



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

Version 1.2

as of 21-02-2025

These guidelines (i) introduce the idea of Responsible Research & Innovation (RRI), (ii) explain how M-ERA.NET supports RRI, (iii) offer practical advice for operationalising RRI in projects and (iv) provide sources of further information for applicants.

M-ERA.NET hopes this document will also help you to prepare proposals to other materials science programmes that include RRI-related aspects, for instance Horizon Europe.

This is a ‘live document’ developed by M-ERA.NET’s RRI Lead (RCN) and RRI advisors (Ellen-Marie Forsberg, NORSUS, Robert Smith, University of Edinburgh) and Michael Bernstein, Austrian Institute of Technology) in conversation with materials scientists and all R&I funding organisations from the M-ERA.NET community.

Update 1.1 placed more emphasis on sustainability dimensions as an integral part of responsible research and innovation, based on recommendations of the 2022 Strategic Expert Group.

Update 1.2 has been revised for clearer language.

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RRI IN A NUTSHELL

For M-Eranet, RRI is about making sure science and new technologies help people and the planet. It asks scientists to think about who might benefit or face challenges from their work and to prepare for possible problems. RRI encourages involving others, like future users or communities, to understand their needs and concerns. It also pushes researchers to reflect on their goals and change plans if new issues come up. By focusing on sustainability and fairness, RRI helps ensure that science and innovation supports global goals like protecting the environment and creating a better future for everyone. Rather than providing strict rules, RRI offers a flexible framework with techniques and tools to guide researchers in considering the ethical, environmental, and social aspects of their work.

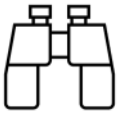
Acknowledging that science is separate neither from society nor the environment but part of them confers a social responsibility on science. It is important, therefore, that funders, researchers and other key groups involved in the development of science, technology and innovation think about:

- (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, environmental and ethical 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 technologists don't lose sight of the context in which they do science, technology and innovation.

WHAT IS M-ERA.NET'S APPROACH TO RRI?

M-ERA.NET's approach to RRI recognises that the materials resulting from the programme need to be designed for a *sustainable* society in the near to medium future. A sustainable society is one that respects and operates within the ecological boundaries of the planet and considers current and future generations in its decision-making. M-ERA.NET's approach to RRI thus highlights the need to address the social, environmental, political, cultural or ethical dimensions of the proposed research. We operationalise this approach through 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, potentially concerned groups, or those affected most by the problems we tackle, 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 exchange of information and lived experience, with the understanding that knowledge that is not 'scientific' in the traditional sense of the word might 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. Additionally, M-ERA.NET has fundamental commitments to sustainability in line with frameworks such as the UN Sustainable Development Goals, and the European Green Deal. This means that methods analysing the current or future ecological impacts of materials and their supply chains are appropriate. RRI provides a framework to ask how research and innovation should be carried out in order to ensure that we achieve the sustainability goals in an open and inclusive way.

SUSTAINABILITY AND RRI IN THE M-ERA.NET CALLS

The specific requirements for each topic in the current call are detailed in a section labelled 'sustainability and RRI requirements'. However, RRI is not a one-size-fits-all approach but must be adapted to the actual social, environmental 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.

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. Overall, the goal is to demonstrate that you have engaged and seriously considered the tensions associated with materials science.

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:

- M-ERA.NET's philosophy is to have **RRI AS AN INTEGRATED PART OF THE PROJECT** involving all project participants.
- 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 upon environmental, 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.
- 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** and should have a **LEAD**.



BUT WHAT SHOULD YOU ACTUALLY DO?

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**¹, by including, for example:
 - a. lifecycle analysis (LCA)
 - b. ecotoxicology studies
 - c. Safe and Sustainable by Design (SSbD) 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.

¹ 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

- 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.
 - 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.
 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 description of the problem fit with other people’s understanding of it? Can you gain access to these alternative understandings?
 - 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? If so, 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 SSbD.
 - 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) satisfies requirements for **production safety** and efficiency.

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.

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, environmental, ethical, political 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 above 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 proposed 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 RRI work is organised? (as a WP, a cross-cutting issue, outsourced etc.)
- Is it clear who is doing the RRI work?
- Are there clear opportunities for the RRI work to shape scientific course?
- Does the work advance RRI scholarship or generate new knowledge of the social, political, ethical or environmental dimensions of material science?

WEB RESOURCES FOR INCLUDING RRI IN YOUR PROJECT:

<https://thinkingtool.eu/> The Societal Readiness Thinking Tool guides you through the steps of including RRI in a project.

The Digital Life Centre [offers practical advice](#) that may help develop your approach.

Tools for public engagement: <https://www.publicengagement.ac.uk/resources> and <http://actioncatalogue.eu/>.

Further examples specific to material science will in the future be provided on the [RRI webpage of M-ERA.NET](#).

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](#).