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Proposal for a

# COUNCIL RECOMMENDATION

## on Advanced Materials

## [Advanced Materials for Europe]

{SWD(2026) 833 final}

# EXPLANATORY MEMORANDUM

## 1. CONTEXT OF THE PROPOSAL

### • Reasons for and objectives of the proposal

Advanced materials are essential to the technologies that will shape Europe's future economic strength, industrial leadership and strategic autonomy. They are key to closing the innovation gap, attracting investments and reshaping resilient global supply chains. The European Commission's Competitiveness Compass[1] and its EU Startup and Scaleup Strategy[2] identify advanced materials as a strategic technological area. Advanced materials had already been recognised as one of the ten critical technology areas for the Union's economic security and were addressed in a related risk assessment carried out with Member States[3]. Advanced materials are materials that are rationally designed to deliver new or enhanced properties, targeted or enhanced structural features, or both, with the objective of achieving specific or improved functional performance. They include new emerging manufactured materials, materials manufactured from conventional materials, and materials produced through innovative manufacturing processes that enable the creation of targeted structures from starting materials[4].

Advanced materials improve the performance of products and technologies and are key enablers for the green, clean, digital transitions and the EU defence readiness, thus also allowing the Union to achieve its policy targets. They underpin innovation in strategic sectors, including energy, mobility, aerospace, defence, construction, electronics or healthcare. By strengthening industrial competitiveness, supporting sustainable prosperity and reducing strategic dependencies, they also contribute to the EU's strategic autonomy. Examples of advanced material applications are thermochromic nanoparticles for smart glass windows that dynamically adjust their tint to ensure buildings' energy-efficiency, novel magnetic alloys (including high-entropy alloys and composite ferrites) for permanent magnets with applications in energy and automotive that can reduce dependencies on critical raw materials, high-performance membranes for the removal of PFAS (that are per- and polyfluoroalkyl substances or so-called 'forever chemicals'), prevention, detection and repair of water leakages and water purification, or light and high-strength composites, including biobased, with graphene for applications in aerospace, automotive and construction. Innovation in these sectors can also benefit other sectors through the cross-cutting application of advanced materials, as for example in agriculture, water and security.

The EU's ability to achieve its climate, water resilience, digital, defence readiness and competitiveness objectives increasingly depends on reinforcing its leadership in advanced materials. Global competition in the development, manufacturing and securing of advanced materials is intensifying rapidly. Countries around the world are investing heavily in research and innovation to capture emerging markets and strengthen their technological leadership. The Union must match this pace, as its scientific leadership is challenged at global level.

At the same time, Europe struggles to translate its scientific excellence into market-ready solutions, commercially successful products, and to turn these strengths into industrial

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1 European Commission, A Competitiveness Compass for the EU, COM(2025) 30 final.

2 European Commission, The EU Startup and Scaleup Strategy – Choose Europe to start and scale, COM(2025) 270 final.

3 Annex to the Commission Recommendation on critical technology areas for the EU's economic security for further risk assessment with Member States, C(2023) 6689 final, 3.10.2023.

4 See OECD working description on advanced materials at https://one.oecd.org/document/ENV/CBC/MONO(2022)29/en/pdf and Annex I for an overview of relevant materials classes, examples, typical properties and application areas across sectors.

leadership supported by sufficient manufacturing capacity, as highlighted in the 2024 Draghi report[5]. The EU's advanced materials ecosystem also remains fragmented across Member States and sectors. This limits its ability to innovate and, scale-up innovation in advanced materials and weakens collaboration across the value chain and across borders. In this context, particular attention should be paid to startups and scaleups in advanced materials, which play a key role in turning scientific breakthroughs into market-ready solutions and in strengthening Europe's innovation capacity and industrial competitiveness.

A coordinated approach with the necessary speed and scale is therefore needed to unlock the full transformative power of advanced materials. Such an approach should strengthen the Union's technological leadership, increase the resilience of its industrial base and value chains, and ensure that innovations developed in Europe are scaled up and commercialised in Europe.

Following the Commission's 2024 Communication setting out a strategy on 'Advanced Materials for Industrial Leadership'[6], the EU has made progress in shaping its advanced materials ecosystem. However, these efforts remain insufficient to keep pace with the growing investments made by other major economies, to improve the translation of research excellence into commercialisation and manufacturing capacity, and to address the persisting fragmentation of efforts and regulatory approaches across the Union. More specifically:

- The EU's advanced materials R&I ecosystem remains fragmented, with persistent gaps between research and market deployment. In advanced materials, this is particularly reflected in the patent landscape, with differing incentives institutional practices, and in the lack of interoperable data, digital tools and platforms, putting Europe's scientific leadership at risk. The latter is also exacerbated by technology leakage risks and the drain of European intellectual property (IP) in this sector due to foreign licensing or acquisitions of EU IP holders.
- European universities, research organisations and companies face financial, organisational, and regulatory barriers to developing, and deploying advanced materials. These include limited access to testing and pilot infrastructures, a complex regulatory environment and shortages of EU-based skilled talent, especially in green-tech, digital and AI-related fields.
- Supply chain dependencies undermine the EU's strategic autonomy and expose industry to price volatility. The EU lacks sufficiently effective tools and policies to secure sufficient production capacity for advanced materials to incentivise companies to invest, despite their importance across key sectors including automotive, aerospace, defence, electronics, renewable and clean energy technologies and healthcare.

The objective of the proposed Council Recommendation is to make the Union a leading innovator, producer and user of safer and more sustainable advanced materials by 2035. To this end, the proposal aims to:

- strengthen the strategic autonomy of the EU's advanced materials ecosystem,
- improve EU competitiveness by shortening the time to market and accelerating the uptake of advanced materials; and
- reinforce the EU's technological and industrial leadership in advanced materials.

5 Draghi Report (2024) The future of European competitiveness – In-depth analysis and recommendations, page 62.

6 European Commission, Advanced Materials for Industrial Leadership, COM(2024) 98 final.

Together, this will strengthen the Union's economic security.

- **Consistency with existing policy provisions in the policy area**

This proposal for a Council Recommendation builds on the 2024 Communication on 'Advanced Materials for Industrial Leadership'. It goes a step further by recommending actions for Member States and seeking their commitment to those actions through the adoption of the Council Recommendation. The Commission will support the implementation of the Recommendation with existing measures introduced following the 2024 strategy, as well as through additional actions. This initiative responds to the global acceleration of investments in advanced materials and to the persisting fragmentation of the EU's advanced materials ecosystem.

The proposal also follows up on the Council Conclusions of 29 November 2024[7], which welcomed the Commission's Communication on advanced materials. It responds to the recommendation of the Draghi report on 'the future of European competitiveness' to strengthen EU industrial leadership in advanced materials and recognises the need to further develop a dynamic, secure and inclusive ecosystem for advanced material across the Union. It further responds to the Scientific Opinion on Advanced Materials by the Group of Chief Scientific Advisors in the context of the Commission's Scientific Advice Mechanism, which called for an integrated approach and urgent action to target strategic dependencies, carbon neutrality and industrial competitiveness, while staying true to Europe's values and societal priorities.[8]

It is designed to allow for immediate action and impact, while ensuring continuity under the current multiannual financial framework (MFF) 2021-2027 and allowing for scalability under the next MFF (2028-2034). This concerns particularly the proposed European Competitiveness Fund[9] and Horizon Europe 2028-2034[10], where advanced materials are relevant for all of the proposed policy windows, given their cross-sectoral enabling role, and particularly those where advanced materials are mentioned specifically: clean transition and industrial decarbonisation, and resilience and security, defence, industry and space. However, the proposal does not pre-empt or prejudge the outcome of the ongoing legislative process on the MFF.

- **Consistency with other Union policies**

This proposal concerns several policy areas where the Union and Member States have shared competences. It complements and reinforces the Union's existing policy framework, which

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7 Council conclusions on the Commission's communication on advanced materials, 29 November 2024, ST 16183/24.

8 European Commission: Directorate-General for Research and Innovation, Ellemers, N., Izdebski, A., Kahanec, M., Łukasik, R. et al. (2026), *Advanced materials*, Independent Expert Report by the Group of Chief Scientific Advisors, Scientific Advice Mechanism, Scientific Opinion No. 18, Publications Office of the European Union, https://data.europa.eu/doi/10.2777/3536600

9 Proposal for a Regulation of the European Parliament and of the Council on establishing the European Competitiveness Fund ('ECF'), including the specific programme for defence research and innovation activities, repealing Regulations (EU) 2021/522, (EU) 2021/694, (EU) 2021/697 and (EU) 2021/783, and amending Regulations (EU) 2021/696 and (EU) 2023/588, COM(2025) 555 final, 16.7.2025.

10 Proposal for a Regulation of the European Parliament and of the Council establishing Horizon Europe, the Framework Programme for Research and Innovation, for the period 2028-2034 laying down its rules for participation and dissemination, and repealing Regulation (EU) 2021/695, COM(2025)543 final, 16.7.2025

strongly emphasises the competitiveness of industries that depends on, or contributes to, the development, deployment and uptake of advanced materials.

The proposal is fully consistent with the Union's competitiveness and economic security agenda. It complements the Critical Raw Materials Act[11], by supporting research and innovation on substitutes for critical raw materials that can contribute to reducing dependencies, and the Net-Zero Industry Act[12], which aims to scale up the European net-zero technology manufacturing capacity that relies on advanced materials. Both strongly depend on the availability of advanced materials. Moreover, the Net-Zero Industry Act aims to strengthen the resilience of Europe's energy system and clean technologies and established a Steering Group for the Strategic Energy Technology Plan (SET Plan)[13], for which advanced materials are equally crucial.

