M-ERA.NET

Vision & policy

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Motivation & context

Materials are completely transverse in the current economy and increasingly critical due to their usage in all aspects of modern societies. Across all sectors and markets, such as energy, healthcare, transportation, building and construction, agriculture and consumer products, the challenges for the 21st century include:

- sustainable use of resources;
- efficient energy production, storage, transmission and usage;
- reduction of greenhouse gas emissions;
- eliminating the use of harmful materials and chemicals;
- resilient supply of raw materials.

Improved and efficient materials processing, manufacturing and upscaling with reduced energy and materials consumption are therefore needed to develop products that are easier to maintain, repair, upgrade, remanufacture or recycle and to enhance economic prosperity while reducing the environmental impact of the manufacturing processes and the associated greenhouse gas emissions to minimise the carbon footprint.

To that end, new materials are crucial for enhancing the durability of processes, for ensuring a resilient supply chain, and for enabling the design for recycling concept.

Therefore, a collective effort and investment is urgently needed to support research and development on advanced materials to enable the green and digital transformation priorities towards a circular economy with smart, safe and sustainable materials.

M-ERA.NET aims to support and increase the coordination and convergence of national and regional funding programmes on research and innovation related to advanced materials. It contributes to the structuring of the European Research Area (ERA).

M-ERA.NET is a strong European network of public funding organisations supporting and increasing the coordination and convergence of national and regional funding programmes on research and innovation related to advanced materials. It started as an EU-funded project in 2012 with 37 partners from 25 European countries, continued as M-ERA.NET 2 from 2016 to 2022 with 43 partners from 29 countries and is now running in its third phase as M-ERA.NET 3 until 2026 under the Horizon 2020 ERA-NET COFUND scheme with 49 public funding organisations from 35 EU and non-EU member states.

Our vision of materials science

Europe has a strong position in research related to materials. However, in an increasingly competitive environment, the European RTD community needs substantial support to generate and exploit high-level knowledge for new applications, to increase the competitiveness of the economy, to secure existing markets and to open access to promising new ones.

M-ERA.NET envisions a future where advanced materials are at the forefront of innovation, driving sustainable development and addressing global challenges. Through collaboration, research excellence, and knowledge transfer, we strive to shape a world where advanced materials play a transformative role in improving people's lives and safeguarding the environment.

In this sense, M-ERA.NET provides EU Member States, Associated Countries and international parties with a flexible framework to involve funding programmes on materials science and to link up with their industrial policies and related national and regional support programmes in the field of advanced materials. Adapting to upcoming needs, M-ERA.NET facilitates fast and wide responses that contribute to reinforcing the resilience and sustainability of Europe.

Mission & expected impacts

M-ERA.NET's mission is to strengthen the European Research Area (ERA) on advanced materials by fostering transnational collaboration among researchers, academia, industry and other stakeholders. With our annual transnational calls, and additional activities such as seminars, reports, etc., we aim to fund ground-breaking research projects, facilitate knowledge exchange, and promote sustainable solutions in the field of materials science. By uniting the efforts of European countries and beyond, our ambition is to enhance Europe's position as a leading player in advanced materials research, development and application.

M-ERA.NET addresses emerging technologies and application areas related to materials research in the context of the green transition, supporting the circular economy and the Sustainable Development Goals.

M-ERA.NET aims at the following impacts:

- **Strengthen the European RTD community** and economy in materials research and innovation.
- Enhance scientific research and **upgrade the technological capabilities of industrial sectors,** targeting the circular economy and Sustainable Development Goals.
- Enable a substantial contribution towards **European technology leadership** and manufacturing competitiveness.
- **Consolidate strategic programming** of joint activities, addressing upcoming societal and technological challenges in an interdisciplinary and flexible approach.
- **Reinforce the dialogue** with relevant stakeholders involved in European Partnerships, European Technology

Platforms and other relevant thematic networks, in order to identify gaps and needs and to ensure support for the green transition while complementing initiatives under Horizon Europe.

- Reduce fragmentation and improve efficiency in the **coordination and cooperation of funding programmes** in EU Member States and Associated States.
- **Mobilise a critical mass of national and regional funding** for transnational RTD cooperation in materials research and innovation.
- Strengthen the participation and **integration of EU-13 countries.**
- Engage further in **international cooperation with partners outside Europe.**
- Facilitate a strong **participation of regions**, having a strong impact on R&I at regional level and support local actors by facilitating global connections and increased productivity.
- Foster the **exploitation of created knowledge** along the whole innovation chain.

Transnational RTD projects funded by M-ERA.NET combine materials research with industrial needs by stimulating new products and production processes and will develop synergies that can be very effective in achieving industrial symbiosis.

