![M-ERA.NET]

M-ERA.NET Call 2022

Guide for Proposers

Version 1.0

15 March 2022

Content:

1. Introduction to M-ERA.NET

What is M-ERA.NET ?

M-ERA.NET is a strong European network of public funding organisations supporting and increasing coordination and convergence of national and regional funding programmes on research and innovation related to materials and battery technologies to support the European Green Deal.

M-ERA.NET Mission

Technological innovation is the foundation of the efforts undertaken to achieve the environmental and growth objectives set in the 2030 Agenda for Sustainable Development[1] and its 17 Sustainable Development Goals (SDGs) 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) and more progress needs to be made regarding integrating renewable energy and its storage into end-use applications in buildings, transport and industry. The development and manufacturing of high-performance, reliable, safe and low-cost energy generating and storing elements is a key to a sustainable mobility and energy supply. The numerous fields of application lead to an increased use of these elements and thus to an increased consumption of resources. Measures must be taken to conserve resources and increase the efficiency of their exploitation.

New materials are crucial for finding solutions for light weighting, for enhancing the durability of process and to ensure a resilient supply chain, improve the performance mainly in terms of energy generation (efficiency, stability) and storage (energy density, power delivery, ultrafast charge, cyclability), cost and safety. In addition to this, new materials will also enable the design for recycling concept, thanks to which the environmental impact of the manufacturing process and the associated greenhouse gas emissions and carbon footprint will be minimized. This will be possible by substituting hazardous and/or hardly recyclable materials for counterparts easier to process and recycle."

Transnational RTD projects funded by M-ERA.NET will combine materials research with industrial needs by stimulating new products and production processes, and by developing synergies that can

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[1]   https://sdgs.un.org/2030agenda

be very effective in achieving industrial symbiosis, in particular with the aim of preventing by-products from becoming waste.

M-ERA.NET Consortium

M-ERA.NET started in 2012 under FP7 with 37 partners from 25 European countries. It 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 currently 50 public funding organisations from 36 countries. The diverse and experienced network comprises national and regional funding programmes from 25 EU member states and 5 associated countries and includes 6 non-European organisations.
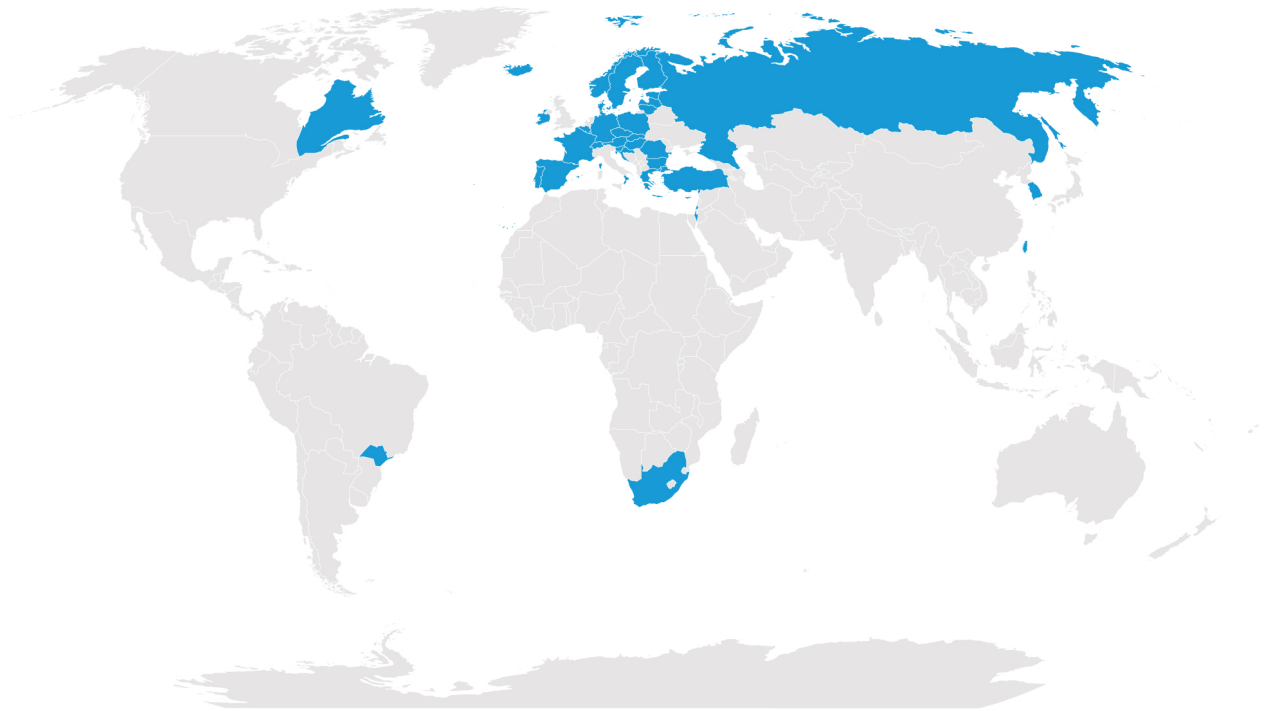
Figure 1: Participating countries and regions of the M-ERA.NET 3 consortium, see also
https://www.m-era.net/about/m-consortium

2. Structure of the M-ERA.NET Call 2022

The objective of the M-ERA.NET Call 2022 is to enable transnational R&D projects between partners receiving funding from regional/national programmes.

Fig. 2 shows the schematic workflow of the Call 2022. Benefits are combined in one approach: On the one hand the regional/national funding organisations apply their own well-established funding rules and procedures known to their applicants, and on the other hand M-ERA.NET provides transnational coordination expertise:

- The call is organised as a 2-step-procedure.The eligibility of funding applications will be checked by national/regional funding organisations according to the rules defined by their respective funding programmes, targeting a reasonable balance of requested and available national/regional budgets.
- There will be a centralised evaluation of Full-Proposals by independent international evaluators resulting in a ranking list.
- The M-ERA.NET Steering Board will agree on a joint selection list at the Selection Meeting
- The final funding decisions will be made by the national/regional funding organisations.

Figure 2: Workflow of the Call 2022

3. Call Announcement

3.1. Objectives and Topics

The aim is to fund ambitious transnational RTD projects addressing materials research and innovation including materials for batteries and low carbon energy technologies.

Horizontal objectives for the Call 2022:

<u>Support the European Green Deal by increasing attention to clean energy technologies and future batteries:</u> M-ERA.NET aims to strengthen the contribution of materials RTD for clean energy-related applications, ene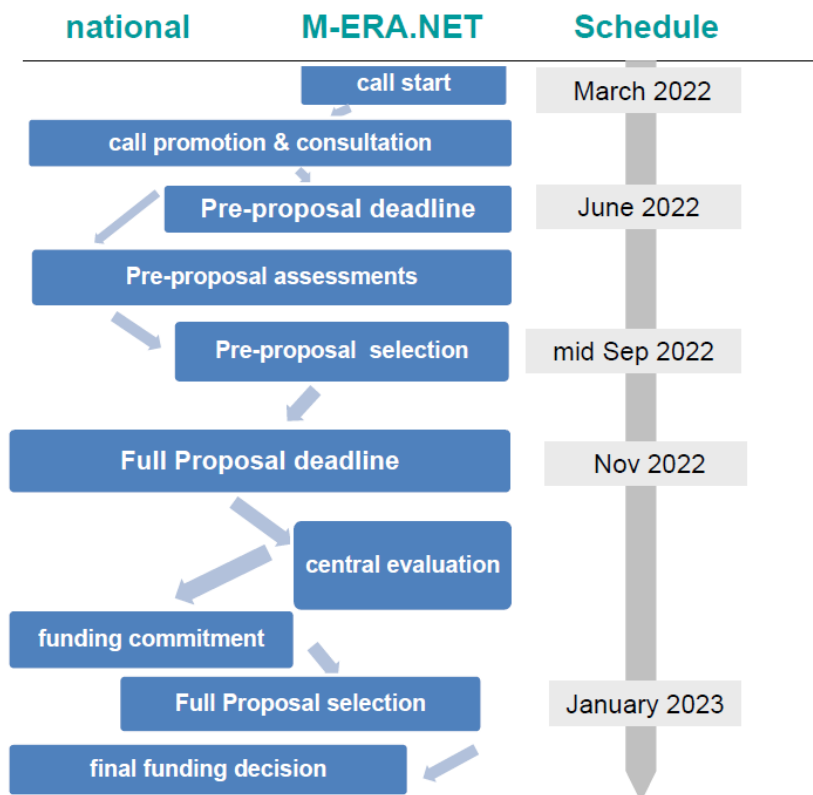rgy generation and harvesting, energy storage (battery technologies), electrolysers and fuel cells. M-ERA.NET will support the transition towards circular economy by addressing aspects like eco-design, design for recycling, durability of products, process efficiency with reduced energy and materials consumption, resulting e.g. in light-weight products.

<u>Support the achievement of the United Nations' Sustainable Development Goals (SDG):</u> M-ERA.NET will contribute to a wider public debate on the impact of materials research and its potential to achieve the SDGs. In particular, M-ERA.NET will support SDG 7 ("Affordable and clean energy") through fostering research on sustainable energy storage technology, SDG 9 ("Industrial innovation and infrastructure") by upgrading the technological capabilities of industrial sectors, and SDG 12 ("Ensure sustainable consumption and production patterns") through an environmentally sound management of natural resources and reduced waste generation.

<u>Socio-ecological benefits in the context of Responsible Research and Innovation (RRI):</u> M-ERA.NET calls will address EU areas of socio-ecological relevance, illustrating the leveraging effects materials research and innovation have on areas that reflect meaningful societal needs. M-ERA.NET will develop responsible research and innovation processes to systematically address socio-ecological, ethical and political dimensions of material research, development and use. As part of this, M-ERA.NET requires that funded researchers engage with the social, ethical, political, environmental or cultural dimensions of their proposed research. As support for this please refer to the new M-ERA.NET guidelines for Responsible Research and Innovation (RRI) in the context of materials science (Annex 5).

<u>Support for the Innovation chain:</u> Making best use of the interdisciplinary network the calls in M-ERA.NET will facilitate the generation of knowledge along the innovation chain, from excellent science and research to innovative industrial applications.

Strengthen interdisciplinarity: M-ERA.NET is the platform for an integrative approach across disciplines and across application fields, making the initiative an attractive and efficient tool for transnational joint projects that were unlikely to be realised before.