The proposal is further aligned with the proposed Industrial Accelerator Act[14] – which builds on the Commission Communication on the Clean Industrial Deal[15]– and envisages to speed up industrial capacity and decarbonisation and proposes Member States to designate industrial manufacturing acceleration areas in strategic sectors (energy-intensive industries, net-zero technologies, and the automotive industry) that again rely on advanced materials and are particularly linked to the identified advanced materials priority areas of energy and mobility. It addresses the weaponisation of the EU's trade dependencies, including in critical raw materials, and focuses on strengthening strategic autonomy and maintaining a strong manufacturing industry base in the Union by accelerating industrial capacity and decarbonisation in strategic sectors.

Furthermore, the proposal provides a cross-cutting enabling framework for a wide range of Union policies and initiatives that are linked to advanced materials. These includes the proposed Chips Act 2.0[16] and the planned EU Quantum Act[17], for which nanotechnology and advanced materials are essential enablers; the revised European assessment framework for 'Safe and Sustainable by Design' chemicals and materials[18], as well as the Chemicals Industry

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11 Regulation (EU) 2024/1252 of the European Parliament and of the Council of 11 April 2024 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, OJ L, 2024/1252, 3.5.2024, ELI: http://data.europa.eu/eli/reg/2024/1252/oj

12 Regulation (EU) 2024/1735 of the European Parliament and of the Council of 13 June 2024 on establishing a framework of measures for strengthening Europe's net-zero technology manufacturing ecosystem and amending Regulation (EU) 2018/1724, OJ L, 2024/1735, 28.6.2024, ELI: http://data.europa.eu/eli/reg/2024/1735/oj

13 European Commission, SET Plan Information System (SETIS), available at: https://setis.ec.europa.eu/

14 Proposal for a Regulation of the European Parliament and of the Council establishing a framework of measures for the acceleration of industrial capacity and decarbonisation in strategic sectors and amending Regulations (EU) 2018/1724, (EU) 2024/1735 and (EU) 2024/3110, COM(2026) 100 final, 5.3.2026.

15 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, The Clean Industrial Deal: A joint roadmap for competitiveness and decarbonisation, COM(2025) 85 final, 26.2.2025.

16 Proposal for a Regulation of the European Parliament and of the Council on a framework of measures for strengthening the Union's semiconductor ecosystem, repealing Regulation (EU) 2023/1781 (Chips Act 2.0), COM(2026) 504 final, 3.6.2026.

17 https://digital-strategy.ec.europa.eu/en/news/commission-invites-contributions-shape-future-eu-quantum-act

18 Commission Recommendation (EU) 2026/510 of 6 March 2026 on revising the European assessment framework for 'safe and sustainable by design' chemicals and materials, OJ L, 2026/510, 10.3.2026, ELI: http://data.europa.eu/eli/reco/2026/510/oj, with its annex setting out the details of the framework based on technical reports from the Commission's Joint Research Centre, which also published a revised methodological guidance in October 2026: https://publications.jrc.ec.europa.eu/repository/handle/JRC146862

Action Plan[19], including actions to support innovation and substitution of hazardous chemicals, the planned Circular Economy Act[20], the proposed Biotech Act I[21] – particularly for medical devices and biomanufacturing –, and planned Biotech Act II[22], the Bioeconomy Strategy[23], the Water Resilience Strategy[24], the plans for the future of the New European Bauhaus[25] as part of the European Affordable Housing Plan, the Strategy for European Life Sciences[26], the AI Continent Action Plan[27] and the AI in Science Strategy[28], the proposed Cloud and AI Development Act[29], the Strategic Technologies for Europe Platform[30], the European Strategy on Research and Technology Infrastructures[31], the EU Startup and Scaleup Strategy, the proposed European Innovation Act[32] in particular relevant for research and development procurement, the proposed Public Procurement Act[33] in particular relevant for the public procurement of innovative solutions, the proposed Council Recommendation on common principles on regulatory sandboxes[34], the planned European Research Area Act[35], the European Economic Security Strategy[36] including the Commission Recommendation on Critical Technology Areas for the EU's Economic Security, the 2025 Joint Communication on Strengthening EU economic security[37], the RESourceEU Action Plan[38], the Global Gateway strategy[39], and the Union of Skills[40].

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19 European Commission, A European Chemicals Industry Action Plan, COM(2025) 530 final, 8.7.2025.

20 https://environment.ec.europa.eu/strategy/circular-economy_en#circular-economy-act

21 Proposal for a Regulation of the European Parliament and of the Council on establishing a framework of measures for strengthening Union's biotechnology and biomanufacturing sectors particularly in the area of health and amending Regulations (EC) No 178/2002, (EC) No 1394/2007, (EU) No 536/2014, (EU) 2019/6, (EU) 2024/795 and (EU) 2024/1938 (European Biotech Act), COM(2025) 1022 final, 16.12.2025.

22 https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/17394-Biotech-Act-II_en

23 European Commission, A Strategic Framework for a Competitive and Sustainable EU Bioeconomy, COM(2025)960 final.

24 https://commission.europa.eu/topics/environment/water-resilience-strategy_en

25 European Commission, New European Bauhaus – from vision to implementation, COM(2025) 1026 final.

26 European Commission, Choose Europe for life sciences, A strategy to position the EU as the world's most attractive place for life sciences by 2030, COM (2025)525 final.

27 European Commission, AI Continent Action Plan, COM (2025)165 final.

28 European Commission, A European Strategy for Artificial Intelligence in Science Paving the way for the Resource for AI Science in Europe (RAISE), COM (2025)724 final.

29 Proposal for a Regulation of the European Parliament and of the Council establishing a framework of measures for strengthening Europe's cloud and AI ecosystem (Cloud and AI Development Act), COM(2026) 502 final.

30 Regulation (EU) 2024/795 of the European Parliament and of the Council of 29 February 2024 establishing the Strategic Technologies for Europe Platform (STEP).

31 European Commission, A European Strategy on Research and Technology Infrastructures, COM(2025)497 final/2.

32 Proposal for a Regulation of the European Parliament and of the Council establishing a framework of measures for strengthening the Union innovation ecosystem and amending Regulation (EU) 2017/1001 (European Innovation Act), COM(2026)567 final, 9.9.2026

33 Proposal for a Regulation of the European Parliament and of the Council on public contracts and concessions, repealing Directives 2014/23/EU, 2014/24/EU and 2014/25/EU, and amending Regulations (EC) No 1370/2007, (EU) 2023/1542, (EU) 2024/1157, (EU) 2024/1252, (EU) 2024/1735, (EU) 2024/1781, (EU) 2024/2847, (EU) 2024/3110 and (EU) 2025/40, and Directives 2008/98/EC, (EU) 2019/882, (EU) 2022/2381, (EU) 2023/1791 and (EU) 2024/1760 (Public Procurement Act), COM(2026)590 final, 9.9.2026.

34 Proposal for a Council Recommendation on common principles on regulatory sandboxes to support innovation and a future-proof regulatory framework, COM (2026)568 final, 9.9.2026

35 https://european-research-area.ec.europa.eu/era-act

36 European Commission and High Representative of the Union for Foreign Affairs and Security Policy (2023) Joint Communication on "European Economic Security Strategy" (JOIN(2023) 20 final).

37 European Commission and High Representative of the Union for Foreign Affairs and Security Policy (2025) Joint Communication on "Strengthening EU economic security" (JOIN(2025) 977 final).

38 Commission Recommendation (EU) 2023/2113 of 3 October 2023 on critical technology areas for the EU's economic security for further risk assessment with Member States, (C/2023/6689). OJ, L 275.

39 European Commission, RESourceEU Action Plan: Accelerating our critical raw materials strategy to adapt to a new reality), COM(2025) 945 final.

40 European Commission, The Union of Skills, COM (2025) 90 final.

Finally, the proposal links to relevant strategic projects and a candidate Important Project for Common European Interest on circular advanced materials[41] on which several Member States are already actively working to boost innovation, sustainability, and circularity across strategic industrial value chains for advanced materials upon which further efforts can build.

## 2. LEGAL BASIS, SUBSIDIARITY AND PROPORTIONALITY

### • Legal basis

The legal base for this initiative is Article 173(3), in conjunction with Article 292, of the Treaty on the Functioning of the European Union (TFEU). In accordance with Article 173 TFEU, the Union and the Member States must ensure that the necessary conditions for the competitiveness of the Union's industry exist. This includes fostering better exploitation of the industrial potential of policies of innovation, research and technological development. Moreover, according to Article 173(3), the Union shall contribute to the achievement of the objectives set out in Article 173(1) through the policies and activities it pursues under other provisions of the Treaties.

Pursuant to Article 292 TFEU, the Council may adopt recommendations on a proposal from the Commission in all cases where the Treaties provide that the Council is to act on the basis of a proposal from the Commission. The initiative does not propose any extension of Union regulatory power or binding commitments on Member States. It is the Member States who will decide, based on their national circumstances, how they implement this Council Recommendation, taking into account relevant applicable Union legislation.

### • Subsidiarity (for non-exclusive competence)

The present proposal is in conformity with the principle of subsidiarity as provided for in Article 5(3) of the Treaty on the European Union (TEU).

The challenges faced by European developers, manufacturers, and users in the advanced materials ecosystem are inherently transnational and cannot be sufficiently addressed by Member States acting in isolation. Advanced materials value chains are globally interconnected and deeply integrated across borders. As a result, Member States face common dependencies and risks linked to concentrated supply from third countries. Uncoordinated national action would fragment effort, dilute the scale required to close the gap with the EU's main global competitors, and produce a patchwork of incompatible national approaches that increases costs for cross-border actors.

Another shared key challenge is the persisting fragmentation of the advanced materials research and innovation ecosystem, together with lengthy qualification procedures for new materials, which remain major bottlenecks to development and deployment. For example, data are not interoperable across national digital infrastructures, while automation and AI-driven experimentation infrastructure remain fragmented across national programmes and initiatives. SMEs, in particular startups and scaleups, need access to specialised facilities across borders.

As set out in greater detail in the accompanying staff working document, the need for EU action is consistent with the needs outlined in the impact assessments accompanying, among others, the Critical Raw Materials Act, the proposed Chips Act 2.0 and the proposed European Competitiveness Fund.