M-ERA.NET has a strong track record of successful research collaborations and achievements. Between 2012 and 2022, more than 2.300 proposal have been submitted to M-ERA.NET calls and we have already supported 380 cutting-edge projects in materials science with 310 M€ national and regional public funding, leading to significant advancements and impact. Some highlights from past calls include:

- Breakthroughs in renewable energy materials, contributing to the transition towards a sustainable and low-carbon energy future.
- Development of lightweight, high-strength materials for the aerospace and automotive industries leading to reduced emissions and increased fuel efficiency.
- Advancements in nanotechnology for healthcare applications such as targeted drug delivery systems and personalized medicine.
- Innovation in smart materials enabling the integration of electronics and sensors into everyday objects for enhanced functionality and efficiency.

Detailed achievements are published on the M-ERA.NET website.

Policy for joint programming

M-ERA.NET follows a multi-annual policy that integrates national and regional priorities with industry needs, European policy priorities and global challenges, and is centred on objectives at various levels.

European policy priorities

M-ERA.NET activities are in line with the priorities defined at European level and support key enabling technologies that are essential for Europe's industrial future. In particular the network is guided by following strategic documents:

- The **Circular Economy Action Plan:** R&I on advanced materials is essential for developing a circular design of products as recommended by the "Report on the implementation of the Circular Economy Action Plan (SDW (2019)90)" [i] supporting the transition towards a "Circular economy and a zero-waste programme for Europe (COM(2014)398)" [ii] . Moreover, the European Strategy for Plastics in a Circular Economy (SDW(2018)16) [iii] specifies the need for plastics design and production fully respecting reuse, repair and recycling requirements.
- The **2030 Agenda for Sustainable Development** [iv] and its **17 Sustainable Development Goals:** Technological innovation is the foundation of the efforts undertaken to achieve the environmental and growth objectives (SDG7, SDG9 and SDG12) set by the general assembly of the United Nations. In that respect, there needs to be more research and development in high-tech products that dominate the manufacturing productions to increase efficiency (material use, recyclability, energy efficiency) More progress needs to be made regarding integrating renewable energy and its storage into end-use applications in buildings, transport and industry.
- The European Commission (**EC) communication "A clean planet for all"** [v]**:** A defined set of seven main strategic priorities considering new and improved materials for buildings, reduction of materials through re-use and recycling, substitution of carbon intensive materials, biogenic materials as well as more efficient and sustainable batteries.
- The **EC Communication "A Chips Act for Europe"** [vi]**:** The first strategic objective is for Europe to strengthen its research and technology leadership as an imperative to preserve Europe's current assets in several break-through technologies, including equipment manufacturing and advanced materials, needed to build next-generation production facilities serving all its sectors.
- The **EC Communication "A secure and sustainable supply of critical raw materials in support of the twin transition"** [vii]**:** the communication explicitly states that "the Commission will present a Coordinated Plan of Action with Member States on advanced materials, including substitution of critical raw materials, in order to secure R&I investments levels commensurate with the challenge".

- **Critical Raw Materials Act** [viii]**:** Critical raw materials are indispensable for a wide set of strategic sectors with still increasing demand. Therefore, a comprehensive set of actions to ensure the EU's access to a secure, diversified, affordable and sustainable supply of critical raw materials.
- **Net Zero Industry Act** [ix]**:** The uptake in clean energy technologies will support the sustainability transition, leading to new products and more efficient and effective ways of generating energy that contribute to the European Green Deal objectives. The proposal strengthens Europe's manufacturing capacity of net-zero energy technologies.
- The **European Green Deal**[x]**:** A set of deeply transformative policies are designed, which include new forms of collaboration with industry and investments in strategic value chains aiming to mobilise industry towards a clean and circular economy, such as the 2030 Climate Target Plan proposed by the Commission[xixii], to reduce emission by 55%. The Commission will also continue to implement the Strategic Action Plan on Batteries and support the European Battery Alliance.
- The **Commission's plan for a new ERA (European Research Area) based on excellence:** The EC communication "A new ERA for Research and Innovation"[xiii] defines several strategic objectives which will be relevant for M-ERA.NET:
  - Prioritise investments and reforms in research and innovation to support the digital and green transition and Europe's recovery.
  - Improve access to excellent research and innovation for researchers across the EU.
  - Translate results into the economy to ensure market uptake of research output and Europe's competitive leadership in technology.
  - Make progress on the free circulation of knowledge, researchers and technology through stronger cooperation with EU countries.