Thematic priorities

The following six topics are defined for the Call 2022

> **1: Materials for energy**
>
> **2: Innovative surfaces, coatings and interfaces**
>
> **3: High performance composites**
>
> **4: Functional materials**
>
> **5: New strategies for advanced material-based technologies in health applications**
>
> **6: Materials for electronics**

M-ERA.NET will support the research and innovation chain described through the Technology Readiness Levels (TRL). **A more detailed description of the topics is available in Annex 1. A description of the TRLs can be found in Annex 2.** Individual national/regional thematic programme focus and funding rules (see chapter 3.2.) must be taken into account.

General considerations

- In general, a special focus on materials science, processing, and engineering that contributes to the implementation of the SDGs and the Green Deal is strongly recommended. Sustainability aspects of the targeted solutions and/or materials must be addressed in the proposal. Proposals should avoid as far as possible the use of hazardous compounds and demonstrate that the materials and processes involved in the research will be safe and will have a minimum impact on the environment.

- Unless expressly justified, proposals should comply with the open data science directive from the EC. It is expected that proposals include intellectual property rights management and proper knowledge transfer and exploitation strategy. It is expected that part of the deliverables of the project include open-source codes, data management and curation methodology, and/or demonstrative examples of the technologies proposed.

- Issues of societal concerns should be addressed in a systematic way, and following the new **M-ERA.NET RRI guidelines** (Annex 5).

- Measures to ensure gender balance in the project consortia should also be considered**.**

3.2. Funding rules

Each project partner has to apply individually for regional/national funding. For each project partner the funding rules of the respective regional/national programmes apply. **This means that depending on the respective national/regional funding rules some project partners have to submit additional national/regional proposals or information on national/regional level.**

To obtain detailed information about the specific funding rules and programme priorities we strongly recommend contacting the respective national/regional funding organisations (see Annex 3 for details).

3.3. Eligible project structure and application

- Project consortia must consist of at least 3 partners (all requesting funding from a funding organisation listed in Annex 3) from at least 3 different countries (at least 2 EU member state or associated country[2]) participating in the M-ERA.NET Call 2022. In addition to the minimum consortium the participation of further partners is possible[3].
- The total effort of one single applicant cannot exceed 60% of the total project efforts (measured in person months) in the proposal.
- The total effort of applicants from one country cannot exceed 70% of the total project efforts (measured in person months) in the proposal
- Coordinator is eligible and requests funding from a funding organisation listed in Annex 3
- Proposal must address appropriate TRLs for selected M-ERA.NET Call 2022 topics.
- Mandatory proposal forms must be used (provided for download at https://www.m-era.net/joint-call-2022)
- Proposal must be written in English.
- Maximum project duration is 36 months.
- Proposal must be recommended for Full-Proposal submission by M-ERA.NET after Pre-Proposal stage.
- Proposers (SMEs, large companies, academic research groups, universities, public research organisations or other research organisations) must be eligible for funding

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[2] https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/list-3rd-country-participation_horizon-euratom_en.pdf

[3] Please note: Applicants from Russia are excluded from participating in M-ERA.NET Call 2022

according to their national/regional regulations (to be checked with funding organisations listed in Annex 3).

- Proposers must provide their respective PIC[4]-numbers in the proposal; proposers without a validated PIC will be able to use a temporary PIC for submission.

- Conflict of Interest. the following individuals are not eligible for proposal submission: M-ERA.NET Steering Board members, researchers from participating Funding Organisations[5]. In addition, proposers cannot act as evaluators of the M-ERA.NET Call 2022.

Typically, small to medium sized consortia (3-5 partners on average per proposal) are expected. However, there is no upper limit and consortia may involve as many partners as necessary for a convincing proposal, ensuring that all participants have a valid role. Each partner within the consortium should clearly add value to the objectives of the proposed project. Depending on the nature of the project, each partner in the consortium must demonstrate how he / she will exploit the expected results.

National/regional funding rules apply. Therefore, in some cases only certain topics, TRLs or types of organisations are eligible (e.g., some national/regional programmes fund only industrial but no academic partners, low/high TRLs). It is highly recommended to contact the respective national/regional funding organisation before proposal submission (see Annex 3 for details).

A consortium agreement between the project partners is recommended for funded projects based on national/regional funding rules. However, the principles of the agreement should already be clear when submitting the proposal. The purpose of the consortium agreement is to clarify:

- the responsibilities of the partners;
- decision processes inside the project;
- management of any change of partners;
- how to exploit and/or commercialise the results (for each partner);
- IPR issues.

A template for the consortium agreement can be found at: http://www.desca-agreement.eu/

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[4] Participant Identification Code: If you want to participate in a project proposal your organisation needs to be registered and have a 9-digit Participant Identification Code (PIC). Please find details here: https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/how-to-participate/participant-register

[5] As an exception, Forschungszentrum Jülich GmbH (JÜLICH) is eligible to apply since measures were already established to avoid any possible conflict of interest with Project Management Jülich as a beneficiary of M-ERA.NET 3, which is a largely independent unit within the research centre Forschungszentrum Jülich GmbH (JÜLICH).

3.4. Project budget

No overall limits have been defined on M-ERA.NET level but national/regional limits regarding the available funding will apply. Budget shares in project consortia have to be in line with eligibility criteria (chapter 5.1.1.).

3.5. Project duration

The maximum project duration must not exceed 36 months. National/regional limits regarding the duration of projects will apply.

3.6. Dates and deadlines

Date	Step	Place
15 March 2022	Launch of the Call 2022	
15 June 2022 12:00 noon Brussels time	Deadline for submission of: a) Pre-Proposals and b) National/regional Funding Applications, if necessary *	a) Online (via IT tool) b) National/Regional funding organisations
End September / October 2022	Feedback to applicants	
17 November 2022 12:00 noon Brussels time	Deadline for submission of: a) Full-Proposals and b) National/regional Funding Applications, if necessary*	a) Online (via IT tool) b) National/Regional funding organisation
Early February 2023	Tentative communication of Full-Proposal assessment	a) Online (via IT tool) b) National/Regional funding organisation
Mid-February 2023	Tentative communication of selection of Full-Proposals recommended for funding	a) Online (via IT tool) b) National/Regional funding organisation
February 2023	Contract negotiations for selected proposals on national/regional level	National/Regional funding organisations
Feb – May 2023	Start of funded projects	

contact your national/regional funding organisation

4. Application process

The M-ERA.NET application process will be a 2-step procedure: Pre-Proposal and Full-Proposal.

1. Before submitting a proposal, all project partners must contact their respective national/regional programme funding organisations in order to discuss the project line-up and the funding conditions.

2. **In stage 1, a Pre-Proposal is mandatory**. It has to be submitted by the coordinator through the M-ERA.NET submission tool until 15 June 2022, 12:00 C.E.T. The mandatory Pre-Proposal form available at https://www.m-era.net/joint-call-2022 has to be used. At the same time national/regional funding applications must be submitted to each of the involved funding organisation according to their specific rules (if applicable).

3. National/regional funding organisations will carry out assessments of Pre-Proposals and respective national/regional funding applications. The Pre-Proposal stage will be used to ensure that only high quality proposals which are in line with national requirements are invited to the Full-Proposal stage. Applicants will be provided with feedback emails after the Pre-Proposal coordination meeting, including a recommendation to submit (or not) a Full-Proposal.

4. A proposal has to be recommended for Full-Proposal submission by M-ERA.NET to be eligible for stage 2.

5. **In stage 2, a Full-Proposal and an Annex 1 to the Full-Proposal are mandatory**. They must be submitted by the project coordinator through the M-ERA.NET submission tool until 17 November 2022, 12:00 C.E.T. The mandatory Full-Proposal form and the mandatory Annex 1 to Full-Proposal form available at https://www.m-era.net/joint-call-2022 have to be used. According to the specific rules of the involved funding organisations, a submission of a national / regional application may be required. Please check with your funding organisation.

6. Only eligible Full-Proposals are sent to central evaluation, organised by the M-ERA.NET call secretariat. The online central evaluation is performed by independent international evaluators, resulting in the M-ERA.NET ranking list of proposals.

7. At the M-ERA.NET selection meeting proposals will be selected for funding based on the M-ERA.NET ranking list and available national/regional funding.

8. M-ERA.NET recommends selected projects for funding to the involved funding organisations. The regional/national funding organisations take the final funding decision.

4.1. Stage 1: M-ERA.NET Pre-Proposal

The mandatory Pre-Proposal gives an overview on the whole project. The M-ERA.NET Pre-Proposal template is mandatory and has to be submitted in English by the project coordinator through the M-ERA.NET submission tool until 15 June 2022, 12:00 C.E.T. In addition to the Pre-Proposal (online submission) corresponding national/regional funding application forms may be requested by the respective funding organisation according to their respective programme rules. After eligibility check and assessment of Pre-Proposals, the project coordinator will be informed if the Pre-Proposal is recommended (or not) for the submission of Full-Proposal.

4.2. Stage 2: M-ERA.NET Full-Proposal

The mandatory Full-Proposal gives an overview of the whole project and describes all national/regional project parts. In addition, the mandatory Annex 1 to the Full-Proposal comprises the partner profiles, CVs of the whole consortium, and if relevant, Letter of Intent (LoI). The M-ERA.NET Full-Proposal and Annex 1 to the Full-Proposal templates are mandatory and have to be submitted in English by the project coordinator through the M-ERA.NET submission tool until 17 November 2022, 12:00 C.E.T. To receive funding, the national/regional parts of the project must fulfil their national/regional criteria. This may create different submission and financing situations for partners from different countries.

Changes from Pre- to Full-Proposal

► *Project objectives stated in the Pre-Proposal cannot be changed.*

► *Changes in the consortium should be avoided. Modifications of the consortium are restricted to applicants from countries already part of the pre-proposal consortium. It is not accepted to introduce new countries into the existing consortium.*

► *In general, changes from Pre- to Full-Proposal should be avoided. In any case changes from Pre- to Full-Proposal stage have to be coordinated by the consortium leader with all involved funding organisations.*

This means that major changes regarding content, project duration, costs, funding or consortium have to be communicated and approved by all involved funding organisations at least 2 weeks before Full-Proposal deadline. The consortium leader is responsible to coordinate and ensure the acceptance of these changes by all involved project partners, funding organisations.and the call secretariat.

4.3. Confidentiality

Proposals and any information relating to them (including the names of the evaluators) will be kept confidential and only be accessible to the funding organisations participating in the M-ERA.NET Call

2022. Proposals will not be used for any purpose other than the evaluation of the applications, making funding decisions and monitoring of the project. International experts are required to sign a confidentiality agreement prior to evaluating proposals.