[41] https://competition-policy.ec.europa.eu/state-aid/ipcei/joint-european-forum-ipcei/past-meetings_en

The objectives of the proposed agenda for 'Advanced Materials for Europe' therefore cannot be achieved sufficiently at Member State level alone, but require joint and coordinated actions by Member States to reach scale and to be effective. The proposal generates Union added value by enabling joint priorities, joint actions and synergies in addressing common challenges, while leaving the detailed design and implementation of national policies, funding programmes, initiatives, and support measures to Member States. This allows for adaptation to the specific features of national and regional advanced materials innovation systems.

- **Proportionality**

The present proposal is in conformity with the principle of proportionality as provided for in Article 5(4) TEU. Neither the content nor the form of this proposed Council Recommendation exceeds what is necessary to achieve the objectives of strengthening cooperation and coordination among Member States as regards the advanced materials technology area.

The form is proportionate as it does not impose legal obligations on Member States – nor indirectly on private actors – and preserves flexibility. It thus does not pre-empt national competence nor establishes a parallel EU regulatory regime or further add to the already complex regulatory landscape, as described in the accompanying staff working document. Legally binding EU rules were considered and eventually discarded at an early stage, on the grounds that they would likely add disproportionate administrative burden for the implementation and enforcement and add regulatory complexity relative to the marginal benefit over coordination-based approaches.

The costs to Member States are limited to the continuation and engagement in the Technology Council for Advanced Materials[42], voluntary contributions to the monitoring of advanced materials value chains, and the design and implementation of national follow-up actions that Member States choose in order to reap the benefits that advanced materials offer to boost industrial competitiveness. Indirect costs to private actors are limited to voluntary engagement with federated infrastructures, the European Advanced Materials Academy and validation activities. There are no new certification, reporting or other requirements imposed.

These limited costs are expected to be considerably outweighed by the benefits that this Recommendation can bring. This comprises the potential impacts from increased investments on shared priorities and efficiency improvements to the advanced materials ecosystem, specifically, and the potential competitiveness boost and positive spillover effects to the overall economy through enhanced, safer and more sustainable products, higher productivity rates and reduced risks of supply chain disruptions, in general. These effects would benefit researchers, businesses and citizens alike.

- **Choice of the instrument**

The Commission work programme 2026 announced an Advanced Materials Act. The proposed instrument takes the form of a Commission proposal for a Council Recommendation, which abides by the principles of subsidiarity and proportionality. A recommendation is a legal act mentioned in Article 288 TFEU available to the Union institutions that is a regulatory instrument which is non-binding, but through which they still 'exercise a power to exhort and to persuade' by promoting a certain course of action or behaviour when adopting recommendations. With the preserved flexibility in this fast-moving technology field, it allows Member States to tailor implementation means to their national programmes and priorities. At the same time, to ensure the necessary impact is achieved, it is important that implementation plans and roadmaps are prepared and discussed together.

[42] Commission Decision of 5 July 2024 setting up the high-level group 'Technology Council for Advanced Materials', C(2024) 4749 final.

## 3. RESULTS OF EX-POST EVALUATIONS, STAKEHOLDER CONSULTATIONS AND IMPACT ASSESSMENTS

### • Ex-post evaluations/fitness checks of existing legislation

Not applicable.

### • Stakeholder consultations

In the run-up to this proposed Recommendation various actions were taken to consult stakeholders. These include: a broadly announced Call for Evidence and Open Public Consultation via the Have Your Say web portal that ran from 21 October 2025 until 13 January 2026, with 192 and 187 responses respectively; a company survey that received 280 responses from advanced materials user and producers, as part of the 2026 Commission study on the 'Production and use of advanced materials'; a survey of research and technology infrastructures that work on advanced materials that received 144 replies in relation to R&I services, funding models and access conditions, as part of the Commission 'Study on the Uptake of Advanced Materials - Mapping and analysing the role of the European Research and Technology Infrastructures focused on Advanced Materials'; a reality check and validation workshop that took place in March and June 2026 respectively; an event on 'Future of Advanced Materials Europe' in Aveiro, Portugal, in November 2025; and a Technology Council meeting that was held in April 2026 to discuss possible approaches and measures for the Advanced Materials Act with Member States, industry and academia representatives. A consultation meeting with advanced materials SMEs beneficiaries from the European Innovation Council was also held in November 2025 to discuss barriers along the advanced materials value chains.

The accompanying staff working document provides more details of these consultations.

### • Collection and use of expertise

In addition to the input received from stakeholders during the public and targeted consultations, the proposal is underpinned by extensive evidence, reports and studies collected over recent years. This includes: i) the Commission study on the 'Production and use of advanced materials'[43], which provides a comprehensive assessment of the supply and demand sides of the advanced materials value chains; ii) the study 'Patent landscape analysis in the field of advanced materials'[44] that analyses how organisations working on advanced materials in the EU generate value from their innovations through intellectual property, and compares EU practices with those in the United States and China; and iii) the 'Study on the Uptake of Advanced Materials – Mapping and analysing the role of the European Research and Technology Infrastructures focused on Advanced Materials'[45], which provides a comprehensive mapping and analysis of the European landscape of 2 943 relevant advanced materials Research and Technology Infrastructures.

Several studies from the Joint Research Centre have analysed substitution of critical raw materials with advanced materials, with the objective to reduce or eliminate, where possible, the use of critical raw materials to improve strategic autonomy in key sectors such as

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43 European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SME: Heatubun D., Tyc E. Terlinden G., Borbon Y., et al, *Production and use of advanced materials*, Publications Office of the European Union, Luxembourg, 2026

44 European Commission, Directorate-General for Research and Innovation, Dėlkutė-Morgan R., Didžiulytė M., Girdzijauskaitė V., Braito N., et al, *Patent landscape analysis in the field of advanced materials*, Publications Office of the European Union, Luxembourg, 2026

45 European Commission, Directorate-General for Research and Innovation: *Mapping & analysing European Research & Technology Infrastructures for Advanced Materials Uptake*, study by Technopolis Group, EFIS, GlassAI, Fraunhofer ISI, DTI, Tecnalia and Tekniker, 2026

energy[46], mobility[47], electronics[48] and construction[49]. Outcomes of the studies conclude that alternatives are available in some cases, while trade-offs with costs, performance and the EU capacity to build the required value chain must be considered.

A supporting study[50] for this proposal collected further data and evidence for the problem definition, activities in Member States and in other world regions, and examined measures needed to address the identified problems.

The preparation of this proposal also benefitted from the Scientific Opinion on Advanced Materials by the Scientific Advice Mechanism (SAM) handed over to the European Commissioner for Startups, Research and Innovation, Ekaterina Zaharieva, on 21 April 2026. This opinion was supported by the evidence report on advanced materials by the Science Advice for Policy by European Academies[51] (SAPEA).

- **Impact assessment**

The current proposal does not require an individual impact assessment given the non-binding legal nature of the proposed instrument. However, it is supported by an accompanying staff working document, which presents the strengths, weaknesses and persisting problems of the EU actors involved in advanced materials. This staff working document further reports about progress made since the 2024 strategy and provides an overview of the existing regulatory and policy landscape. It puts the proposed Recommendation in a context and gives an overview of supporting actions from the Commission, that already exist or are planned under the Horizon Europe work programme 2026-2027, to support Member States and to achieve the objectives.

- **Regulatory fitness and simplification**

This proposal respects 'regulatory discipline'[52], its non-binding nature would avoid administrative burden for companies and Member States, while allowing agility and tailoring to national contexts when implementing the actions.

This proposal for a Council Recommendation furthermore strives to achieve simplification, such as to shorten the time to market and to reduce fragmentation of the EU's advanced materials ecosystem. The Recommendation should provide simpler and easier access to testing and qualification infrastructures, notably for SMEs, startups and scaleups. It also aims to simplify, accelerate and – where relevant – harmonise the qualification and certification

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46 European Commission, Joint Research Centre, Ierides, M., Nohl, L., Alves Dias, P., Nohl, M., Blagoeva, D. et al . *Substitution and reduction of critical and strategic raw materials in clean energy technologies – An overview of solutions using advanced materials*, Publications Office of the European Union, Luxembourg, 2025

47 European Commission, Joint Research Centre, Coelho, F., Awais, I., M. Oliveira, F., Mourdikoudis, S. and Pennington, D., *R&I needs to reduce dependencies on critical raw materials through advanced materials in passenger vehicles*, Publications Office of the European Union, Luxembourg, 2026

48 European Commission, Joint Research Centre, Coelho, F., M. Oliveira, F., Mourdikoudis, S. and Pennington, D., *R&I needs to reduce dependencies on critical raw materials through advanced materials in electronics*, Publications Office of the European Union, Luxembourg, 2026

49 European Commission, Joint Research Centre, Haveriku, S. and Lamperti Tornaghi, M., R&I needs to reduce critical raw materials with advanced materials in construction, Publications Office of the European Union, Luxembourg, 2026

50 European Commission (2026), Directorate-General for Research and Innovation, (2026) Supporting study for a proposal establishing a framework of measures for strengthening Europe's advanced materials ecosystem, Idea Consult

51 SAPEA, Advanced materials: Evidence review report, produced as part of the Scientific Advice Mechanism (SAM) to the European Commission, April 2026, https://doi.org/10.5281/zenodo.18222345 Munich: Science Advice for Policy by European Academies (SAPEA).

52 European Commission, A simpler, clearer and better enforced EU rulebook, COM(2026)380 final.

procedures across the Union and to support pre-normative research, standardisation, harmonisation and qualification of newly developed or modified test methods.

The elements of the proposed Recommendation related to a federated digital infrastructure would simplify the exchange of data and development of common tools, facilitating R&I efforts across the Union and enable a better connection and use of AI. This would make it easier for academia, research organisations and industry to collaborate and re-use existing data while benefitting from common, distributed workflows using the research and technology infrastructures available in the Union. This could in the long run also facilitate data collection for regulatory purposes, such as for digital product passports.

- **Fundamental rights**

The proposal is in line with the protection of fundamental rights.

