand in the EU, with new projects in **Austria, Germany, Finland, Portugal, Spain**, and others, though many face challenges like **community opposition**. Most projects plan to extract lithium from hard rock ore, while some explore direct lithium extraction (DLE) from geothermal brines, like companies in **Germany**, which aim for carbon-negative production. The **environmental benefits** of EU lithium depend on replacing imports from high-emission sources like China, though DLE technology is still new and uncertain. **Emerging battery technologies**, such as solid-state and sodium-ion batteries, could reduce future lithium demand, but data on their **environmental impacts** is limited. Reducing **battery demand** through efficiency, recycling, and shared mobility could lower the need for raw materials in the long term. To bring back more mining to the EU, mine **permitting processes** need to be streamlined, and domestic mining and circular economy **skill sets** further established, e.g., via designated educational programs.
- Overall, the **medium- and long-term scenarios**, if implemented, could **avoid the emissions of between 0.5 and 1 million tonnes of CO2-Eq. per year**, showing the importance of decisions in choice of supplying countries, investment in recycling technologies and domestic production.

EGD investment needs

Table 2.1 Additional annual investment needs 2021-2030 for delivering on EGD environmental goals, compared to 2011-2020 (€ bn 2015)

<i>Climate and energy policy</i>		<i>Average 2011-2020 per year</i>	<i>Average 2021-2030 per year</i>	<i>Additional investment needs 2021-2030* per year</i>
<i>Sector</i>	<i>Sub-sector</i>	<i>€ bn</i>	<i>€ bn</i>	<i>€ bn</i>
Supply side	Power grid	12.8	43.8	31
	Power plants, incl. boilers and new fuels	34.4	59.2	25
Demand side	Industrial sector	10.2	24.7	14
	Residential	87.8	180.1	92
	Tertiary	40.2	94.2	54
	Transport sector	474.3	649.3	175
Subtotal		659.5	1.051.3	392
<i>As a % of GDP</i>		<i>5.4%</i>	<i>7.6%</i>	<i>2.2%</i>
<i>Other environmental objectives</i>			<i>Additional investment needs 2021-2030* per year</i>	
<i>Sector</i>	<i>Sub-sector</i>	<i>€ bn</i>		
Protection of biodiversity and ecosystems	Biodiversity landscapes/nature restoration	4		
	Management of forest resources	2		
	Management of wild flora and fauna	1		
Circular Economy and Resource Efficiency	Management of materials and efficiencies	10		
	Waste management	10		
	Additional potential in 3 sectors (food, mobility and built environment)	15		
Pollution prevention and control	Protection of ambient air and climate	40		
	Noise and vibration abatement	1		
	Protection against radiation	5		
Water protection and management	Management of waters	21		
	Wastewater management	15		
Research and Development	Resource management R&D	5		
	Environmental R&D	2		
Subtotal		130		
TOTAL		522		

* Numbers have been rounded.

Source: EC, 2022k and EC, 2021i

Additional investment needs to achieve the targets

- **2020-2030**: about **€520 billion/year** in the present decade with respect to the average level of the last decade, of which **€392 billion/year** for climate and energy
- **2031-2050**: average annual investments needed close to **€660 billion/year** (3.2% of EU GDP) for the energy system and **€870 billion/year** (4.2% of EU GDP) for transports

Huge need of private investments

- Estimated ratio 2- 5 Euros of private investments for each Euro of public resources
- Enough returns? Vs military/defence



ETC CE 2026 (ongoing)

- **GTA – Green Transition Accelerator**
- **Investment needs and gaps 2**

Segnali, verso Circular Economy Act 2026

- CE in **riconfigurazione** come **strategia industriale** (CC, CID, NZIA, CRMA), complessità
- Rischio di '**priorità minoritaria**' rispetto a energia-clima ?
- Materiali secondari: logica **value chain** e **mercati**, da offerta a **domanda, domanda, domanda !**
- **Saldare** la **CE** con **Critical Raw Materials**, priorità strategica