5. Evaluation

The M-ERA.NET selection process will be a 2-step procedure: Pre-Proposal and Full-Proposal. M-ERA.NET aims at providing a transparent, fast and straight forward assessment of the submitted proposals.

5.1. Pre-Proposal

5.1.1 Eligibility check

At M-ERA.NET level:

- requested M-ERA.NET Pre-Proposal form in English is uploaded to the M-ERA.NET submission tool until submission deadline 15 June 2022, 12:00 C.E.T.
- maximum project duration is 36 months
- minimum of 3 applicants (all requesting funding from a funding organisation listed in the Guide for Proposers) from at least 3 different countries (at least 2 EU member states or associated countries[6]) participating in the Call 2022; applicants not asking for funding can participate in addition to the minimum consortium of 3 applicants from 3 different countries[7]
- project coordinator is eligible and requests funding (from a funding organisation listed in the Annex 3)
- total effort of one single applicant cannot exceed 60% of the total project efforts (measured in person months) in the proposal
- total effort of applicants from one country cannot exceed 70% of the total project efforts (measured in person months) in the proposal
- Pre-Proposal is recommended for Full-Proposal submission by a minimum of 3 funding organisations from 3 different countries of the M-ERA.NET call consortium

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[6] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/3cpart/h2020-hi-list-ac_en.pdf

[7] Please note: Applicants from Russia are excluded from participating in M-ERA.NET Call 2022

At national/regional level:

- presence of requested national/regional Pre-Proposal forms (if applicable)
- minimum number of eligible, independent applicants (if applicable, criteria of involved funding programmes apply)
- relevance to funding programme (if applicable, criteria of involved funding programmes apply)
- addressing the horizontal objectives of M-ERA.NET
- financial status of applicants, especially industrial applicants

5.1.2. National / regional assessment and ranking

Only project consortia fulfilling the abovementioned requirements and passing applicable national/regional assessments will be invited to the Full-Proposal stage. Pre-Proposals with one or more not recommended project partners are not invited to Full Proposal stage if the total effort of the not recommended partner(s) exceed 15% of the person months.

5.1.3. Result of Pre-Proposal phase

After the Pre-Proposal coordination meeting of the involved funding organisations, the selection of Pre-Proposal results in one of the recommendations, to be communicated to the applicants:

- *Recommended for submitting the Full-Proposal*
- *Not recommended*

The results of the Pre-Proposals stage will be provided with feedback emails sent by the call secretariat after the Pre-Proposal coordination meeting to the project coordinators and all applicants.

5.2. Full-Proposal

Full Proposals will be selected by the following steps:

5.2.1 Eligibility check

Eligibility checks of Full-Proposals are performed before the central evaluation.

At M-ERA.NET level:

- requested M-ERA.NET Full-Proposal form and Annex1 to the Full-Proposal form in English is uploaded to the M-ERA.NET submission tool until submission deadline 17 November 2022, 12:00 C.E.T.
- maximum project duration of 36 months

- minimum of 3 applicants (all requesting funding from a funding organisation listed in the Guide for Proposers) from at least 3 different countries (at least 2 EU member states or associated countries[8]) participating in the Call 2022; applicants not asking for funding can participate in addition to the minimum consortium of 3 applicants from 3 different countries
- project coordinator is eligible and requests funding (from a funding organisation listed in the Annex 3)
- total effort of one single applicant cannot exceed 60% of the total project efforts (measured in person months) in the proposal
- total effort of applicants from one country cannot exceed 70% of the total project efforts (measured in person months) in the proposal;

At National/regional level:

- programme regulations observed if applicable (e.g. presence of requested nat/reg proposal forms, financial standing of industrial applicants, etc.)
- recommendations and requirements given in the Pre-Proposal stage are fulfilled, if applicable.
- addressing the horizontal issues of M-ERA.NET

5.2.2. Central evaluation of Full-Proposal

Only eligible Full-Proposals are sent to central evaluation carried out by independent international evaluators according to the EC rules for ERA-NET Cofund.

The M-ERA.NET Call 2022 Evaluation Procedure:

- individual written assessments: 3 individual and independent written assessments including scoring for each Full-Proposal provided by selected and agreed experts
- 1 peer review report (PRR): 3 individual assessments are compiled by one of the 3 experts (= rapporteur). The compilation consists of peer review report and scoring. All experts who provided individual written assessments confirm the compilation and consistency of peer review report and scoring. Evaluators will have the possibility to exchange opinions.
- quality check of the peer review report by the M-ERA.NET call secretariat

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[8] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/3cpart/h2020-hi-list-ac_en.pdf

- ranking list of recommended projects is based on the scoring
- involved funding organisations meet for a selection meeting to assemble and commit themselves to the final list of selected proposals (= selection list). The selection is based on the M-ERA.NET ranking list and the available national/regional budgets.
- The names of the independent experts will be kept confidential.

individual (online) → 3 written assessments incl. scoring → **discussion & compilation** (online) → 1 peer review report incl. scoring → **Ranking list** based on scoring (online) → **Selection** meeting (respecting national/ regional budgets)

information available for whole call consortium
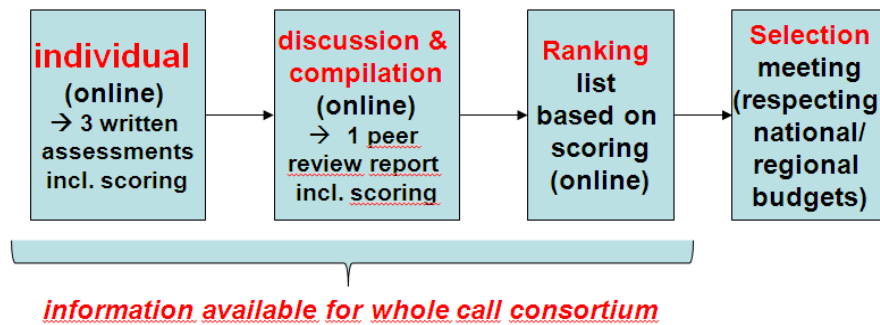
The M-ERA.NET Call 2022 Evaluation Criteria for Full-Proposal:

The Full-Proposals will be evaluated according to the following criteria:

- **Excellence**
- **Impact**
- **Quality and efficiency of the implementation**

Evaluation criteria, scoring and thresholds are described in **Annex 4.**

5.2.3. Result of Full-Proposal phase

As a result of the M-ERA.NET central evaluation Full-Proposals will either be:

- Recommended for funding *or*
- Not recommended for funding

The results of the Full-Proposals stage including a compiled peer review report (anonymised result of central international peer review process excl. scoring) will be provided by the call secretariat via feedback emails to the project coordinators and all applicants.

6. Decision

6.1. Decision process

The M-ERA.NET selection meeting results in the M-ERA.NET recommendation for funding decisions at national/regional level. The recommended selection list will be forwarded to the involved programme owners who will be in charge of the final funding decisions.

Applicants may submit a complaint to the M-ERA.NET coordinator (office@m-era.net) until one week after the communication of the Full-Proposals assessment if any procedural error may be perceived to exist.

6.2. Funding

6.2.1. Contract

Funding contracts are signed directly between the project partners and their national/regional funding organisations.

6.2.2. Start of projects

Depending on the national/regional regulations, a pre-condition might be the existence of a consortium agreement that also includes IPR related issues.

It is highly recommended that the project start and end dates are synchronised for all project parties.

7. Monitoring

7.1. National/regional project review

The progress of each individual contract will be monitored by the respective national/regional funding organisation through specific project review processes.

7.2. Reporting to M-ERA.NET

Apart from the national/regional project review, the transnational cooperation aspects will be monitored at M-ERA.NET level, e.g. by using online questionnaires. This will also facilitate the identification of potential success stories.

A final project report must be submitted to M-ERA.NET by the project coordinator using the M-ERA.NET reporting templates. The reporting templates we will available on the Call 2022 web page.

7.3. Change in active projects

Any substantial change in an on-going project must be reported immediately to the involved funding organisations and the call secretariat. The project partners should be aware that changes may affect their funding.

8. Dissemination

A reference to M-ERA.NET is requested in publications, exhibitions, lectures, success stories and press information concerning results of the projects.

9. Support

Frequently Asked Questions (FAQ) are listed in the call website https://www.m-era.net/joint-call-2022. In addition, all funding organisations participating in the call will provide assistance to project proposers in the case of any questions.

Annex 1: Thematic priorities for the M-ERA.NET Call 2022

Topic 1:   **Materials for energy**

Topic 2:   **Innovative surfaces, coatings and interfaces**

Topic 3:   **High performance composites**

Topic 4:   **Functional materials**

Topic 5:   **New strategies for advanced material-based technologies in health applications**

Topic 6:   **Materials for electronics**

Topic 1: Materials for energy

Technical Content and Scope

The EU commitment to mitigate climate change is rooted in the way we use energy and the decarbonisation strategies we take. It is a main objective of M-ERA.NET to support SDG 7 "Affordable and clean energy". The development of advanced materials can play a key role in resolving these issues, enabling new and cleaner energy production, storage, conversion and utilisation. To be effective, materials development should take into account the following aspects including: circularity, sustainability, end of life treatment, recyclability, social impact, Life Cycle Assessment (LCA), Techno-Economic Analysis (TEA) and RRI. Furthermore, methodologies supported by digitalisation (computational modelling, artificial intelligence, etc.) are needed for accelerated materials design and optimisation for energy applications. These methodologies are expected to save time and cost in the materials discovery and design process versus traditional trial and error approaches.

Objectives and Transversal aspects

The objective of this topic is to develop materials to enable new and cleaner energy production, storage, conversion and utilisation. Proposals submitted under this topic can address any of the following items:

- Additive manufacturing for 3D structured energy storage and conversion devices, e.g. batteries.
- Multiscale modelling and artificial intelligence for accelerated energy materials optimisation.
- Integrative workflows encompassing multiscale modelling and artificial intelligence for improved prediction of materials behaviour in energy conversion or storage devices.
- Digitalisation of manufacturing processes of composite materials for energy applications.
- Novel materials for H_2 production and storage.
- Improved active materials and electrolytes for next generation batteries for mobility (i.e. solid state Li-ion batteries and beyond Li-ion batteries) and for stationary applications (i.e. flow batteries).
- Materials ensuring fire safety in energy storage and conversion devices, i.e. batteries, fuel cells and electrolysers.
- Development of new catalysts to improve fuel cell and electrolyser efficiency based on computation and experiments.
- Photovoltaics: new concepts and architectures for solar cell materials and efficient photovoltaic cells.
- Materials operating at high temperatures in heat-to-power processes.
- Materials for short, medium and long-term thermal storage over a wide temperature range**.**
- Energy harvesting materials for piezoelectric and triboelectric applications.