## 4. BUDGETARY IMPLICATIONS

It is expected that the preparation of proposed 'priority challenges' and the coordination of related projects, the monitoring of value chains related to advanced materials as well as the development and validation of new test methods and guidelines for the safety and sustainability assessment will require additional resources, however this will be compensated internally without additional staff implications for the Commission. Contributions from the MFF 2028-2034, notably Horizon Europe 2028-2034 and the European Competitiveness Fund, cannot be prejudged at this stage, given the ongoing legislative process.

## 5. OTHER ELEMENTS

- **Implementation plans and monitoring, evaluation and reporting arrangements**

Progress on the implementation of this Recommendation should be monitored closely by the Technology Council for Advanced Materials, based on the envisaged milestones, benchmarks and concrete key performance indicators in relation to the implementation of the recommendations. The key performance indicators could comprise the following:

- indicators in relation to the focussed R&I investments on priority challenges and their implementation plans (such as the amount of funding attributed to priority challenges, the number of countries engaged, the number of projects and companies supported);
- indicators in relation to the leverage of digitalisation and AI through the 'Materials Commons' (such as the number of Member States engaged in its consolidation as a permanent European digital R&I infrastructure, the number of their active users, the size of datasets shared, and the number of R&D projects using the infrastructure);
- indicators in relation to the leverage of digitalisation and AI through the establishment of self-driving laboratories[53] for advanced materials and the joint roadmap (such as the number of self-driven labs set-up, the number of countries engaged in a roadmap, the number of connected research and technology infrastructures, the number of projects and companies supported);
- indicators in relation to the shortening of the time to market (such as the number of new or adapted test methods and guidelines for the safety and sustainability of advanced materials; the amount of targeted funding provided for the promotion of the uptake of the Safe and Sustainable by Design Framework; initiatives and amount of

[53] Self-driving laboratories are advanced research facilities that integrate AI, robotics and lab automation to conduct experiment execution faster with minimal human intervention.

targeted funding supporting the substitution of critical raw materials or hazardous substances with safer and more sustainable alternatives; for the promotion of SMEs access to research and technology infrastructures, pilot lines and upscaling facilities for the testing of advanced materials; for the strategic intellectual assessment management and technology transfer, matchmaking mechanisms and platforms; and the number of accessible cross-border services);

- indicators in relation to the boosting of scaling-up and uptake (such as amount of innovation procurement launched for advanced materials; the amount of investments mobilised towards the industrial scale-up of advanced materials projects – including for related enabling advanced manufacturing technologies, in particular additive manufacturing – through strategic projects and Important Projects of Common European Interest, the share of supported pilot projects that move to commercial production, the number of matchmaking and investment events organised and participating advanced materials user and producers and investors);
- indicators in relation to startups (such as share of start-ups among all supported companies in advanced materials actions; number of cooperation agreements between advanced materials start-ups and established companies; number of pilot projects or demonstrators jointly undertaken by start-ups and industry; the scale-up rates of supported start-ups; or number of start-ups entering first market deployment).
- indicators in relation to bridging the skills gap (such as the level of funding provided for the education and training in relation to advanced materials, the number of students and workers trained, upskilled and reskilled; the number of learning programmes, micro-credentials, content and training materials by the European Advanced Materials Academy integrated into national education curricula or training initiatives).

- **Detailed explanation of the specific provisions of the proposal**

This proposal for a Council Recommendation has the overarching goal of making the Union the leading innovator, producer and user of safer and more sustainable advanced materials by 2035, with three objectives to achieve: i) increasing the strategic autonomy of the EU's advanced materials ecosystem, ii) shortening the time to market and unlocking the potential of advanced materials to improve EU competitiveness, particularly for startups and scaleups, and iii) improving the EU's technological leadership in advanced materials, including by pursuing the simplification agenda. The proposed elements in the Recommendation are focussed around *five pillars*:

(1) ***Focus R&I investments for advanced materials on priority challenges***, to direct EU, national and private research and innovation funding on advanced materials 'priority challenges' that strengthen competitiveness, resilience and strategic autonomy.

(2) ***Leverage digitalisation and AI***, to build shared data, AI infrastructures and automation to speed up the discovery, design, development and testing of advanced materials in the Union.

(3) ***Shorten the time to market***, to improve collaboration in testing, qualification and access to research infrastructures so that advanced materials reach the market faster.

(4) ***Boost scaling-up and deployment***, to support demand, strategic projects and increase public procurement to help advanced materials move from first deployment to large-scale industrial use.

(5) ***Bridge the skills gap***, to ensure the Union has the skilled workforce needed for the design, production and use of advanced materials by strengthening education, training, reskilling and upskilling, and by attracting and retaining talent across the value chain.

The Commission may complement the measures that Member States haven taken or may take based on this Recommendation with additional actions, such as by further monitoring of advanced materials value chains, sharing best practices and sector-specific guidelines for advanced materials testing and qualification and by facilitating coordination via the Technology Council, as explained in the accompanying Staff Working Document. It would therefore closely support and work with Member States and stakeholders and follow a comprehensive, cohesive and integrated approach to achieve the objectives of this proposal.

2026/0360 (NLE)

Proposal for a

# COUNCIL RECOMMENDATION

## on Advanced Materials

## [Advanced Materials for Europe]

THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Articles 173(3) and 292 thereof,

Having regard to the proposal from the European Commission,

Whereas:

(1) Advanced materials have been identified as a critical technology and strategic technology area and they are key enablers of other critical and strategic technologies. Together they provide solutions for the Union to meet its policy ambitions in competitiveness, resilience and sustainable prosperity. They underpin innovation and performance of products across a wide range of strategic sectors, including energy, mobility, electronics, construction, health, defence and aerospace, including dual-use applications. They are crucial for the development and deployment of clean, digital and emerging technologies necessary to achieve the Union's industrial, climate neutrality, sustainability and technological objectives.

(2) Advanced materials are increasingly important for the Union's strategic autonomy, competitiveness and economic security. In this context they have been identified amongst the 10 critical technology areas for the Union's economic security[1]. Advanced materials are subject to an economic security risk assessment, carried out in cooperation with Member States to identify: (i) strategic dependencies on critical inputs (in particular critical raw materials) and potential supply disruptions, including their likelihood and potential impact; and (ii) appropriate mitigating measures. Such measures are intended to strengthen the single market, including through alternative materials, technologies and manufacturing techniques, partnering with trusted third countries and not only protect but, importantly, strengthen the Union's economic security. In this context, cooperation with enlargement countries, where appropriate, can contribute to mere resilient and diversified European value chains, while supporting their gradual integration into relevant EU industrial and innovation ecosystems. Against this backdrop, advanced materials could also contribute to the Union's commitment to strengthening competitiveness, prosperity, security, global influence, and independence, as set out in the joint 'One Europe, One Market roadmap'[2] of the European Parliament, the Council and the Commission.

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1 Commission Recommendation (EU) 2023/2113 of 3 October 2023 on critical technology areas for the EU's economic security for further risk assessment with Member States (OJ L, 2023/2113, 11.10.2023

2 Joint roadmap of 24 April 2026, https://commission.europa.eu/topics/competitiveness/one-europe-one-market-roadmap_en

(3) In its 2024 Communication on Advanced Materials for Industrial Leadership, the Commission set out a European strategy to ensure industrial leadership in advanced materials as a key technological area. It highlighted the need for a dynamic, secure and inclusive ecosystem that strengthens research leadership and accelerates innovation in the Single Market, initially focusing on the four sectors of energy, mobility, construction and electronics. Several initiatives have been launched since then. The Technology Council for Advanced Materials[3] has provided a framework to identify common priorities, coordinate actions and promote cooperation among Member States, industry, research organisations and the Commission, while also recognising the health sector, notably medical devices, as a fifth strategic area. The European Partnership on Innovative Advanced Materials for Europe (IAM4EU)[4], launched in 2025, unlocks public and private investments on the basis of a strategic research and innovation (R&I) agenda. The Horizon Europe[5] funded Materials Commons project[6] is advancing towards a federated digital R&I infrastructure for materials, and the European Advanced Materials Academy[7] is developing skills and learning programmes. Further analysis of the socio-economic, scientific and technological analysis, including through the EU Observatory of Critical Technologies for space and defence, have also highlighted advanced materials risks and dependencies.

(4) In its conclusions of November 2024 on Advanced Materials[8], the Council recognised the strategic importance of advanced materials and called for coordinated action across the Union. In its conclusions of 24 May 2024 on '[a] competitive European industry driving our green, digital and resilient future'[9], the Council also stressed the need to promote advanced materials and circularity.

(5) In view of the global competition in strategic technologies and the cross-cutting role of advanced materials for the Union's competitiveness and as an engine for economic growth, it is necessary to provide a common strategic direction for coordinated action at Union and national levels. To concentrate efforts where they can deliver the greatest impact, 'priority challenges' with common objectives and targets should be identified for advanced materials and associated implementation plans. Solving such challenges would support the ambition of making the Union a leading innovator, producer and user of safer and more sustainable advanced materials by 2035, with actions taken in time to have full effect by then. Implementation plans should specify clear objectives and deliverables, relevant actors and funding instruments. Progress should be monitored.

(6) Rising geopolitical tensions are increasing the risk of advanced materials value chains, particularly those linked to critical raw materials, and related processing and

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3 Commission Decision of 5 July 2024 setting up the high-level group 'Technology Council for Advanced Materials', C(2024) 4749 final.