Alignment of national and regional priorities

M-ERA.NET supports the alignment of national and regional funding programmes in materials research and innovation with European policies, strategies and roadmaps. recognising that alignment aims at structuring both research and innovation efforts of EU Member States and Associated Countries, to help establishing the European Research Area (ERA) and tackle societal challenges more effectively. The network has been making significant efforts towards a better alignment by improving the collaboration and cooperation of key players at all levels. This is already evident in the process to establish the annual work programmes and identify common topics, in which all network partners are involved. In addition, a dialogue with European stakeholders and the international RTD community ensures an appropriate scope that reflects the state of the art.

Materials research challenges & relevant stakeholders

Innovation is needed at the scale of the whole product (design, manufacturing, interfaces, surfaces, assembling) or in its very constitutive materials (e.g. via self-healing properties). M-ERA.NET supports research that connects the world of materials science with the needs of industries. This collaboration sparks the creation of new products and makes industrial production more efficient. It also helps develop strong partnerships among industries, which can be very effective in working together for mutual benefit. In this way, we identify the following main challenges for materials research:

- A systemic approach is needed. Innovative materials must be developed and designed considering the whole life cycle, enhancing the durability of products, improving process efficiency with reduced energy and materials consumption, substituting critical, hazardous or hardly recyclable materials, and developing products easier to maintain, repair, upgrade, remanufacture or recycle with the aim of preventing by-products from becoming waste. M-ERA.NET therefore also addresses bio-degradable and compostable plastics, improved polymer design and innovative compositions, aimed at reducing potential health effects and preventing plastic waste and micro-plastics pollution, by replacing chemicals of concern to achieve higher recycling rates.
- Digitalisation and materials modelling contribute to the identification of new materials, tailoring the material properties and performance at the design phase, optimising production processes or operation strategies for devices and systems. Supporting the need for uniform data structures, uniform data processing (exchange, evaluation, further processing) and uniform concepts for handling materials data, so-called digital workflows across all borders.
- Meeting the challenges of climate neutrality requires a reduced use of unsustainable resources along with more efficient, sustainable energy harvesting and storing devices. The development and manufacturing of high-performance, reliable, safe and low-cost batteries is key. Research on the design of future batteries or disruptive technologies with advanced chemistry are encouraged, including aspects like high-energy, high-power density, long cycle lifetime, recyclability and low environmental footprint.
- Catalysing progress in materials research: This includes promoting advancements in the domains of functional materials, high-performance composites, and innovative surfaces, coatings, and interfaces. These are foundational to the Materials Innovation Markets described in AMI2030's Strategic Materials Agenda, serving as the bedrock for driving innovation, shaping sustainability, enhancing efficiency, and fostering competitiveness in areas of profound industrial and societal significance.

While continuity in support is crucial to reach long-term goals, M-ERA.NET also recognises the need to react to future emerging trends by continuously interacting with the relevant players in materials research including industry. When planning the M-ERA.NET activities respective roadmaps are considered, such as:

- ETIP Batteries Europe: Strategic Research Agenda for batteries 2020[xiv]
- BATTERY 2030+ long-term roadmap for forward-looking battery research in Europe [xv]
- EMIRI Technology Roadmap[xvi]
- EMMC RoadMap 2020 for Materials Modelling and Informatics[xvii]
- SusChem Strategic Research and Innovation Agenda
- Strategic Energy Technology Plan (SET Plan)[xviii]
- Nanomedicine Strategic Research and Innovation Agenda [xix]
- Made in Europe Strategic Research and Innovation Agenda [xx]
- Process4Planet Strategic Research and Innovation Agenda [xxi]
- CETPartnership Strategic Research and Innovation Agenda[xxii]
- ERA4HEALTH Strategic Research and Innovation Agenda[xxiii]
- AMI2030 Strategic Materials Agenda [xxiv]

M-ERA.NET annual work programmes

M-ERA.NET develops annual work programmes following a model of continuous improvement based on lessons learned from past years. Building on the vision and policy this approach considers inputs from the M-ERA-NET stakeholders in a way which results in annual work programmes that reflect the needs of both society and the RTD community.

The work programmes also include annual updates of horizontal objectives. Among others, in 2023, these objectives were focused on supporting the achievement of Sustainable Development Goals, contributing to the European Green Deal by supporting a circular economy and future batteries, setting synergies with topics of the Horizon Europe and with related European Partnership initiatives, etc.