In addition to the topics above, the project proposal may also include materials processing, reduced energy consumption through light-weight materials, and/or flexible design for repurposing and recycling. Such integration could be further enhanced by fostering collaboration between universities and industry, to strengthen the whole innovation chain.

M-ERA.NET requires that all proposers explain how their projects demonstrate a commitment to RRI by investigating and addressing the environmental, social, ethical, political, or cultural dimensions of the proposed research.

Expected impact

The proposals shall address how they will contribute to the expected impact of the topic, defined as follows:

- It is expected that the proposed research will lead to energy conversion and storage systems with higher efficiency, improved overall performance and lower cost.
- The proposed research should minimise the use of critical raw materials and contribute to a circular economy, thereby lowering the carbon footprint.
- To increase the impact of research activities, open access raw data and metadata should be made available. This will facilitate comparison between project results and provoke cooperation between related research groups.
- In proposals including modelling activities, the developed software should be reusable and interoperable with pre-existing software solutions.
- Proposals should emphasise how they support the Green Deal and the achievements of Sustainable Development Goals as described in the horizontal objectives (Section 1.2).

All proposals should clearly state the TRL at the project start and at the project end (see 1.3.). The proposals should include a plan for the transition to higher TRLs at a later stage (i.e. beyond the project end date). Establishing an industrial advisory board or the participation of one or more companies in the project consortium is encouraged. In proposals targeting TRL 5, industrial partners and at least one project partner specialised on customer or end-user demands should be involved in the project consortium.

Target groups

This topic is targeted at all groups: disruptive research, applied research, industrial research and development.

Keywords

Multiscale modelling; artificial intelligence; materials processing; efficient electrodes for batteries electrolysers and fuel cells;; thermochemical materials; photovoltaic materials; piezoelectric materials; triboelectric materials; thermoelectric materials; light-weighting, photovoltaics, energy storage, fire safety, inactive materials and components for battery systems

Indicative targeted TRL range: 1-5

Topic 2: Innovative surfaces, coatings and interfaces

Technical content/scope

Surface and coating technology is a key enabler for new solutions in numerous industrial sectors worldwide. This call will stimulate application driven development of innovative surfaces, thin films, coatings, interfaces and related process technologies, including a broad spectrum of compounds (from electrodes and batteries up to antipathogen coatings).

The proposals should consider the development, processing or production aspects including modelling and circular economy, where applicable, aiming at flexible and energy-efficient technologies with sustainable use of materials in an environmentally friendly manner with special attention to Critical Raw Materials (CRM).

Objectives and Transversal aspects

The proposals shall address at least one of the following items:
- Development of innovative surfaces, thin films, coatings and/or interfaces.
- Nano-engineered coatings, surfaces and interfaces.
- Smart materials for multifunctional devices and interfaces.
- Development or improvement of process technologies considering circular economy to enable deposition of new coatings and/or surface modification.
- Development of optimised interfaces e.g. for chemical linkage and interphases e.g. interpenetrating networks.
- Development of new materials and processing for long-time stable antipathogen coatings (note: direct interaction with human/bio surfaces will be addressed in Topic 5).
- Development of environmentally friendly interfaces in battery cells or innovative battery-or electrolyser- or fuel cell components, including post Li-ion battery.
- Development of thin films and coatings for sensing applications, including biosensing and gas sensing.
- Multiscale modelling of coating materials and interfaces.
- Engineered functional interfaces between electronics and biological systems.

Project proposals should consider at least one of the following:
- Consider aspects such as fundamental understanding of the mechanisms, experimental assessment and where applicable prototyping, up-scaling, manufacturing and validation demonstrating prototype in an operational environment with a view to final customer applications.
- Address complementary characterisation techniques and/or where relevant modelling techniques and/or how to rationalise data for future use in modelling processes (data base)
- Ensure relevance for different partners in the value chain by stating clear concepts for application(s) in targeted industrial sector(s).

M-ERA.NET requires that all proposers explain how their projects demonstrate a commitment to RRI by investigating and addressing the environmental, social, ethical, political, or cultural dimensions of the proposed research.

Expected impact

The proposals shall address how they will contribute to the expected impact of the topic, defined as follows:

- Innovative process technologies related to interface optimisation, coating development and application as well as surface modification
- Availability of high-end components, products with tailored properties or functionalities by innovative surfaces, coatings and interfaces. All addressed technologies and/or products should include minimum health and safety impact.
- Achieving a positive ecological and energy impact in terms of avoidance of hazardous materials and compounds by developing processes, coating materials, technology and product life cycles following a circular economy and CRM strategies in accordance to SDG 7.
- Proposals should aim to develop innovative products or technologies based on functionalised surfaces, coatings and interfaces that are likely to have a positive societal impact, on e.g. safety, economics, employment, life quality and avoid the release of toxic materials.
- The proposal should demonstrate synergies between industry and academia in a convincing way.

All proposals should address environmental aspects, including re-use, re-manufacturing or recycling considerations, and broader social or ethical impacts when relevant. All proposals should clearly state the TRL at the project start and at the project end (see 1.3.). The proposals should include a plan for the transition to higher TRLs at a later stage (i.e. beyond the project end date). Establishing an industrial advisory board or the participation of one or more companies in the project consortium is encouraged. For proposals aiming at TRL 4 or higher, industrial partners and at least one project partner, specialised on customer demands, should be involved in the project consortium.

Target groups

This topic is targeted at all groups in the innovation chain: disruptive research, applied research, industrial research and development. The topic is particularly suitable for the establishment of a strong collaboration between research entities and industry including Small and Medium Enterprises (SMEs). Participation of large enterprises may be considered due to their powerful research units or as potential end users of the technology or of the product proposed.

Interdisciplinary projects along the value chain are encouraged and should enable a broader cross-sectorial use.

Keywords

Innovative surfaces, functional coatings, sensing surfaces, nano-engineered coatings, antipathogen coatings, bio-interfaces, thin films, interfaces, interphases; advanced coating, functionalisation, surface technologies, structured surfaces, textured surfaces, modelling.

Indicative targeted TRL range: 1-7

Topic 3: High performance composites

Technical Content and Scope

Within the scope of this call, composites are defined as engineered materials, including hybrids, composed of two or more constituents, for example, a polymer or metallic matrix reinforced by a fibre, particle, container or a filler that meets the requirements which cannot be otherwise fulfilled by one component alone. The matrix, fibres, particles and fillers can be metallic, ceramic, mineral, synthetic or from biological sources. Fibres, particles, containers, and fillers can be on the nanoscale.

Objectives and Transversal aspects

This call topic is aimed at high performance composites having functional properties for engineering applications such as transportation, construction, light-weighting, packaging, energy (including electrochemical energy storage) and medical implants.
Regarding the properties of materials, the composites should combine at least two of the following:
- High strength and stiffness to weight-ratio.
- Durability (e.g. good resistance to creep, fatigue, humidity, etc.).
- Tailored thermal, electrical and/or mechanical properties.
- Self-healing functionalities or self-monitoring properties.
- Thermal management properties (e.g. phase change materials).
- Electronic and/or ionic conductivity.
- Electrochemical energy storage properties.
- Biocompatible or anti-microbial properties.
- Biodegradable and compostable properties.
- Recyclability/Reuse/Repurpose for circular economy.
- Fire retardant properties with environmentally friendly substances.
- Reinforced stability and safety

In addition, the research proposals should address one or more of the following material design and manufacturing issues (descriptive of process):
- Modelling and simulation including data driven approaches.
- Molecular design, functionalisation and characterisation for improved reinforcement/matrix interaction.
- New bio-based resins and/or bio-based fibres or fillers, and their composites.
- Materials use optimisation. Use of recycled materials to develop composites.
- Methodology and validation tools for design optimisation, e.g. 3D printing.
- Determination of long-term properties (e.g. creep, fatigue, ageing, etc.).
- Understanding of failure and prediction of failure.
- Recycling strategies for composites.
- New scalable, high throughput and rapid manufacturing techniques, e.g. fast curing, low viscosity resins, extrusion, thermoforming, and roll-to-roll processing.
- Automation, robotisation or cost-efficient manufacturing techniques.
- Novel composites architectures and constituent designs, including, e.g. thin tapes, structural batteries.
- Joining, assembly and repair, including solutions for optimising the interface between dissimilar materials.

To strengthen the whole innovation chain, it is strongly recommended that the project proposal covers materials, processing, application, and recycling development of

composites. Such integration could be further enhanced by fostering collaboration between universities and industry, and by a consortium covering the whole value chain and LCA.

M-ERA.NET requires that all proposers explain how their projects demonstrate a commitment to RRI by investigating and addressing the environmental, social, ethical, political, or cultural dimensions of the proposed research.

Expected impact

The proposals shall address how they will contribute to the expected impact of the topic, defined as follows:

- Composites with advanced functionality and an optimised consumption of resources using advanced composite materials design and manufacturing concepts, in particular, avoiding the use of toxic and/or harmful compounds in the final product and in the processing, from both the environment and human point of view.
- Addressing SDG 7 "Affordable Clean Energy" and/or SDG 9 "Industry Innovation and Infrastructure".
- More competitive industrial products and processes.
- Socio-ecological benefits provided by products with higher integration level of functionality, lighter and more robust products to transport, lighter dynamic applications to decrease energy consumption, efficient and/or effective energy storage, and by using materials that will result in a lower environmental impact.
- Because the composites industry is characterised by a large number of scattered players, including SME manufacturers and equipment suppliers, the project(s) is expected to have a strong global perspective, thereby improving the sharing of knowledge and reinforcing both technological and scientific platforms.

All proposals should clearly state the TRL at the project start and at the project end (see 1.3.). The proposals should include a plan for the transition to higher TRLs at a later stage (i.e., beyond the project end date). Establishing an industrial advisory board or the participation of one or more companies in the project consortium is encouraged. Also consider the inclusion of a societal stakeholder. For proposals aiming above TRL 4, industrial partners should be involved in the project consortium.

Target groups

This topic is targeted at all groups in the innovation chain: disruptive, applied research, industrial research and development. Collaboration between research entities and industrial partners is encouraged also at low (<4) TRL levels.