4 Innovative Advanced Materials Initiative (IAM-I), *IAM4EU Partnership*, available at: https://www.iam-i.eu/iam4eu-partnership/

5 Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination, and repealing Regulations (EU) No 1290/2013 and (EU) No 1291/2013

6 Materials Commons, *Driving Digital Innovation in Materials Science within Europe*, available at: https://www.materialscommons.eu/

7 EIT Raw Materials, *European Advanced Materials Academy*, available at: https://eitrawmaterials.eu/education-skills/european-advanced-materials-academy

8 Council conclusions on the Commission's communication on advanced materials, 29 November 2024, ST 16183/24.

9 Council conclusions on "A competitive European industry driving our green, digital and resilient future", 24 May 2024, ST 10127/24.

production technologies, being weaponised and thereby facing strategic restrictions, particularly where dual-use applications are concerned. Such risks and the unreliability of supply chains have growing implications for the Union's resilience, economic security and defence readiness. Advanced materials are regularly identified as essential elements to ensure resilience, strategic autonomy and EU defence readiness, as they in certain applications can help to improve durability, recycling and circularity and facilitate alternatives to, or the partial replacement, of critical raw materials[10]. Addressing this risk should therefore be considered as a priority.

(7) The substitution of hazardous substances remains particularly challenging in applications where their unique technical properties are not yet easily replicated. Advanced materials can make an important contribution by enabling the development of safer alternatives and new technological solutions that reduce risks, while preserving the necessary performance.

(8) The Union's path to climate neutrality and greater climate resilience can benefit from advanced materials that contribute to reducing $CO_2$ emissions along their life cycle, and which improve energy and resource efficiency and the performance, durability and circularity of products across many sectors and industrial value chains. Examples include advanced materials used in renewable energy systems, smart electrical grids, batteries and energy storage applications, clean mobility technologies, energy-efficient buildings, industrial decarbonisation, electrification, carbon capture, and resilient infrastructure. Advanced materials also contribute to circularity in two complementary ways: (i) by enabling circular technologies and product designs, for example through reversible adhesives that facilitate the repair; and (ii) by improving the efficiency and quality of recycling and recovery processes, for example through selective membranes, sorbents or catalysts used to remove pollutants. Advanced materials can therefore contribute to reducing the overall consumption of primary raw materials and resources. This supports the objectives of the planned Circular Economy Act and the development of a competitive European market for secondary raw materials .

(9) Advanced materials are cross-cutting by nature. Innovation in advanced materials developed in one sector can generate significant spill-over effects in other sectors, including agriculture, water and security, thereby accelerating the uptake of innovative solutions across the Union economy. It is therefore important to promote the development and deployment of advanced materials in a manner that facilitates such cross-sectoral applications and maximises their wider societal, environmental and economic benefits.

(10) The 2024 Draghi report called for European R&I excellence to be boosted in alternative materials or processes that can substitute critical raw materials in various applications to reduce dependencies. The report recommended building on the Commission's 2024 strategy on advanced materials for industrial leadership and ensuring that Union funds strengthen and steer investment in technology development and deployment through direct support. This can be achieved by mobilising private capital and by building on the new partnership with industry under Horizon Europe 2021-2027. The Union has a strong scientific and technological base in advanced materials R&I, with advanced materials also accounting for a strategic portion of the fundamental research funded by the European Research Council (13% of all of its

[10] OECD, *Steering the future of advanced materials: strategic intelligence in action*, OCED Science, technology and Industry Policy Papers No. 185, October 2025

grants)[11]. However, the Union's relative competitive standing, such as in patents, is being increasingly challenged[12] with further efforts needed to translate scientific excellence into industrial leadership, manufacturing capacity and market-ready solutions.

(11) Innovative enterprises, startups and scaleups play a key role in the development and commercialisation of critical and strategic technologies, such as advanced materials and their related production equipment, placing such enterprises at the heart of innovation-led growth. Stronger support for their creation, growth and retention is needed in line with the ambition of the 'EU Startup and Scaleup Strategy'[13], which identified advanced materials as a strategic technology area.

(12) Global competition in advanced materials is intensifying, with major economies treating advanced materials as a strategic priority to transform their economies and export high value products.

(13) Research, innovation and investment activities in advanced materials remain fragmented across Member States and regions, with national programmes and priorities still insufficiently aligned. Agile governance and stronger coordination are necessary to address technological development and, in particular, common industrial and societal challenges, while maximising synergies and avoiding unnecessary duplication. In this context, Member States and regions should both intensify their efforts and strengthen cross-border collaboration, including by supporting networks, clusters and collaborative projects involving innovative small and medium-sized enterprises (SMEs), including startups and scaleups.

(14) Digital technologies are transforming the way advanced materials are designed, developed and deployed. Interoperable data infrastructures and connected digital ecosystems are accelerating collaboration and innovation across the Union. To speed up advanced materials research and innovation, it is essential to ensure access to high-quality data that comply with the 'findable, accessible, interoperable and reusable' (FAIR) principles with safety and sustainability information (FAIR+). A shared Union infrastructure for advanced materials data, building on the European Open Science Cloud, could facilitate the effective use of data and the creation of interoperable digital tools throughout the innovation cycle. This would enable shared workflows among Union researchers and innovators and help overcome fragmentation across the Union.

(15) Artificial intelligence (AI), supported by increasing data availability and advances in robotics, is transforming materials development by accelerating research, enabling automated experimentation and improving productivity. In combination with additive manufacturing, AI can support a step change in advanced materials innovation. It can also facilitate the screening of candidate materials against technical, safety, sustainability and regulatory criteria, thus supporting regulatory readiness. The 'Resource for AI Science in Europe'[14] (RAISE), supports the use of AI in scientific

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11 European Research Council (2026) *Advanced materials: ERC frontier research for a competitive, sustainable Europe*.

12 European Commission, Joint Research Centre, Albora, G., Benoit, F., et al., *Path to innovation: an Economic Complexity analysis of technological perspectives in the EU – Advanced Materials*, November 2025, https://publications.jrc.ec.europa.eu/repository/handle/JRC144431

13 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions,, The EU Startup and Scaleup Strategy – Choose Europe to start and scale, COM(2025) 270 final

14 Communication from the Commission to the European Parliament and the Council, A European Strategy for Artificial Intelligence in Science Paving the way for the Resource for AI Science in Europe (RAISE), COM(2025) 724 final, 8 October 2025

discovery, notably through Horizon Europe projects that develop foundation models for materials[15], networks of excellence for AI-powered materials science and self-driving laboratories[16]. Self-driving laboratories, connected with open pilot lines, testbeds and research and technology infrastructures, can help bridge autonomous materials design with prototype testing, scale-up and industrial deployment. Their development and use should ensure appropriate human oversight, intervention and accountability. Stronger links with digital R&I infrastructures, like the Materials Commons, can contribute to a better and secure use of industrial data and make advanced materials a tangible industrial application of Union's AI ambition.

(16) Advanced manufacturing, including additive manufacturing, plays an important role in enabling the use of advanced materials to produce high-performance, specialised and transformative solutions and products with a unique shape, composition or other physical characteristics enabling specific or improved functions. To ensure that advanced materials are not only designed but also produced in the Union, it is important to ensure scientific and industrial leadership in advanced manufacturing.

(17) Despite the Union's strengths in research and innovation, many advanced materials enterprises struggle to progress from laboratory-scale development to commercial application and scaleup. The transition from research to industrial and market uptake can be held up by lengthy testing and qualification processes, insufficient access to demonstration facilities and limited support for scale-up. Greater support is needed to accelerate knowledge valorisation, industrial uptake and deployment, in particular by addressing the gap between research results and deployment. This can be achieved, in particular, by helping startups and scaleups cross the 'valley of death' between research, demonstration and market entry.

(18) Research and technology infrastructures play a critical role in testing, qualification and demonstration activities. Improving access to such infrastructures – particularly for SMEs, including startups and scaleups – can help innovators test, qualify and demonstrate advanced materials and related enabling manufacturing technologies more effectively and reduce technological and commercial risks, as explained in the Charter of access for industrial users to research and technology infrastructures[17]. Likewise, market entry and industrial deployment could be facilitated by simpler and more transparent access conditions, including through voucher schemes, harmonised access rules and better awareness of available services.

(19) The economic and societal value of research depends on the effective management and valorisation of intellectual assets. A strategic approach to intellectual property (IP) management and technology transfer is crucial for safeguarding technological innovations, particularly for an emerging and critical technology like advanced materials. Such an approach can also facilitate collaboration between industry and academia as well as commercialisation. Effective IP rights strategies help attract investment, especially for deep-tech startups and scaleups. Similarly, the commercial use of research results and data in advanced materials can be boosted by structured matchmaking platforms, clear partnering agreements and collaborative licensing

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15 https://cordis.europa.eu/programme/id/HORIZON_HORIZON-CL4-INDUSTRY-2025-01-DIGITAL-61

16 https://cordis.europa.eu/programme/id/HORIZON_HORIZON-RAISE-2027-01-01

17 European Commission, *Charter of access for industrial users to research and technology infrastructures*, C/2026/5174, *OJ C, C/2026/4100, 28.7.2026,* available at: https://research-and-innovation.ec.europa.eu/strategy/strategy-research-and-innovation/our-digital-future/charter-access-industrial-users-research-and-technology-infrastructures_en

models, support for intellectual asset management and portfolio development in academia.

(20) By increasing uncertainty and regulatory compliance costs, the scarcity of validated, standardised or qualified test methods for the safety and sustainability assessment of advanced materials creates barriers to industry. Accelerating the development of validated, standardised or qualified cutting-edge, science-based testing methods is essential to fill data gaps, reduce compliance costs, and speed up the market uptake of innovation. New approach methodologies (NAMs) can support this acceleration and facilitate regulatory readiness. They comprise non-animal testing strategies like in vitro methods (for example test tube biological experiments) and in silico and AI-supported approaches (that is to say, computational modelling)[18]. The development of such methodologies is supported, for instance, by the European Partnership for the Assessment of Risks from Chemicals (PARC)[19]. Additionally, the Versailles Project on Advanced Materials and Standards (VAMAS)[20], brings together laboratories, industries, national metrology institutes, and governmental organisations, to develop test methods, perform inter-comparisons and consolidate priorities of standard needs for advanced materials.