A rigorous and inclusive process established for preparing the annual work programmes includes the following key elements:

- Baseline Establishment: M-ERA.NET conducts a comprehensive analysis of existing and future challenges, opportunities, and societal needs related to advanced materials. This baseline establishment exercise helps M-ERA.NET to identify priority areas for research funding and innovation.
- Stakeholder Consultation: We engage with a wide range of stakeholders, including researchers, industry representatives, policymakers and the public, to identify pressing challenges and emerging trends in materials science. The thematic scope of annual calls is drafted based on

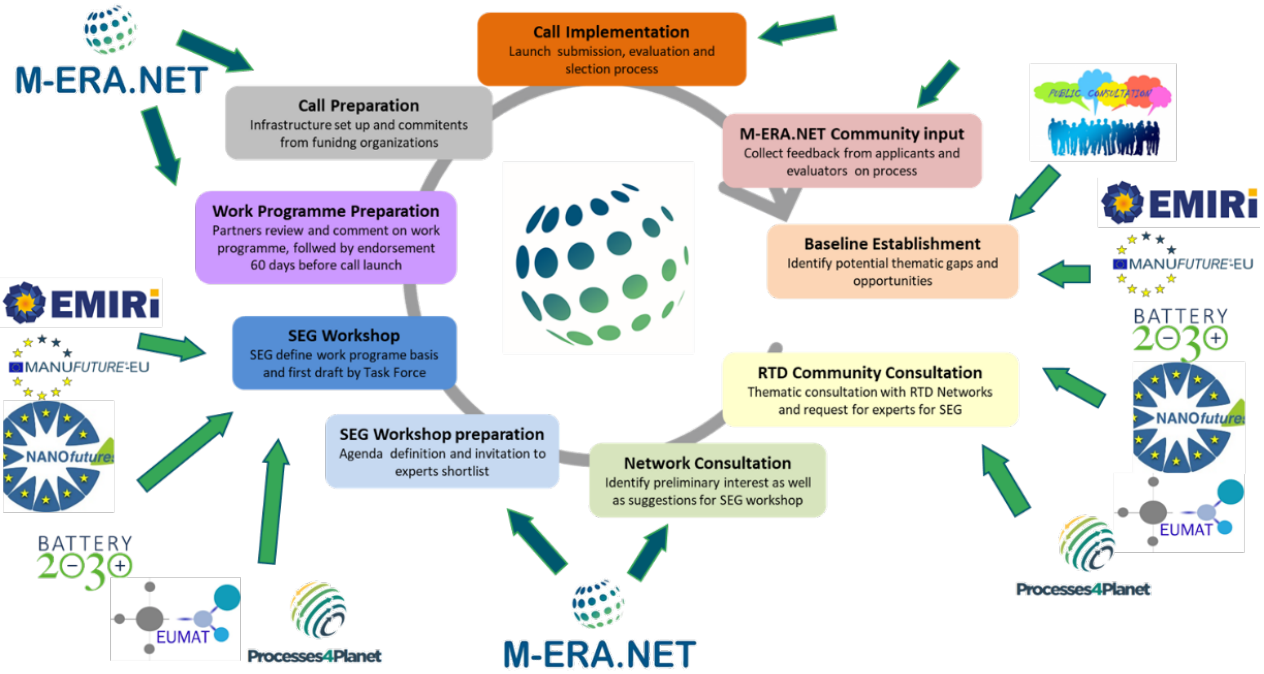

Figure 1. Schematic illustration of the steps of the yearly cycle that defines de process of M-ERA.NET annual work programmes.

consultations among **M-ERA.NET members** and the **RTD community**. A key element is the **Strategic Expert Group (SEG),** which helps identify gaps and opportunities for transregional, transnational and international cooperation and further defines the topics in detail.

- Alignment of national and regional with European policy priorities: Our work programme is aligned with the European Commission's strategic priorities and initiatives on research and innovation. We strive to contribute to the achievement of the European Green Deal, the Digital Agenda, and other relevant policies.

SEG members provide a comprehensive overview of needs, possibilities and trends at European and international levels to help M-ERA.NET identify gaps and opportunities, considering the national and regional interests of the M-ERA.NET consortium. They are also requested to contribute new topic suggestions for subsequent annual work programmes.

The resulting annual work programme, which also includes the call schedule and procedures, is finally endorsed by the **Steering Board**.

Further activities

In addition to the annual joint calls several other joint activities are considered:

- continuous monitoring and evaluation of funded projects to assess the effectiveness of our activities and make data-driven decisions for future funding priorities.
- encourage researchers to share data, methodologies, and results to accelerate knowledge dissemination and foster innovation.
- engage in proactive communication with policymakers and stakeholders and the general public to raise awareness about the importance of advanced materials research and the benefits it brings to society.
- support the training and development of a skilled workforce in materials science, fostering the next generation of researchers, engineers and innovators.

Outlook

With new priorities, instruments and initiatives launched under Horizon Europe the M-ERA.NET consortium will take on the challenge to identify the best way forward, highlighting options for future development during the project lifetime and after the project end. A durable, long-term partnership between funding organisations is a clear goal as well as a valuable role in the context of Horizon Europe. M-ERA.NET will closely follow the progress and developments concerning the European Partnerships to identify relevant initiatives as well as options and needs for coherence, cooperation and continuation.

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