Keywords

Modelling, simulation, understanding failure, synthetic composites, hybrid material systems, polymer matrix, metal matrix, ceramic matrix, bio-based composites, additive manufacturing, functional properties, energy storage, in-service behaviour, design methodology, process technology, recycling, long-term properties, flame retardancy, safety of advanced materials

Indicative targeted TRL range: 1-6

Topic 4: Functional materials

Technical Content and Scope

Advanced functional materials are an important economic and employment generator in Europe. Functional materials and their interfaces are the key enabler, transversal and bottleneck for almost all technologies. Design and simulation of materials and microstructures with tailored properties and appropriate process technologies are needed to achieve high performance in industrial applications. European product innovation relies strongly on deep theoretical knowledge on functional materials and more efficient technologies with new physical properties and performance. Improved materials are expected to contribute to reducing our dependence on oil, gas and coal. In terms of circular economy, there is increasing concern regarding critical raw materials, toxic materials, recycling and long-term stability and safety.

Functional materials specifically targeting only one application among energy, electronics or health applications should be submitted to the corresponding call topic.

Objectives and Transversal aspects

Proposals within the scope of this topic should target the development of advanced functional materials or materials systems in at least one of the following areas:

- Materials for sensing and actuation: smart materials, stretchable materials and metamaterials with controlled electrical, magnetic, thermal, optical, and mechanical properties, photonic materials.
- Materials for smart and zero-energy buildings: thermal insulation materials and efficient heat radiation solutions, smart windows.
- Materials for greenhouse gas capture/conversion.
- Materials for energy-efficient separation, purification and process intensification.
- Safe and sustainable by design materials.
- Dynamic, self-healing smart materials to enable longer service lifetime like detecting defective components and local spots to be repaired and triggering self-healing processes.
- Waste-energy harvesting materials and solutions: new energy harvesting materials based on advanced thermoelectric, caloric, piezoelectric, phase change, triboelectric and others. New designs and architectures for increased energy efficiency.
- Sustainable fabrication routes for materials.
- Biobased materials.
- Smart, adaptive and functional textiles.

To strengthen the whole innovation chain, it is strongly recommended that the project proposal covers materials, processing, application, and recycling and make use of new development strategies such as modelling, artificial intelligence, high-throughput, in robotics and additive manufacturing. Such integration could be further enhanced by fostering collaboration between universities and industry, and by a consortium covering the whole circular value chain and LCA.

M-ERA.NET requires that all proposers explain how their projects demonstrate a commitment to RRI by investigating and addressing the environmental, social, ethical, political, or cultural dimensions of the proposed research.

Expected impact

The proposal shall address how it will contribute to the expected impact of the topic, defined as follows:
- Support the future European circular and sustainable industry through technological development based on novel functional materials and their production processes.
- Support the European strategic policy targets in terms of greenhouse gas emission reduction and carbon (CO_2) capture and sequestration.
- Improved competitiveness and strengthened industrial leadership.
- Strengthened innovation excellence of the European academia and research institutes.

All proposals should address environmental, including reuse, remanufacturing or recycling considerations, toxicity, social or ethical impacts. All proposals should clearly state the TRL at the project start and at the project end (see 1.3.). The proposals based on original and innovative approaches may start with TRL 1. The proposals should include a plan for the transition to higher TRLs at a later stage (i.e., beyond the project end date). Establishing an industrial and stakeholder advisory board or the participation of one or more companies in the project consortium is encouraged. For proposals aiming at TRL 4 or higher, industrial partners should be involved in the project consortium.

Target groups

This topic is targeted at all groups: disruptive research, applied research, industrial research and development.

Keywords

Advanced functional materials; smart materials; magnetic; optical; photonic; thermoelectric; piezoelectric; thermal; triboelectric; tribological; structural; redox materials; processing technologies; sensors, catalysts; electrochromics, photochromics, waste energy harvesting materials; membranes; self-healing materials; reusable and recyclable materials; materials synthesised by energy efficient processes; greenhouse gas capture; greenhouse gas conversion; materials for process intensification

Indicative targeted TRL range: 1-6

Topic 5: New strategies for advanced material-based technologies for health applications

Technical Content and Scope

Wellness and healthy ageing of the European population require new or improved solutions to health-related issues. Many of these solutions will come from the development of new advanced materials and coatings as key components of diagnostics, clinical or surgical treatments, and therapeutics (e.g. medical devices, drug delivery systems, implants, regenerative and reparative medicine, cell and gene therapies, real-time monitoring in vivo sensors, and others). These materials and coatings will be in contact with the human body at different levels. In addition, engineered matrices might provide solutions to deepen our understanding of how tissue-specific cells sense and respond to key biophysical properties of the surrounding substrates. In vitro recapitulation of the homeostatic renewal of adult tissues, tissue or organ morphogenesis during the development and pathogenesis of many disorders is critical for the development of organ-on-chip devices.

The purpose of this call topic is to provide opportunities to raise critical knowledge and advance material-based technologies towards the market related to materials and coatings for applications in health. This action is aligned with societal challenges related to health as articulated by the SDGs. This call topic is also in agreement with the recognition of advanced materials as a Key Enabling Technology for strengthening the competitiveness of the European industry.

Objectives and Transversal aspects

The objective is to develop engineered materials and coatings for implants, drug delivery systems, real-time monitoring in-vivo biosensors, and scaffolds to replace, restore and regenerate physiological functions, tissues and organs. These substrates can be tailored for applications in organ-on-chips (spheroids/organoids), medical phantoms and bioinks. The investigated engineered materials and coatings should target at least one clinical indication. Such materials and coatings may include functionalised, adaptable or stimuli-responsive elements, hierarchical structures to modulate 3D cell growth and structural or topographic modifications to direct specific cell responses. The development of the materials with properties-by-design can be supported/designed by in silico techniques. Proposals can be supported by big data/artificial intelligence approaches.

Proposals should address at least one of the following:
- Interactions between the newly developed materials or coatings and the biological environment/surrounding tissues.
- Mechanical, physical, and chemical properties of the materials and coatings which are relevant for the foreseen application.
- Aspects such as biodegradation, biological performances, toxicity, and inflammatory/immune response at the short, medium and long term.

Proposals are expected to consider at least one of the following:
- The potential market and exploitation routes include a robust risk and contingency plan and the overall scalability and relevant regulatory issues.
- When appropriate, the in vitro testing and/or assays in animals must be conducted following the national ethical rules of each relevant partner involved.
- Where relevant, alternatives to animal testing (methods and models) need to be incorporated into the study design.

- If the proposal requires animal or human subjects, gender aspects in research study design need to be accounted for.
- Life Cycle Assessment aspects should be addressed.

Moreover, the proposals are strongly encouraged to consider relevant, cross-disciplinary collaboration between material scientists, engineers, biologists, clinicians, immunologists, regulatory scientists, standardisation bodies, toxicologists, social scientists, patient organisations, and/or industrial partners.

M-ERA.NET requires that all proposers explain how their projects demonstrate a commitment to RRI by investigating and addressing the proposed research's environmental, social, ethical, political, or cultural dimensions.

Expected impact

The proposals shall address how they will contribute to the expected impact of the topic, defined as follows:

- Understanding the complexity of material/biology interfaces over time;
- Achievement of new or improved materials or coatings performance for at least one clinical target;
- Higher competitiveness of the European health industry through more reliable products, scalable and reproducible processes, and awareness of the standardised and regulatory protocols;
- Increased collaborations between material science RTD performers, patient organisations, industrial and medical stakeholders in the health sector;

All proposals should clearly state the TRL at the project start and end (see 1.3.). At the end of the project, the addressed technology is expected to reach at least TRL 3. The proposals should outline a plan for the transition to higher TRLs at a later stage (i.e. beyond the project end date). The participation of one or more companies in the project consortium is encouraged. Establishing a multi-stakeholder advisory board (e.g. clinicians, patient organisations, and industrial experts) is recommended.

Target groups

This topic is targeted at all groups in the innovation chain: disruptive, applied and industrial research. Collaboration between research entities including clinical centres and industrial partners is encouraged.

Keywords

biodegradation, bioinks, biointerfaces, biomaterials, coatings, drug delivery systems, implants, in vivo biosensors, medical devices, medical phantoms, organ-on-chip, real-time monitoring scaffolds, regenerative medicine, regulatory science, toxicology

Indicative targeted TRL range: 1-4

Note: TRL 4 in biomaterials include in vitro/in vivo but not pre-clinical tests (which are included in TRL 5).

Topic 6: Materials for electronics

Technical Content and Scope.

Advanced materials provide solutions for tomorrow's challenges of micro/nano electronics because of its cross-cutting and presence in every tangible form of our daily life working as an accelerator for the challenges we have concerning the Internet of Things (IoT), Industry 4.0 and the need for digital interconnectivity. To turn European heritage in RTD into benefits for a sustainable Europe, materials-based innovation and system solution needs to be expanded. As a founding element of Pan-European innovation and prosperity and to lead to a newly committed European electronic industry, fully connected with deep tech green technologies and products, able to build the transition towards the next generation of hyper-trends, research needs to be carried out on multifunctional materials for sensing and electronics, chip-less integrated systems, beyond silicon, ultra-low power sensing electronic systems, flexible and/or printed electronics and Quantum Devices, among others. With this we aim to address the challenges of our collective future where the aim is to preserve the European life quality and living standards by integrating co-creation and citizen involvement, with circularity and a sustainable supply chain.

The topic supports proposals on material research and its application, with special focus on physical properties of electronic and magnetic materials, spintronics, materials design and architecture for nano-electronics and chipless electronics, device physics and engineering, micro- and nano-electro(-opto) mechanical systems and organic and inorganic electronic devices and their integration.

Objectives and Transversal aspects

Proposals within the scope of this topic should target the development of new or improved materials for electronics with a particular emphasis on at least one of the following:
- Advanced materials in sensor electronics. Materials for ultralow power sensors, transductors, power electronics, thermoelectrics.
- Smart advanced packaging and materials for cooling and thermal distribution management in electronics. Coating, aggressive environments, Electromagnetic compatibility (EMC), self-cleaning, etc.
- Wearable, flexible and stretchable materials for green electronics. Substrates, 3D printed components and devices. Reliability, self-healing, hybrid integration, assembly and bonding/soldering of heterogeneous components.
- Advanced materials for optoelectronic applications: Light Emitting Diodes (LEDs), optical communications, other materials.
- Materials for chipless applications, transparent, flexible and printable electronics, new strategies for materials beyond silicon.
- New high throughput manufacturing approaches for electronic components: Printing technologies, additive manufacturing techniques, patterned coatings.
- Low cost and disposable materials for electronics: ink materials, polymers, cellulose, etc.
- Next generation of electronic materials for supercapacitors and other green technologies.
- 2D materials for advances in transistor technology and quantum computing.
- Magnetic materials for spintronics and quantum technology.
- Materials with multifunctionality: devices with radically different assembled materials.