(21) Demand-side measures can further support uptake, help bridge the gap between first deployment and large-scale production, and contribute to the creation of Union lead markets for emerging technologies, including by facilitating the market entry of innovative startups and scaleups. Demand-side measures should include: (i) research and development procurement; (ii) public procurement of innovative solutions; and (iii) pre-commercial procurement – and the use in it of non-price award criteria such as functional requirements and, where needed, performance requirements. Standardisation and technical harmonisation can further support market uptake by reducing uncertainty, improving interoperability and facilitating the deployment of advanced materials across sectors.

(22) Regulatory sandboxes have been increasingly used both nationally[21] and at Union level. They are recognised as a tool to support innovative companies in developing and testing new ideas, assessing regulatory compliance of new technologies, products and solutions, and in improving regulatory learning[22].

(23) Ensuring safety, transparency and societal trust in the development, production and use of advanced materials is essential for their acceptance and uptake. This requires robust assessment frameworks, such as the safe and sustainable by design framework, set out in Commission Recommendation (EU) 2026/510[23]. 'Safe and sustainable by design' promotes a voluntary decision-making approach to guide responsible innovation practices and appropriate safeguards, particularly in the case of materials

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18 Communication from the Commission - Roadmap towards phasing out animal testing for chemical safety assessments C(2026)3497.

19 https://www.eu-parc.eu/

20 https://www.vamas.org/

21 European Commission: Directorate-General for Research and Innovation, Vuorinen, H., Isakovic, S. M. and Bonel, E., Use of regulatory sandboxes in EU Member States – 2025 survey report, Publications Office of the European Union, 2026, https://data.europa.eu/doi/10.2777/9535645

22 Council conclusions on 'The importance of research and innovation for the EU Startup and Scaleup Strategy', 30 September 2025, 13357/25, https://data.consilium.europa.eu/doc/document/ST-13357-2025-INIT/en/pdf.

23 Commission Recommendation (EU) 2026/510 of 6 March 2026 on revising the European assessment framework for 'safe and sustainable by design' chemicals and materials OJ L, 2026/510, 10.3.2026, ELI: http://data.europa.eu/eli/reco/2026/510/oj, with its annex setting out the details of the framework based on technical reports from the Commission's Joint Research Centre, which also published a revised methodological guidance in October 2026: https://publications.jrc.ec.europa.eu/repository/handle/JRC146862

with novel features, with the objective of minimising environmental and climate impacts, promoting resource efficiency, circularity, enabling recycling and reuse, and ensuring high levels of protection for human health, animal health and the environment throughout the materials' life cycle, and minimising development costs by anticipating and addressing risks early.

(24) The transition from advanced materials research to industrial deployment depends not only on investment, infrastructure and regulatory conditions, but also on the availability of specialised skills. A highly skilled workforce is essential if the Union is to strengthen its leadership in advanced materials research, innovation and manufacturing, as also highlighted by the STEM education strategic plan[24], part of the Union of Skills. The European Skills Intelligence Observatory identifies and analyses broader skills gaps, emerging knowledge and skills needs, and labour market trends. Persistent shortages of scientists, engineers, technicians and digital specialists risk constraining the development and uptake of advanced materials. Identified skills gaps – such as in digital transformation competencies, including AI and in the circular economy (for example, recycling technologies) – represent a major obstacle. Attracting, developing and retaining talent is essential to support future growth and to strengthen the Union's advanced materials ecosystem.

(25) The Member States and the Commission should work in full partnership, together with academia, innovators and industry, to achieve the objectives set out in this Recommendation. Coordinated action at Union, national and regional levels, as well as at international level, is necessary to accelerate research and innovation, strengthen industrial deployment and ensure that the Union fully capitalises on its scientific excellence and industrial capabilities in advanced materials.

HEREBY RECOMMENDS:

1. OBJECTIVE

The objective of this Recommendation is that Member States, together with the Commission, support the ambition of making the Union the leading innovator, producer and user of safer and more sustainable advanced materials at global level by 2035. To achieve this, Member States are invited to aim for:

a. Full implementation of this Recommendation by 31 December 2030 with an integrated approach towards scientific and industrial leadership in light of actions being urgently needed;

b. Focus, speed and scale in implementation, from research and innovation to manufacturing and deployment, while ensuring independence and industrial capacity, particularly in the energy, mobility, construction, electronics, health (medical devices), aerospace and defence sectors as well as in cross-sectoral applications, also beyond these sectors, and in dual-use applications for all;

c. Measurable progress against concrete key performance indicators for the implementation of this Recommendation and the following general benchmarks compared with the year 2023:

[24] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'A STEM education strategic plan: skills for competitiveness and innovation', COM(2025) 89 final

i. an increase of at least 20% in the research and innovation investment for advanced materials and related manufacturing technologies at Union, national and regional levels;

ii. at least 20% of the Union and national research and innovation funded projects in safer and more sustainable advanced materials reaching Technology Readiness Levels 7-8 are pushed to deployment;

iii. an increase of at least 20% in the number of Union based advanced materials startups and scaleups, particularly in the sectors referred to in point 1 b.

2. DEFINITIONS

For the purposes of this Recommendation, the following definitions apply:

a. 'advanced materials' means materials, including but not limited to the examples of classes listed in Annex I, that are rationally designed to have new or enhanced properties, targeted or enhanced structural features, or both, with the objective of achieving specific or improved functional performance; this includes both new emerging manufactured materials and materials manufactured from conventional materials as well as materials from innovative manufacturing processes that enable the creation of targeted structures from starting materials;

b. 'priority challenges' means specific, large-scale, cross-sectoral industrial initiatives that are of strategic relevance to the Union's industrial competitiveness, technological sovereignty, EU defence readiness and/or societal objectives and that are centred on the R&D and deployment of advanced material solutions in at least four Member States.

3. FOCUS RESEARCH AND INNOVATION INVESTMENTS FOR ADVANCED MATERIALS ON PRIORITY CHALLENGES

It is recommended that Member States:

a. Endorse the approach of using priority challenges to prioritise research and innovation investments for advanced materials;

b. identify, by 31 December 2027 at least five joint priority challenges on advanced materials within the Technology Council for Advanced Materials ('the Technology Council', with a particular focus on energy, mobility, electronics, construction, health, and aerospace, including dual-use applications as well as defence; a non-exhaustive list of possible priority challenges for consideration is set out in Annex II. Priority challenges should not be pursued independently of considering wider impacts. Each joint priority challenge should be endorsed by at least four Member State representatives in the Technology Council, signalling their countries' intention to participate in addressing the priority challenge, and it should actively build upon consultation, input and feedback from stakeholders, including coordination with relevant fora, established by sectoral regulations, and expert groups, when applicable;

c. coordinate and contribute, within the Technology Council, to developing implementation plans for each of the joint priority challenges and any additional priorities set at a later stage; those implementation plans should:

(i) lay out a collective agenda with a clear timeline, participating countries and actors, allocated responsibilities, expected core outcomes, benefits to societal objectives, measurable targets and milestones, potential projects, human capital

and skills needs, envisaged funding allocations and pathways for the innovation-to-investment journey;

(ii) set out a concrete route to industrial deployment and market uptake;

(iii) be reviewed periodically within the Technology Council;

d. implement the plans referred in point c in a timely and coordinated manner, making use of regional, national and Union research, innovation and competitiveness programmes and instruments, including state aid in compliance with Union State aid and competition rules, and ensure consistency, synergies and complementarities between actions taken at Union, national and regional levels through mutual information and coordination steered by the Technology Council. Projects to be considered for support should provide a meaningful contribution to the objective of this Recommendation;

e. explore opportunities for private funding to support the implementation of the initiatives addressing priority challenges, including through public-private partnerships, and in close coordination with the Technology Council and other relevant forums, such as the Critical Raw Materials Board established by Regulation (EU) 2024/1252 of the European Parliament and of the Council[25], the Net Zero Europe Platform set up in accordance with Regulation (EU) 2024/1735 of the European Parliament and of the Council[26], the European Semiconductor Board established by Regulation (EU) 2023/1781 of the European Parliament and of the Council[27];

f. strengthen monitoring, foresight capabilities and generation of strategic intelligence and knowledge of advanced materials value chains and contribute to the Commission's activities in these regards; this should be achieved by supporting the collection and exchange of relevant information and expertise from national and regional and international sources and by building upon the work and insights gained from the economic security risk assessment on advanced materials with Member States within the Technology Council; the monitoring and foresight should help to identify emerging technological trends, industrial strengths, opportunities, strategic dependencies, vulnerabilities and trade-offs, and to informing policy priorities, and investment decisions, including with the identification of possible future priority challenges through the Technology Council.

4. LEVERAGE DIGITALISATION AND AI

It is recommended that Member States:

a. consolidate by 30 June 2028 the Materials Commons project as a permanent Union digital R&I infrastructure for advanced materials data, tools and knowledge, supported by the necessary national and regional financial commitments for its continued operation and development and make this infrastructure fully operational

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25 Regulation (EU) 2024/1252 of the European Parliament and of the Council of 11 April 2024 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 (OJ L, 2024/1252, 3.5.2024, ELI: http://data.europa.eu/eli/reg/2024/1252/oj).

26 Regulation (EU) 2024/1735 of the European Parliament and of the Council of 13 June 2024 on establishing a framework of measures for strengthening Europe's net-zero technology manufacturing ecosystem and amending Regulation (EU) 2018/1724 (OJ L, 2024/1735, 28.6.2024, ELI: http://data.europa.eu/eli/reg/2024/1735/oj).

