PATHFINDER CHALLENGE

RESPONSIBLE ELECTRONICS
CHALLENGE GUIDE

EIC Work Programme reference: HORIZON-EIC-2023-PATHFINDERCHALLENGES-01-04
Call deadline date: 18 October 2023, 17.00 CET
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The EIC will hold an Info Session on this Pathfinder Challenge call on February 9th between 10:00 and 11:25 AM CET. Participants can access the meeting as guests here. Participation in the meeting, although encouraged, is optional and is not required for the submission of an application. A recording of this Info Session will be made available on the same page. Notifications of additional dissemination events can be found at [Events (europa.eu)](Events)

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1. About this document

The Challenge Guide serves as guidance and background for the common understanding, participation rules and obligations for the EIC beneficiaries that are involved in the Challenge Portfolio. Contractual Obligations are further detailed in the EIC Work Programme 2023.

The Challenge Guide is a guidance document accompanying a Pathfinder Challenge topic for proposals to provide further information about how portfolio considerations will be taken into account in the evaluation of proposals for that topic.

The Challenge Guide is prepared by and under the responsibility of the relevant EIC Programme Manager (information about the EIC Programme Managers is available on the EIC Website

(https://eic.ec.europa.eu/eic-communities/eic-programme-managers_en). It complements the Scope, Specific Objectives and/or Specific Conditions set out in the EIC Work Programme by a description of the portfolio considerations and how a portfolio will be built. The presentation provided by the Programme Manager during the Info Day gives applicants a further opportunity to understand the background of the call, and to ask questions to the Programme Manager. In no case does the Challenge Guide contradict or supplant the Work Programme text.

Following the selection of a proposal to be funded under the Challenge, the Programme Manager will work together with the consortia of the selected projects to develop a common roadmap with a strategic plan for the Challenge. This roadmap/ strategy plan will integrate the activities and milestones of the individual projects into a shared set of objectives and activities across and beyond the projects. The roadmap serves as a common basis for the project portfolio and may affect the project implementation - including possible adjustments, reorientations or additional support to projects. The roadmap will be updated in light of emerging results or issues during the implementation.

2   Scope and objectives of the Challenge as defined in the Work programme

> *This section is a copy of the Challenge call in the EIC work programme text. Proposals to this Challenge are expected to explain how they relate to and intend to go beyond the state of the art, and how they interpret and contribute to the objectives of the Challenge.*

EIC Pathfinder Challenge: Responsible electronics

Background and scope

Responsible electronics represents a unique opportunity for the future of EU industrial autonomy in a decarbonised and digital society, however fundamental scientific and technological challenges remain to be addressed. It has been predicted that by 2050, the production of electronic components and devices will rise exponentially and thus the use of raw materials in the sector will increase accordingly. As a result, the amount of electronic waste is also set to rise massively. Responsible electronics can contribute to drastically reducing the environmental load of the electronic industry by shifting from traditional manufacturing industrial methods to innovative methods and materials with a lower environmental impact. This is in line with the EU Circular Economy Action Plan1 fostering research towards a circular economy with effective waste and carbon recycling strategies as well as complementary with the objectives of the European Chips Act2. Besides reducing the environmental impact of the electronics sector, innovations such as sustainable manufacturing or bio-inspired electronic systems can help Europe overcome the current chips crisis by reducing the dependency on critical raw materials3 and traditional high energy demanding semiconductor processes. Moreover, investing in responsible electronics would be beneficial for the entire semiconductor ecosystem in Europe and will uphold the EU technology sovereignty.

Overall goal and specific objectives

The overall goal of this Challenge is to create opportunities for discovery of new environmentally friendly electronic materials, thus reducing its environmental impact and the need for critical raw materials and hazardous chemicals. The projects supported under this Challenge are expected to offer either materials with improved properties (such as flexibility, durability, end of life recyclability/reusability), materials processed with low energy consumption and low carbon footprint processing (such as printing instead of photolithography, avoiding use of fluorinated gases for patterning), or alternatives, including nano-sized ones, to replace common electronic materials such as silicon and silicon nitride.

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[1] Circular economy action plan (europa.eu)
[2] European Chips Act | Shaping Europe's digital future (europa.eu)
[3] Critical raw materials (europa.eu)

The specific objectives of this Challenge are to support the scientific community in reaching breakthroughs in development/discovery of:

- Advanced electronic materials for unconventional devices:
    - small-molecule and polymeric organic materials,
    - solution-processable inorganic materials,
    - hybrid organic-inorganic materials,
    - polymer-matrix nano-composite materials,
    - bio-based and nature-inspired materials
    - for the manufacturing of n- and p-semiconductors, dielectrics, conductors, including transparent conductors, particularly those suitable to make functional inks, passivation/encapsulation/packaging materials, flexible/stretchable substrates, etc.
- Advanced processes:
    - production methods based on solution processing such as blade coating, slot die coating, spray coating, screen printing, inkjet printing, offset, gravure and flexo-printing, or
    - other techniques particularly suitable for sheet-to-sheet or roll-to-roll manufacturing.
- Unconventional applications including e-textile/e-skin:
    - backplane and logic circuits,
    - microprocessors (4-8 bits),
    - sensors,
    - displays,
    - power supplies,
    - wireless transmitters/receivers, etc.

    particularly those suitable for Internet-of-Thing (IoT) applications, while applying the life-cycle thinking approach.

Expected outcomes and impacts

This Challenge is expected to contribute to the development of materials with new properties or replacing materials used in current electronic devices with materials, which:

- reduce dependency on critical raw materials,
- are sustainable: having a low environmental footprint and developed recurring to the life cycle thinking approach.