- Moulded interconnect devices (MID): Plastic substrates with electrical infrastructure. The possibility of miniaturization of three-dimensional components with electrical conductivity is especially attractive for automotive and the medical sector, but it has the potential to also impact on other industrial fields.

Proposals including and considering modelling and artificial intelligence approaches are welcome. Green and sustainable materials should be prioritized. Increasing the efficiency of the devices and reduce the power consumption and new improvements for circular economy are also encouraged.

M-ERA.NET requires that all proposers explain how their projects demonstrate a commitment to RRI by investigating and addressing the environmental, social, ethical, political, or cultural dimensions of the proposed research

Expected impact

The proposal shall address how it will contribute to the expected impact of the topic, defined as follows:

- Improvement of the existing electronic devices with more versatility, better efficiency, strongly reduced power consumption and added functionality.
- Development of new materials for wearables and flexible electronics.
- Innovation in materials for quantum computing and spintronics.
- Substitution of toxic and hazardous materials with greener technology materials.
- Exploration of innovative multifunctional materials in electronics.
- Multidisciplinary teams (materials, electronics, and security) potentially involving co-creation and citizen involvement are encouraged.

All proposals should address environmental, including reuse, remanufacturing or recycling considerations, toxicity, social or ethical impacts. All proposals should clearly state the TRL at the project start and at the project end. The proposals based on original and innovative approaches may start with TRL 1. The proposals should include a plan for the transition to higher TRLs at a later stage (i.e., beyond the project end date). Establishing an industrial and stakeholder advisory board or the participation of one or more companies in the project consortium is encouraged. For proposals aiming at TRL 5 or higher, industrial partners should be involved in the project consortium.

Target groups

This topic is targeted to academic research groups, SMEs, or large companies that develop innovative disruptive, applied, and industrial focused investigations.

Keywords

wearable materials, flexible and stretchable materials, smart packaging, 2D materials, optoelectronics, supercapacitors, multifunctional materials, transparent electronics, spintronics, quantum technology, sensors, transductors, actuators, low cost electronics, printed electronics, moulded interconnect devices.

Indicative targeted TRL: 1-5

Annex 2: Technology Readiness Level

All proposals should clearly state and motivate at what level on the Technology Readiness Level (TRL) scale the project is situated at the beginning and after the project is finished. In order to increase the potential for new business opportunities and commercial exploitation of the results:

• Proposals aiming at TRL below 4 should include a plan for the transition to higher TRL's at a later stage (i.e. beyond the project end date) and demonstrate industrial involvement. This can be realised by establishing an industrial advisory board (or alternatively by the participation of one or more companies in the project consortium when feasible).

• For proposals aiming at TRL above 4, industrial partners should be involved in the project consortium.

Where the topic description refers to the concept of **"Technology Readiness Level"** (TRL), the following definition in accordance with H2020[9] applies:

TRL 1 – basic principles observed
TRL 2 – technology concept formulated
TRL 3 – experimental proof of concept
TRL 4 – technology validated in lab
TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 7 – system prototype demonstration in operational environment
TRL 8 – system complete and qualified
TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

In the project proposal, it should be indicated what is the TRL position in the beginning of the project and after the project is finished.

Topic	TRL 1	TRL 2	TRL 3	TRL 4	TRL 5	TRL 6	TRL 7	TRL 8	TRL 9
Topic 1: Materials for energy	▉	▉	▉	▉	▉	▨			
Topic 2: Innovative surfaces, coatings and interfaces	▉	▉	▉	▉	▉	▉	▉	▨	
Topic 3: High performance composites	▉	▉	▉	▉	▉	▉	▨		
Topic 4: Functional materials	▉	▉	▉	▉	▉	▉	▨		
Topic 5: New strategies for advanced material-based technologies in health applications	▉	▉	▉	▉	▨				
Topic 6: Materials for electronics	▉	▉	▉	▉	▉	▨			

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[9] *https://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-g-trl_en.pdf*

Annex 3: Funding organisations participating in the M-ERA.NET Call 2022

Country	National / regional coverage	Funding organisation	Contact person:
Austria	national	Austrian Research Promotion Agency (FFG)	Name: Fabienne Nikowitz Phone:+43 57755 5081 e-mail: fabienne.nikowitz@ffg.at
			Name: Johannes Fritzer Phone: +43 (0) 57755 5032 E-mail: Johannes.fritzer@ffg.at
Belgium	regional: Flanders	Fund for Innovation and Entrepreneurship. Flanders Agency for Innovation and entrepreneurship (VLAIO)	Name: Maarten Rockele Phone: +32 2 432 42 78 e-mail: marten.rockele@vlaio.be
			Name: Elsie De Clercq Phone: +32 2 432 42 78 e-mail: elsie.declercq@vlaio.be
	regional: French-Speaking Community	Fund for Scientific Research – FNRS (F.R.S.-FNRS)	Name: Florence Quist Phone: +32 2 504 93 51 e-mail: international@frs-fnrs.be
			Name: Joël Groeneveld Phone: +32 2 504 92 70 e-mail: international@frs-fnrs.be
	regional: Wallonia	Service public de Wallonie (SPW)	Name: Pierre Demoitié Phone: +32 81 33 45 40 e-mail: pierre.demoitie@spw.wallonie.be
Brazil	regional: Sao Paulo	Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP)	Name: Alexandre Roccatto Phone: + 55 11 3838 4000

Country	National / regional coverage	Funding organisation	Contact person:
			e-mail: chamada_meranet@fapesp.br
			Name: Virginia Sanches Subiñas; Phone: + 55 11 3838 4000 e-mail: chamada_meranet@fapesp.br
Bulgaria	national	Bulgarian National Science Fund (BNSF)	Name: Milena Alexandrova Phone: +359 884 171 363 e-mail: aleksandrova@mon.bg
Canada	regional: Québec	PRIMA Québec	Name: Michel Lefèvre Phone: +1-514-284-0211 #227 e-mail: michel.lefevre@prima.ca
Croatia	national	Ministry of Science and Education (MSE)	Name: Mateo Ante Bosnić Phone: +385 01 4594 166 e-mail: mateo.ante.basnic@mzo.hr
Czech Republic	national	Technology Agency of the Czech Republic (TA CR)	Name: Katerina Volfova Phone: +420 234 611 629 e-mail: katerina.volfova@tacr.cz
Denmark	national	IFD – Innovation Fund Denmark	Name: Jens Peter Vittrup Phone: +45 6190 5023 E-mail: jens.peter.vittrup@innofond.dk
			Name: Martin Søndergaard Phone: +45 6190 5065 e-mail: martin.sondergaard@innofond.dk
Estonia	national	Estonian Research Council (ETAg)	Name: Margit Suuroja Phone: +372 731 7360 e-mail: margit.suuroja@etag.ee

Country	National / regional coverage	Funding organisation	Contact person:
Finland	national	Business Finland	Name: Sampo Tukiainen Phone: --- e-mail: sampo.tukiainen@businessfinland.fi
France	national	Agence Nationale de la Recherche (ANR)	Name: Manuel de Anda Villa Phone: --- e-mail: manuel.deandavilla@anr.fr
			Name: Aymen Ben Amor Phone: --- e-mail: aymen.benamor@anr.fr
	regional: Nouvelle Aquitaine	Region Nouvelle-Aquitaine (RNA)	Name: Emmanuelle Pallier Phone: +33 5 55 45 00 80 e-mail: emmanuelle.pallier@nouvelle-aquitaine.fr
			Name: Hélène Boisserie Phone: +33 5 56 56 38 53 ; (0)6 71 56 92 89 e-mail: Helene.boisserie@nouvelle-aquitaine.fr
Germany	regional: Freestate of Saxony	Saxon State Ministry for Science, Culture and Tourism (SMWK)	Name: Gabriele Süptitz Phone +49 351 564 64210 e-mail: Gabriele.Sueptitz@smwk.sachsen.de
Hungary	national	National Research, Development, and Innovation Office (NKFIH)	Name: Elod Nemerkenyi Phone: +36-1-896-3987 e-mail: elod.nemerkenyi@nkfih.gov.hu
Israel	national	Ministry of Science and Technology (MOST)	Name: Avi Raveh Phone: +972 (2) 5411136 e-mail: AviR@most.gov.il

Country	National / regional coverage	Funding organisation	Contact person:
	national	Israel Innovation Authority (IIA)	Name: Rachel Loutaty Phone:+972 3 5118152 e-mail: Rachel.l@iserd.org.il
Latvia	national	Latvian Council of Science (LZP)	Name: Maija Bundule Phone: +371 26514481 e-mail: maija.bundule@lzp.gov.lv
Lithuania	national	Research Council of Lithuania (LMT)	Name: Saulius Marcinkonis Phone: --- e-mail: saulius.marcinkonis@lmt.lt
Luxembourg	national	Luxembourg National Research Fund / Fonds National de la Recherche (FNR)	Name: Christiane Kaell Phone: +352 261925-34 / +352 691 362 817 e-mail: christiane.kaell@fnr.lu
Poland	national	National Centre for Research and Development (NCBR)	Name: Krzysztof Jabłoński Phone: +48 22 25 66 702 e-mail: krzysztof.jablonski@ncbr.gov.pl
	national	National Science Centre (NCN)	Name: Anna Kotarba Phone: +48 695 211 482 e-mail: anna.kotarba@ncn.gov.pl
			Name: Dr inż. Klaudyna Śpiewak-Wojtyła Phone: --- e-mail: klaudyna.spiewak@ncn.gov.pl

Country	National / regional coverage	Funding organisation	Contact person:
Romania	national	Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI)	Name: Domnica Coteț Phone: +4021 302 38 80 e-mail: domnica.cotet@uefiscdi.ro Name: Cristina Coteț Phone: +4021 302 38 84 e-mail: cristina.cotet@uefiscdi.ro
Slovak Republic	national	Slovak Academy of Sciences (SAS)	Name: Martin Novak Phone: :+421 2 5751 0 119 e-mail: mnovak@up.upsav.sk Name: Zuzana Panisova Phone: :+421 2 5751 0 245 e-mail: panisova@up.upsav.sk
Slovenia	national	Ministrstvo za izobrazevanje, znanost in sport	Name: Doroteja Zlobec Phone: +386 (0)1 478 46 24 e-mail: Doroteja.zlobec@gov.si
South Africa	national	Department of Science and Technology (DST)	Name: Tugela Matubatuba Phone: +27 12 843 6860 e-mail: tugela.matubatuba@dst.gov.za Name: Ntombi Mchuba Phone: +27 12 843 6370 e-mail: Ntombi.mchuba@dst.gov.za
South Korea	national	Korea Institute for Advancement of Technology (KIAT)	Name: Joosuk (Jason) Kang Phone: +32-2-431-0591 e-mail: kangjs@kiat.or.kr