27 Regulation (EU) 2023/1781 of the European Parliament and of the Council of 13 September 2023 establishing a framework of measures for strengthening Europe's semiconductor ecosystem and amending Regulation (EU) 2021/694 (Chips Act) (OJ L 229, 18.9.2023, p. 1, ELI: http://data.europa.eu/eli/reg/2023/1781/oj).

by 1 January 2030; for this purpose, the development and support for a joint proposal for a European Research Infrastructure Consortium (ERIC) within the meaning of Council Regulation (EC) No 723/2009[28] should be considered;

b. develop and connect national and regional digital infrastructures and data ecosystems and progressively align them with the Materials Commons, enabling interoperability, data sharing, digital modelling and experimentation workflows across Member States, including through AI-ready data flows and feedback loops between data repositories, digital tools and experimental facilities; support, with facilitation by the Commission, interoperability between the Materials Commons and the Common Data Platform on Chemicals established by Regulation (EU) 2025/2455 of the European Parliament and of the Council[29]; particular focus should be given to supporting advanced materials startups and scaleups based in the Union;

c. make data from nationally funded advanced materials R&I projects discoverable and available through the European Open Science Cloud and the Materials Commons, taking into account data ownership and the protection of intellectual property;

d. contribute, within the Technology Council and facilitated by the Commission, to the development by 31 December 2027 of a joint roadmap for self-driving laboratories for advanced materials that would use the integration of AI models, robotics and automated experimentation to accelerate the R&I process from discovery to manufacturing and integration into products; the roadmap should ensure synergies and interoperability with the Materials Commons, the 'Resource for AI Science in Europe' (RAISE) framework, and existing national projects; it should also connect with open pilot lines, testbeds and research and technology infrastructures to support the pathway from autonomous materials design to prototype qualification and scale-up, with accessible cross-border services for researchers and businesses, particularly SMEs, startups and scaleups;

e. enable Union businesses active in advanced materials and related advanced manufacturing technologies – in particular SMEs, startups and scaleups – to harness digitalisation and AI; this should be achieved by raising awareness of the opportunities of data sharing, collaboration and AI-enabled optimisation of the development, processing and testing of advanced materials and making available or signposting dedicated support and support networks to facilitate readiness and uptake.

5. SHORTEN TIME TO MARKET

It is recommended that Member States:

a. fund and accelerate the development and validation, standardisation, qualification and harmonisation of new test methods and guidelines for the safety and sustainability assessment of advanced materials; this process should be carried out in line and in coordination with the European Commission roadmap towards phasing out animal testing for chemical safety assessments; the process should also take into

[28] Council Regulation (EC) No 723/2009 of 25 June 2009 on the Community legal framework for a European Research Infrastructure Consortium (ERIC) (OJ L 206, 8.8.2009, p.1, ELI: http://data.europa.eu/eli/reg/2009/723/oj).

[29] Regulation (EU) 2025/2455 of the European Parliament and of the Council of 26 November 2025 establishing a common data platform on chemicals, laying down rules to ensure that the data contained in it are findable, accessible, interoperable and reusable and establishing a monitoring and outlook framework for chemicals (OJ L, 2025/2455, 12.12.2025, ELI: http://data.europa.eu/eli/reg/2025/2455/oj).

account recommendations of the One-Substance-One-Assessment[30] subgroup on test method development and validation, make use of computational modelling, and AI in safety assessment, and build on the OECD process[31] for developing test guidelines; this should be considered for the implementation plans for priority challenges as referred to in point 3 (c);

b. promote the uptake and implementation of the 'safe and sustainable by design framework, as set out in Recommendation (EU) 2026/510, throughout the entire advanced material innovation process for practical applications throughout the entire lifecycle also considering recovery; this includes (i) targeted funding, guidance, training, collaborative projects and knowledge exchange activities; (ii) the facilitation of collaboration between national organisations responsible for chemical safety and sustainability assessment; (iii) support to the establishment and operation of the EU Chemicals Innovation and Substitution Hubs[32]; and (iv) support for seeking synergies between these organisations and the Hubs to help innovators, in particular SMEs, bring safer and more sustainable advanced materials to the market faster;

c. support the development, implementation and uptake of guidelines for advanced materials testing and qualification in application areas such as energy, electronics, mobility, construction, health and aerospace;

d. facilitate the setting up, operation and evaluation of regulatory sandboxes to experiment with advanced materials; this should be considered for the implementation plans for priority challenges, referred to in point 3 (c);

e. facilitate and expand access for SMEs, startups and scaleups to research and technology infrastructures, pre-industrial pilot lines and upscaling facilities for their testing and qualification of advanced materials; this should be achieved through dedicated access or voucher schemes, including cross-border access, and improved awareness of available services and facilities;

f. promote harmonised and transparent access rules among research and technology infrastructures, building on the Charter of Access for Industrial Users to Research and Technology Infrastructures;

g. promote among industry and academia strategic approaches to intellectual asset management and technology transfer in advanced materials; this could be achieved by providing standardised models and templates for collaboration agreements, licensing, joint ownership and data sharing, to reduce transaction costs and time for concluding such agreements, taking into account applicable EU State aid and competition rules;

h. strengthen the capacities of intermediaries, including technology transfer offices, to identify high-potential R&I results in the field of advanced materials and support their strategic management, portfolio development and commercialisation of intellectual assets;

i. advance co-creation, open innovation, spin-off and knowledge transfer opportunities between academia and industry by aligning research priorities, industrial needs and technological challenges; establish or strengthen structured matchmaking

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30 Expert Group on One Substance, One Assessment (E03792) https://ec.europa.eu/transparency/expert-groups-register/screen/expert-groups/consult?lang=en&groupID=3792

31 https://www.oecd.org/en/topics/sub-issues/testing-of-chemicals/test-guidelines.html

32 Commission Communication COM(2025) 530 final, A European Chemicals Industry Action Plan, 8 July 2025.

mechanisms and platforms to connect industrial partners, SMEs, startups and scaleups with the public sector, including research organisations and researchers, to promote the development of advanced materials, proofs of concept and demonstration projects;

j. strengthen access to dedicated funding to support the testing, qualification and prototyping, including proof-of-concept and demonstration projects, to accelerate the translation of research results into real-world applications, including in a transnational context.

6. BOOST SCALING UP AND UPTAKE

It is recommended that Member States:

a. make use of R&D procurement and public procurement of innovative solutions, including joint procurement and pre-commercial procurement, for advanced materials by relevant public and private buyers; in particular to address the priority challenges requiring advanced materials identified by the Technology Council, and to create lead-market opportunities for innovative SMEs, startups and scaleups;

b. mobilise investments from Union, national and regional investment programmes, as well as from private actors, to support the industrial scale-up of advanced materials projects with targeted funding, facilitated by the Technology Council. These efforts should create pathways for the innovation-to-investment journey of such projects with a concrete route to industrial deployment and market uptake; this should include systematic links to ongoing strategic projects and important projects of common European interest (IPCEI), ;

c. identify and promote advanced materials projects, including R&I industrial projects, and projects relevant for the Union's economic security, defence readiness and competitiveness, where relevant Union sectoral legislation could facilitate their manufacturing, deployment and scale-up within the Union; this may include strategic projects in response to calls for applications launched at Union level under Regulation (EU) 2024/1252 [Critical Raw Materials Act], particularly to reduce strategic dependencies by substituting critical raw materials, investing in new production capacities or extending existing production capacities for advanced materials critical for the Union's defence readiness and competitiveness; it may also include the possibility for relevant advanced materials projects to apply for net-zero strategic project status under Regulation (EU) 2024/1735 [Net-Zero Industry Act][33], to provide planning and investment certainty and thereby further enabling the contribution of advanced materials to net-zero technology manufacturing in the Union;

d. engage in and consider supporting, in line with EU State aid and competition rules, European-scale innovative industrial projects; this would be to help scale up advanced materials and promote circular economy solutions envisaged as too risky, complex or ambitious to be financed by the market alone as part of IPCEI;

e. Strengthen matchmaking and networking opportunities for advanced materials companies at Union, national and regional levels; this could be achieved by organising events, including as part of national or regional programmes and innovation ecosystem initiatives, cluster organisations and other business support

[33] Project promoters are encouraged to apply via the Commission website's application process, which transfers applications to the relevant Member State: https://single-market-economy.ec.europa.eu/industry/sustainability/net-zero-industry-act/strategic-projects-under-nzia_en

network organisations – including the announced EU Chemical Innovation and Substitution Hubs, and by encouraging the participation of startups, scaleups, research organisations, investors, producers and users of advanced materials in compliance with EU competition rules; those activities should specifically support startups and scaleups in securing industrial partnerships, pilot and first industrial deployment opportunities, access to markets, investment opportunities and the scaling-up of production capacities in the Union; consider also participation in matchmaking and investment events at European level organised in collaboration with the European Partnership on Innovative Advanced Materials and the European Innovation Council established by Commission Implementing Decision (EU) 2021/173[34], including in the context of the Scaleup Europe Fund established by Commission Decision C(2026)5688[35].

7. BRIDGE THE SKILLS GAP

It is recommended that Member States:

a. support knowledge sharing and the mapping and anticipation of knowledge and skills needs in advanced materials provided, particularly by the European Advanced Material Academy, including the identification of gaps; facilitate the exchange of information on emerging knowledge and skills needs, labour market trends and relevant educational practices at Union, national and regional levels;

b. strengthen the quality and attractiveness of education and training in science, technology, engineering, and mathematics (STEM) disciplines related to advanced materials, specially chemistry, physics, engineering, digital technologies and AI, data science and regulatory science; integrate the relevant skill sets in national education, training and lifelong learning strategies and programmes, contributing to the 2030 targets for STEM enrolment in initial vocational education and training and in tertiary education[36];

c. make effective use of study programmes, learning pathways, innovative lifelong learning approaches, such as Individual Learning Accounts, micro-credentials, industry-aligned training materials, train-the-trainer programmes and SME starter packages, including those developed by the European Advanced Materials Academy, for their integration into national educational curricula for students and national initiatives to train, upskill and reskill workers; build in this context also on European Universities alliances, Marie Sklodowska-Curie Actions, Erasmus+ actions and the Choose Europe initiative to address identified skills gaps, and to attract, develop and retain global talent for advanced materials research and innovation in the Union;

d. ensure that education, training and lifelong learning systems respond to emerging industrial, technological, research and regulatory needs in advanced materials; this

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34 Commission Implementing Decision (EU) 2021/173 of 12 February 2021 establishing the European Climate, Infrastructure and Environment Executive Agency, the European Health and Digital Executive Agency, the European Research Executive Agency, the European Innovation Council and SMEs Executive Agency, the European Research Council Executive Agency, and the European Education and Culture Executive Agency and repealing Implementing Decisions 2013/801/EU, 2013/771/EU, 2013/778/EU, 2013/779/EU, 2013/776/EU and 2013/770/EU (OJ L 50, 15.2.2021, p. 9, ELI: http://data.europa.eu/eli/dec_impl/2021/173/oj).