Country	National / regional coverage	Funding organisation	Contact person:
Spain	national	Agencia Estatal de Investigación (AEI)	Name: Beatriz Gómez Miguel Phone: --- e-mail: beatriz.gomez@aei.gob.es
			Name: Jorge Sotelo Santos Phone: --- e-mail: era-mat@aei.gob.es
	regional: Asturias	IDEPA - Instituto de Desarrollo Económico del Principado de Asturias (Regional Economic Development Agency)	Name: Ana E. Fernández Monzón Phone: --- e-mail: anae@idepa.es
	regional: Basque Country	EJ-GV (EUSKO JAURLARITZA – GOBIERNO VASCO)	Name: Catalina Chamorro Silgado Phone: +34 945 018 210 e-mail: cat-chamorro@euskadi.eus
			Name: Judith de Prado Olivenza Phone: +34 944 209 488 e-mail: jdeprado@innobasque.eus
Taiwan	national	Ministry of Science and Technology (MOST), Taiwan	Name: Dr. Ching-Mei Tang Phone: +886- 2-2737-7557 e-mail: cmtom@most.gov.tw
			Name: Yu-Ming Chang Phone: +886-2-33665277 e-mail: ymchang@ntu.edu.tw
			Name: Randy Chang Phone: +886-2-27898975 e-mail: mcchang76@gate.sinica.edu.tw

Country	National / regional coverage	Funding organisation	Contact person:
Turkey	national	The Scientific and Technological Research Council of Turkey (TÜBİTAK)	Name: Burcu Koç Haskılıç Phone: +90 312 298 94 67 e-mail: burcu.haskilic@tubitak.gov.tr Name: Tayyip Kösoğlu Phone: +90 312 298 18 06 e-mail: tayyip.kosoglu@tubitak.gov.tr

Commitment per funding organisation:

	Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6		
	Materials for energy	Innovative surfaces, coatings and interfaces	High performance composites	Functional materials	New strategies for advanced material-based technologies in health applications	Materials for electronics	Thematic restrictions	Indicative call budget (MEUR)
Austria: FFG (PdZ)		X	X			X	No	1,00
Austria: FFG (MdZ)	X	X	X	X			Yes, see note 1	2,00
Belgium (Flanders): VLAIO	X	X	X	X	X	X	No	1,00
Belgium (French Speaking Community): FNRS	X	X	X	X	X	X	No	0,20
Belgium (Wallonia): SPW	X	X	X	X	X	X	No	1,00
Brazil (Sao Paulo): FAPESP	X	X	X	X	X	X	No	0,40
Bulgaria: BNSF	X	X	X	X	X	X	No	0,38
Canada (Québec): PRIMA	X	X	X	X	X	X	No	0,70
Croatia: MZE	X	X	X	X	X	X	No	0,15
Czech Republic: TA CR	X	X	X	X	X	X	Yes see note 2	1,00

	Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6		
Denmark IFD	X	X	X	X			No	1,50
Estonia: ETAG	X	X	X	X	X	X	No	0,15
Finland: Business Finland	X	X	X	X	X	X	No	1,00
France: ANR	X	X		X			No	1,00
France (Novelle-Aquitaine): Nouvelle-Aquitaine Region	X	X	X	X	X	X	No	0,50
Germany (Saxony): SMWK	X	X	X	X	X	X	No	3,00
Hungary: NKFIH	X	X	X	X	X	X	No	0,30
Israel: MOST	X	X	X	X	X		No	0,50
* Israel: IIA	X	X	X	X	X	X	No	0,50
Latvia: LZP	X	X	X	X	X	X	No	0,80
Lithuania: LMT	X	X	X	X	X	X	No	0,45
Luxembourg: FNR	X	X	X	X	X	X	No	0,50
Poland: NCBR	X	X	X	X	X	X	No	2,00

	Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6		
Poland: NCN	X	X	X	X	X	X	No	1,00
* Romania: UEFISCDI	X	X	X	X	X	X	No	1,00
Slovak Republic SAS	X	X	X	X	X	X	No	0,36
Slovenia MIZS	X	X	X	X	X	X	No	0,84
South Africa: DST	X	X	X	X	X	X	No	0,40
South Korea KIAT	X	X	X	X	X	X	No	1,00
Spain AEI	X	X	X	X	X	X	No	1,00
Spain (Asturias): IDEPA	X	X	X	X	X	X	No	0,30
Spain (Basque Country): EJ-GV	X	X	X	X	X	X	Yes see note 3	0,50
Taiwan: MOST	X	X	X	X	X	X	No	0,75
* Turkey: TÜBITAK	under approval							

*): The participation and / or the details of their commitments of the countries marked with a star is under approval.
Note 1: Research must be relevant for light weight technologies for mobility.
Note 2: Research on regenerative medicine (under topic 5) is not supported.
Note 3: Research must fit within Basque Country's strategic specialization areas defined in the PCTI 2030: smart industry, cleaner energies, personalised healthcare, healthy food, eco-innovation, sustainable cities, creative Basque Country

Annex 4: Full-Proposal evaluation criteria, scoring, thresholds

Evaluation criteria:
3 main criteria are pre- defined by the EC for ERA-NET Cofund:
(a) excellence   **(b) impact**   **(c) quality and efficiency of the implementation**

Sub-criteria, scoring and thresholds are defined by the call consortium.

Main Criteria	*Sub Criteria*	*Score (points)*
Excellence	*Clarity and pertinence of the objectives;*	*max. 1.5*
	Credibility of the proposed approach and soundness of the concept. including engagement with the social, ethical, political, environmental or cultural dimensions of the proposed research	*max. 2.0*
	Extent that proposed work is ambitious, has innovation potential, and is beyond the state of the art (e.g. ground-breaking objectives, novel concepts and approaches)	*max. 1.5*
Impact	*Contribution at the European or international level to the expected impacts listed in the work programme under the relevant topic*	*max. 2.5*
	Enhancing innovation capacity and integration of new knowledge	*max. 1.0*
	Strengthening the competitiveness and growth of companies by developing innovations meeting the needs and values of European and global markets; and, where relevant, by delivering such innovations to the markets	
	Any other environmentally and socially important impacts (not already covered above)	
	Effectiveness of the proposed measures to exploit and disseminate the project results (including management of IPR), to communicate the project, engage with stakeholders and user groups, and to manage research data where relevant	*max. 1.5*
Quality and efficiency of the implementation	*Quality and effectiveness of the work plan, including extent to which the resources assigned to work packages are in line with their objectives and deliverables*	*max. 1.0*
	Appropriateness of the management structures and procedures	*max. 1.0*
	Quality and relevant experience of the individual participants	*max. 1.0*
	Quality of the consortium as a whole (including complementarity, balance) , inter- or transdiciplinarity	*max. 1.0*
	Appropriate of the allocation of tasks, ensuring that all participants have a valid role and allocation and justification of the resources to fulfil that role	*max. 1.0*

Ethical issues: Full-proposal includes Horizon Europe"Ethical Issues Table", adapted to M-ERA.NET specifications. In case ethical issues apply (applicants mark respective issues in the table) M-ERA.NET recommends that the national/regional organisations observe these issues (e.g. post-evaluation review) for their respective funded projects.

Scoring and Thresholds

Individual assessment report (IAR): Each criterion will be scored between 0.0 and 5.0 representing the sum of the scoring of the individual sub criteria.
Sub-criteria have individual maximum scores with a resolution of 0.1 points. There are no thresholds for sub-criteria. The awarded scores for each sub-criterion have to be justified with written statements by the evaluators.

Peer review report (PRR): the rapporteur will compile a peer review report, to be accepted by all 3 evaluators. The final scoring of the main criteria will take into consideration the scores from the individual assessments. Each criterion will be scored between 0.0 and 5.0 in multiples of half (0.5) points.

Threshold: the threshold for individual criteria will be 3.0; the overall threshold, applying to the sum of the individual scores will be 10.0.

Annex 5: RRI Guidelines

M-ERA.NET guidelines for Responsible Research and Innovation (RRI) in the context of materials science

1. What is RRI and why do we need it?

In the broadest terms, governments fund research to deliver benefits for society. However, these benefits are often slow to accrue, occur unexpectedly and will be distributed unevenly. It is often hard to correct the downsides of innovations once they have become embedded in society. Science and innovation are built gradually through a series of decisions made by funders, scientists and policy makers. Social scientific research has drawn attention to how values are embedded in these decisions – in seemingly mundane and foundational work such as the choice of reagents or analytical equipment, the use of lab animals, through to questions about what research funders choose to prioritise or how a new technology should be regulated.

Acknowledging that science is not separate from society but part of it confers a social responsibility on science. It is important, therefore, that funders, researchers and other key groups involved in the development of science, technology and innovation think about: (i) the potential directions of research being taken; (ii) who might benefit and who might not from new inventions; and (iii) how consideration of the potential social, ethical and environmental issues can be considered *throughout* the science and innovation process. Responsible research and innovation (RRI) is not about adjudicating what is 'good' or 'bad', 'positive' or 'negative', or 'responsible' or 'irresponsible'. Instead, RRI offers techniques, tools and frameworks to think about questions of social responsibility and ensure scientists, funders and technologies don't lose sight of the social context in science, technology and innovation.

2. M-ERA.NET's approach to RRI

M-ERA.NET's approach to RRI builds on previous frameworks published by the UK's EPSRC, the Research Council of Norway, the European Commission and funding programmes such as ERA CoBioTech and ERA EuroNanoMed III. It highlights the need to address the social, ethical, political, environmental or cultural dimensions of the proposed research and offers four dimensions that researchers, funders and technologists should engage with to maintain focus on the social context of their work:

- *Anticipation* suggests that actors should map the plausible intended and unintended effects of their work. Anticipation is not about exhaustively predicting all outcomes but about building a sense of preparedness so that potential downsides can be addressed as they are foreseen and arise.
- *Inclusion* encourages researchers, funders and developers to engage with future users, interest groups or potentially concerned groups to gain insights about the application contexts and what desirable trajectories would be. Engagement here should move beyond dissemination or outreach to pursue a two-way engage of

information. It should be pursued with the understanding that knowledge might not be 'scientific' in the traditional sense but could still be valuable.