35 Commission Decision C(2026)5688 of 3 August 2026 on establishing the Scaleup Europe Fund (SEF) compartment of the European Innovation Council (EIC) Fund

36 Communication from the Commission 'A STEM education strategic plan: skills for competitiveness and innovation', COM(2025) 89 final. The EU-level targets set out in the plan are that, by 2030, the share of students enrolled in STEM fields should be at least 45% in initial medium-level vocational education and training and at least 32% in tertiary education.

could be achieved through closer cooperation between academia, research and technology organisations, vocational education and training institutions, industry and regulatory bodies;

e. promote multidisciplinary training that combines materials science, AI, safety, sustainability, circularity, regulatory considerations and industrial needs.

8. GOVERNANCE, MONITORING PROGRESS AND STAKEHOLDER ENGAGEMENT

It is recommended that Member States:

a. bring together stakeholders from their advanced materials ecosystems to gather further feedback and input for the implementation of this Recommendation; the stakeholder feedback and input should focus in particular on identifying of priority challenges and on prioritisation for implementation plans and roadmaps and other related activities, so that a truly collective agenda towards achieving the Recommendation's objective can be set; this includes discussions envisaged at the Technologies for Europe 2027 and 2028 Presidency conferences[37];

b. strengthen international cooperation with like-minded third countries and strategic partners, including enlargement countries, on advanced materials and related manufacturing technologies, to (i) support the identified priority challenges, (ii) to diversify sourcing and promote resilient value chains, (iii) to foster innovation, and (iii) to advance common standards, sustainability and economic and research security objectives; in this context, leverage the Global Gateway Strategy and the Pact for the Mediterranean to develop mutually beneficial projects that allow the EU to advance on the above-mentioned objectives;

c. share information and closely monitor progress on the implementation of this Recommendation, particularly through the Technology Council, based on the envisaged milestones, benchmarks and implementation plans; for that purpose, the Technology Council is invited to prepare an interim stocktaking by 31 December 2028 and a report on the implementation of this Recommendation by 31 December 2030, facilitated by the Commission;

d. for measuring progress in the implementation of this Recommendation, in particular the following key performance indicators should be used:

   i. the amount of R&I funding attributed to 'priority challenges' and the number of countries engaged in related implementation plans;

   ii. the number of Member States engaged in a permanent Union R&I digital infrastructure for the 'Materials Commons' and in the joint Self-Driving Lab roadmap;

   iii. the amount of targeted regional, national and Union funding supporting the substitution of critical raw materials or hazardous substances with safer and more sustainable alternatives;

   iv. the amount of targeted regional, national and Union funding provided to promote the access of startups, scaleups and SMEs to research and technology

[37] These Presidency conferences are supported by the Horizon Europe work programme 2026-2027: Commission Implementing Decision C(2025)8493 of 11 December 2025 on the financing of the Specific Programme implementing Horizon Europe – the Framework Programme for Research and Innovation – and the adoption of the work programme for 2026-2027.

infrastructures, pilot lines and upscaling facilities for the testing of advanced materials;

v. the number of Union based advanced materials startups and scaleups, particularly in the sectors referred to in point 1 b;

vi. the increase in the number of Net-Zero Industry Act strategic projects that can be considered advanced material projects;

vii. the level of investments mobilised for advanced materials through the launch of R&D procurement, procurement of innovative solutions, IPCEIs, or new strategic projects, including for the industrial uptake and deployment of advanced materials; and

viii. the number of learning programmes, micro-credentials, content and training materials by the European Advanced Materials Academy integrated into national education curricula or training initiatives.

e. examine the assessment by the Technology Council and discuss annually in the Council whether further steps and measures are required to ensure that the Union will be a leading innovator, producer and user of safer and more sustainable advanced materials by 2035.

Done at Brussels,

*For the Council*
*The President*

EUROPEAN
COMMISSION

Brussels, 18.11.2026
COM(2026) 833 final

ANNEXES 1 to 2

**ANNEXES**

**to the Proposal for a COUNCIL RECOMMENDATION**

**on Advanced Materials**

**[Advanced Materials For Europe]**

{SWD(2026) 833 final}

## ANNEX I - Examples of advanced materials classes, non-exhaustive list.

| **Material classes** | **Material examples** | **Typical properties** | **Application area examples** (across different sectors) |
|---|---|---|---|
| **Advanced ceramics and glasses** | Ceramic matrix composites, glass-ceramics, adsorbent materials. | Very hard inorganic, non-metallic materials with high temperature and corrosion resistance, often brittle. | High-performant gas turbines, engines and fuel cells, durable automotive brakes, lightweight heat shields in aerospace, durable medical implants or high-performance thermal imaging and night vision, replacement of hazardous materials (e.g. in wear-resistant coatings), high efficiency adsorbent materials to capture pollutants. |
| **Advanced composites and hybrid materials** | Carbon fibre reinforced, (bio)polymer matrix. | Strong and lightweight composed (mixed) materials with tailored properties. | Longer-lasting wind blades, light vehicles, dual-use aerostructures (transport aircraft, helicopters), space launcher and satellite structures, high-performant built structures and low-carbon building elements, robust pipes or high-performance body armour and protective gear, replacement of hazardous fibres in composites. |
| **Advanced metals, alloys and semiconductors** (as defined per Commission proposal COM(2026)504) | Superalloys, high-entropy alloys, lightweight metals/alloys, advanced steels. | Strong, (semi)conductive materials with high temperature, corrosion, fatigue resistance and enhanced properties. | More efficient robust gas/steam turbines, durable combustion engines, batteries, critical raw material-free permanent magnets, long-lasting medical implants, or high-performance protective armour, replacement of critical raw materials and hazardous materials (e.g. in wear-resistant coatings), dual-use space and defence systems. |
| **Advanced polymers and precursors** | Conductive, self-healing, shape-memory (bio)polymers, membranes. | Lightweight, flexible, adaptive and durable macromolecular materials with enhanced properties or functions. | Safer, more efficient and recyclable batteries (e.g., electrolytes, membranes), protective coatings, flexible wearables and displays, or innovative wound dressings and artificial tissues, replacement of hazardous lubricants / surfactants (e.g. PFAS), high-performance membranes for water purification. |
| **Nanomaterials** (as defined per Commission Recommendation 2022/C 229/01). | Nanoparticles, quantum dots, nanotubes, 2-dimensional materials (e.g. graphene). | Materials with structures at the nanoscale leading to peculiar properties, e.g. based on quantum effects. | More efficient solar cells, energy-harvesting windows, anodes and cathodes for batteries, self-healing concrete, low-power chips, quantum computing and sensors as contrast agents in medical imaging. |
| **Smart and functional (intelligent/responsive) materials** | Shape memory, piezoelectric, sensors. | Adaptive materials responsive to external stimuli. | More efficient energy harvesting, self-healing coatings, self-expanding medical implants or morphing aerospace structures, smart sensors for quality monitoring. |
| **Stealth and metamaterials** | Negative index materials, acoustic metamaterials, photonic crystals. | Artificially engineered structured materials with unique electromagnetic, optical, electrical or acoustic properties. | Stealth and camouflage, electromagnetic shielding, or high-efficiency antennas and wireless communication. |

## ANNEX II

### Priority challenges

The process for identifying **priority challenges** should follow the existing governance structure of the Technology Council for Advanced Materials. Subgroups should be used for technical discussions, while high-level plenary meetings will endorse new priority challenges. Each priority challenge should be supported by an implementation plan for an initiative addressing the challenge, covering the full 'innovation to investment journey'. This plan should identify the relevant actors involved – including the EU, Member States and industry – as well as the available funding mechanisms and relevant human capital and skills needs.

A feedback mechanism could be established between the funded projects supporting the agreed actions and the Technology Council in order to monitor progress and, where relevant, further support the innovation to investment journey, while protecting business secrets, e.g. by sharing only what is strictly necessary or aggregating sensitive data where possible.

Possible priority challenges that the Technology Council could consider include the following:

**Critical Raw Material-free permanent magnets for clean energy**. The Union's clean energy future – from wind turbines to electric vehicles – depends on rare-earth-free magnets. Today China provides 100% of the EU's supply of heavy rare earth elements, creating supply chain vulnerabilities and geopolitical risks. By accelerating R&I into advanced materials with Critical Raw Material-free alternatives and scaling industrial deployment, we can cut dependency and boost European manufacturing jobs.

**Low carbon binders for cement production.** Cement is the world's most used building material, with annual production of around 30 billion tons, and its industry accounts for around 8% of global $CO_2$ emissions. A novel binder that releases no $CO_2$ during production and can be made at much lower temperatures could deliver major climate benefits.

**Circular fibre reinforced composites.** Fibre composites are essential for lightweight construction and energy efficiency, particularly in electric vehicles, aviation, rail and urban mobility. However, fibre-reinforced composites face high material and processing costs, limited scalability and major recycling gaps. Import dependency on key raw materials remains high, with carbon fibres sourced mainly from Japan and the USA. A circular European value chain for secondary carbon and glass fibres could strengthen industrial sovereignty.

**PFAS-free materials and process chemistries for semiconductors and electronics manufacturing.** The Union must lead in semiconductors free of per- and polyfluoralkyl substances (PFAS) to secure its technological sovereignty and green transition. PFAS known as persistent 'forever chemicals' – pose growing health and environmental risks. By investing in R&I, scaling production, and commercialising alternatives, the Union can ensure that its energy, mobility, and chips industry – critical for AI, quantum technologies, and defence – stays competitive, sustainable, and resilient.