- ***Reflexivity*** asks researchers, funders and developers to create specific opportunities to consider the underlying assumptions and values driving their funding programmes and projects.
- ***Responsiveness*** reminds us that science and innovation are processes of exploration and learning. It urges scientists, funders and developers to change course if any of the above dimensions (anticipation, inclusion or reflexivity) generate new knowledge, identify public concerns, or reveal potential harms.

As the involvement of societal groups is essential in RRI it is often connected to co-creation, co-design and co-production – methodologies in which R&I projects are structured to include stakeholders from the beginning (e.g. users or interest groups) – and is related to the general Open Science agenda, prominent in Horizon Europe.

M-ERA.NET emphasises that RRI is not a one-size-fits-all approach, but must be adapted to the actual social and ethical issues raised by the R&I activities funded in the programme. Foundational, exploratory research will require a different approach to applied, high-TRL research. Disruptive, pathbreaking research, may require a more substantive approach to RRI than tentative, incremental research. And the specific issues raised by the biological sciences differ to those raised by the physical sciences. This means that *the commitment* to RRI is clear and fixed in the programme, but there is an openness about the issues addressed and the specific ways to practice responsibility – these must be adapted to each project.

Finally, there are other fundamental value commitments in M-ERA.NET, most prominently related to sustainability and the UN Sustainable Development Goals. RRI complements this commitment to sustainability by emphasising *how* research and innovation should be carried out in order to ensure that we achieve the sustainability goals in an open and inclusive way.

3. How can you include RRI in your proposal?

Recalling the above explanation, the diversity of material science and the range of local contexts engaged within M-ERA.NET means that there cannot be a one size fits all approach. The text below therefore provides overall ideas and advice but cannot give a recipe that all potential applicants may use. In general, your approach to RRI should be proportionate to your proposal – disruptive, ground-breaking or high-TRL work is likely to require a more substantive engagement with RRI. If the research is exploratory then RRI components can also be exploratory – teasing out the potential visions, goals and end uses of a project.

While RRI may focus on broadly recognised issues, the approach taken should be specific to the project. Nevertheless, these three points provide general principles from which to develop your approach to RRI:

1. M-ERA.NET's philosophy is to have **RRI as an integrated part of the project** involving all project participants.
2. Developing a **shared understanding of the project's RRI aspects** as early as possible is important. With 'RRI aspects' we mean implications or characteristics of your research that touch up societal and ethical values. This implies having

conversations about their importance and potential actions to address RRI aspects. Such understanding will evolve in a learning process that should be encouraged throughout the project.

3. Considering RRI related issues and acting upon them, must be done as a cross-cutting part of the project or a separate work package. RRI in the project needs to be **coordinated**.

The following list provides examples of different RRI perspectives applicable for materials science research projects. Please be aware that these guidelines and reflections neither represent the only RRI approach nor a complete list of examples of measures when implementing RRI in materials proposals. You should identify the points relevant for your project.

1. Address **environmental impacts and sustainable solutions**, in line with the **Do No Significant Harm principle[10],** by including, for example:
   a. lifecycle analysis (LCA)
   b. ecotoxicology studies
   c. recyclable by design methodologies

2. Involve **relevant stakeholders in the project at the earliest stage as possible**, and provide opportunities for them to contribute to your work.
   a. Co-design methodologies are important to generate trust and **allow stakeholders to contribute knowledge** of the social, environmental or commercial problem you are trying to address in your project.
   b. Think also about the appropriate **timing** of different stakeholders' inclusion: certain kinds of knowledge may be more useful than others at different points of your project.

> **Web resources for including RRI in your project:**
>
> www.rri-tools.eu provide numerous resources for practical RRI.
>
> https://thinkingtool.eu/ The Societal Readiness Thinking Tool guides you through the steps of including RRI in a project.
>
> The Digital Life Centre has also compiled a range of resources that may help develop your approach.
>
> Further examples specific to material science will in the future be provided on the RRI webpage of M-ERA.NET.

   c. It will likely be valuable (but not obligatory) to include **expertise beyond the natural and physical sciences** – such as lawyers, social scientists or philosophers – to provide anticipatory and reflective methodologies or to address key challenges.
   d. Think about **how** the involvement of such researchers and their knowledge can be formalised within your project. Are they best placed as scientific collaborators, as members of an advisory board, or as consultants to deliver only specific tasks? Please check if your approach is in line with the national/regional funding rules before designing your proposal.

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[10] For more information on this principle see Horizon Europe's Programme Guide, page 37: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/programme-guide_horizon_en.pdf

3. **Create good deliberative spaces** for a range of partners, stakeholders and participants to anticipate, discuss and reflect on the social, political, ethical or environmental context of your research. RRI experts may be able to help you with this in project design and implementation. A number of different approaches are possible, e.g.:
    a. Focusing on your day-to-day research work ("philosopher in the lab approach")
    b. At bi-annual/annual consortium meetings
    c. By using stage-gate approaches where explicit decisions about technological choices are taken.
4. Consider **who will benefit** and who may experience new risks from your project.
    a. Does your project address a specific societal or environmental problem or need?
    b. Does your framing of the problem fit with other people's understanding of it? Can you gain access to these alternative framings?
    c. In addition to societal benefits, also consider benefits to the research community through the generation of knowledge, access to infrastructure, the creation of networks and funding.
    d. Reflect on the most the appropriate form of intellectual property (IP) to suit your project goals. Do classical IP strategies deliver the broadest benefit? Can new strategies (e.g. Open Material Transfer Agreements) be adopted at certain points of the research process?
    e. Could commercial or non-commercial organisations benefit from your research? How?
    f. Consider also the risks and ways that these can be ameliorated. For instance, what are the risks of potential risks of data being released? How can you take care to ensure these data are interpreted appropriately?
5. Reflect on/consider adapting **your choice of research methods** regarding, for example:
    a. ethical issues,
    b. in vivo/in vitro experiments,
    c. use of new approaches such as "Safe(r) by Design".
    d. Are there ways that your project can advance common practices on these issues?
6. Engage with important aspects of **your research environment** such as:
    a. gender, ethnicity and intersectional equality, diversity and inclusivity
    b. Open Science and other publication practices
    c. career progression and precarity
    d. equity between partners in your research consortium
7. Show how the project (and product) satisfy requirements for **production safety** and efficiency.

4. How does M-ERA.NET support and evaluate RRI?

RRI requires a multi-level approach that pays attention to the different sites of research and innovation (e.g. universities, companies, policy arenas), different stages of research (i.e. across the TRL spectrum) and different research cultures. Responsibility must be shared,

and RRI is therefore a cross-cutting issue for M-ERA.NET. It is considered in development of the annual work programme and the resulting funding calls. The programme will also facilitate a dialogue among stakeholders in materials research about the sustainable development goals, circular economy perspectives, and RRI.

At the level of research projects, *M-ERA.NET requires that all proposers explain how their projects demonstrate a commitment to investigating and addressing the social, ethical, political, environmental or cultural dimensions of the proposed research*. Integration of RRI should lead to an improved awareness of the possible benefits, risks, and uncertainties of material science across a broad cross-section of society. This may include (but is not limited to) any of the approaches described in the next section.

RRI should not be thought of as 'distinct from the science', but central to it. *RRI components will therefore be evaluated by experts as integral components within the scope of all evaluation criteria (Excellence, Impact, and Implementation)*. RRI does not detract from the overall scoring but contributes to it: Proposals that explicitly aim to advance processes of anticipation, reflection, inclusion and responsiveness by developing new analyses or methodologies will be rewarded in the review process and the scores will be adjusted accordingly. The kinds of questions the reviewers will ask regarding RRI are:

- Is the RRI approach proportionate to the content of the scientific proposal?
- Is there appropriate RRI expertise in the project?
- Is RRI work adequately resourced? Is it clear *how* the objectives will be achieved?
- Does RRI extend across the lifespan of the project? (e.g. as a sub-project, an advisory board or to be considered in annual meetings)
- Is it clear how the work is organised? (e.g. as a WP, a cross-cutting issue, outsourced etc.)
- Is it clear who is doing the work?
- Are there clear opportunities for the RRI work to shape scientific trajectories?
- Does the work advance RRI scholarship or generate new knowledge of the social, political, ethical or environmental dimensions of material science?

Annex 6: Checklist for Proposers

The proposal conforms to the call guidelines.	☐
Every project partner has been in direct contact with his/her national/regional funding agency and has checked that their collaboration and their project contributions are eligible for funding.	☐
All project partners have checked the national/regional programme procedures and regulations. All project partners are aware of documents requested by the national/regional funding organisations. *IMPORTANT REMINDER: All consortium partners must check if applications (at Pre-Proposal and/or Full-Proposal stage) have to be submitted also to their national/regional funding organisations.*	☐
All partners who are not eligible for 100% funding are able to provide financial resources for their own contribution.	☐
A PIC[11] is available for all project partners.	☐
The consortium is aware that a duly signed and stamped consortium agreement (CA) between the project partners is recommended for funded projects based on national/regional funding rules, including agreements on intellectual property rights (IPR) and agreements on scientific publications. At the time of proposal submission it is recommended to provide the principles ruling the CA but not the CA itself.	☐

Please go https://www.m-era.net/joint-call-2022 to submit the:
>   **1. Pre-Proposal form online.**
>   **Deadline for submission: 15 June 2022, 12:00 noon Brussels time**
>   **2. Full-Proposal form + Annex 1 to the Full-Proposal form online.**
>   **Deadline for submission: 17 November 2022, 12:00 noon Brussels time**

For further information on M-ERA.NET please go to: http://www.m-era.net

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[11] Participant Identification Code: If you want to participate in a project proposal your organisation needs to be registered and have a 9-digit Participant Identification Code (PIC). Please find details here: https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/how-to-participate/participant-register

Abbreviations and Clarifications:

CRM - Critical Raw Materials

IoT - Internet of Things

LCA - Life Cycle Assessment

RTD - Research and Technological Development;

RRI - Responsible Research and Innovation

SDGs - Sustainable Development Goals;

SMEs - Small and Medium Enterprises

TEA - Techno-Economic Analysis

TRL - Technology Readiness Level

"*Disruptive research*" also encompasses "*basic and fundamental research*"