The overall outcome of this Challenge is to support the move from traditional materials and manufacturing processes to less environmental impactful ones. It is expected that the Challenge will lead to the development of lab-scale validated proof of concept devices based on the developed innovative materials and manufacturing processes, which may represent a potential application of a more sustainable, trusted and secure electronics.

Specific conditions

Projects with multidisciplinary and cross-sectorial approaches, looking for inspiration, ideas and knowledge in a broad range of disciplines are particularly welcome. The safe and sustainable use of non-critical raw materials or the full recycle/reuse of them is mandatory.

All projects are expected to conduct a full life cycle analysis of the proposed solutions and they shall apply or identify a methodology to measure the environmental and/or carbon footprint of the proof of principle/s that will be developed during the project. Applicants should ensure that the proposed method/technology/material/s is not harmful to the natural ecosystems. Packaging and durability should be taken into consideration.

3   Portfolio considerations for the evaluation of applications to the Challenge

This section describes how portfolio considerations will be taken into account in the second evaluation step. For more details of the full evaluation process please refer to the EIC Work Programme pages 29-32.

Portfolio considerations

For this Challenge the portfolio-building process will be based on the preliminary mapping by the committee of the proposals to one or several of the following categories:

       i)   Organic small-molecule and/or polymeric materials
       ii)   Solution or vapor processable inorganic materials
       iii)   Hybrid organic-inorganic materials and/or nanocomposites
       iv)   Nature inspired solutions
       v)   Other (not falling in the previous categories) radically new materials or processes in Electronic Devices particularly those suitable for functional inks, passivation/encapsulation/packaging and/or flexible/stretchable substrates

The evaluation committee will aim to compose a balanced and diverse portfolio covering the five aforementioned categories.

Within and among these categories, the evaluation committee will look at shared components or potential complementarities among the projects to identify a clear added value for the development of synergies and collaborations among the projects in the portfolio in order to maximise the overall impact on the expected outcomes and impacts of the Challenge. Shared components could be related to a device (sensors, power components, etc…) and/or technological approach or process (such as but not limited to additive techniques, plasma based or others) with the assumption that results of the portfolio activities would benefit from the convergence of different research disciplines.

Starting from the highest ranked proposal, a portfolio of proposals will be selected based on shared components/complementarities, while ensuring diversity among the selected proposals and coverage of the five categories. This implies that if the evaluation committee considers that a highly ranked proposal does not have a shared component/complementarity with other proposals, it will not be selected for the portfolio. To ensure diversification, proposals which the evaluation committee considers to be very similar to a proposal already included in the portfolio will not be selected. Consequently, this means that the projects selected for funding after the second step is expected to differ from the ranking list established from the first step (score-based ranking after assessment of each proposal separately).

The following table summarises the portfolio building approach.

Category	Shared component/complementarity	
	Devices	**Technological approach**
i) Organic small molecule and/or polymeric materials **ii)** Solution or vapor processable inorganic materials **iii)** Hybrid organic-inorganic materials and/or nanocomposites **iv)** Nature inspired solutions **v)** Other radically new materials or processes for Electronic Devices particularly those suitable for functional inks, passivation/encapsulation/packaging and/or flexible/stretchable substrates	• Novel discrete analog components especially those for power devices • Optoelectronic devices • Sensors and Actuators (with at least the following sub-categories: chemical, mechanical, temperature, physiological and biosensing) • Displays and illumination solutions • Logic circuits, microprocessors and memories • Wireless transmitters/receivers and other devices for Communication • ..	• Printing techniques for flexible devices: Inkjet, aerosoljet, etc.. • Solution-based coating techniques: slot-die, spray-coating, blade-coating dip-coating, etc.. • 3D printing • Vapor or other energy-efficient source based processes • Low-energy low-carbon emission patterning • ...

4   Implementation of the Challenge portfolio

Once funded, projects will be expected and obliged to work collectively during the implementation of their projects under the guidance of an EIC Programme Manager. This section summarises some of the key aspects of this pro-active management which applicants should take into account in preparing their proposals.

Proposal preparation and Grant negotiations

Applicants may be requested to make amendments to their proposed project in order to enhance the portfolio. Such changes may for instance include additional tasks to undertake common/ joint activities (workshops, data exchanges, joint research, etc) with other projects in the portfolio.

Based on first experience, it is advised to foresee in your proposal a dedicated work package for portfolio activities and to allocate at least 10 person-months (see below for the purpose and examples of such activities. You may propose concrete activities or remain generic in your description).

If you fail to do this during proposal time, your proposal will not be scored lower during the evaluation, but in case your proposal is selected for grant agreement preparation, you will be requested to add the portfolio work package to your grant agreement. Please be aware that in that case the maximum grant you receive will not change, and you will need to find the resources for portfolio activities within the foreseen project budget.

Challenge portfolio roadmap/ strategy plan

This Challenge aims at:
1. **Enhancing the opportunities of the new environmentally friendly electronic materials potential or novel processes of the portfolio individual project, as a result of its active participation in the portfolio activities:** Ensuring that portfolio members can access a much higher number of relevant applications/devices to explore key partnerships
2. **Enhancing the commercialisation potential of the portfolio individual project, as a result of its active participation in the portfolio activities:** Ensuring that portfolio members can access the right industry partners to explore key partnerships

In order to accomplish the above, the Programme Manager needs to develop and agree on a strategy plan for the responsible electronics portfolio with the portfolio projects.

Portfolio Strategy Plan

Following the selection of a proposals to be funded under the Challenge, the Programme Manager will work together with the consortia of the selected projects to develop a common strategy plan/roadmap for the Challenge. This plan will integrate the activities and milestones of the individual projects into a shared set of specific objectives and activities across and beyond the projects. The roadmap serves as a common basis for the project portfolio and may affect the project implementation - including possible adjustments, reorientations or additional support to projects. The roadmap will be updated in light of emerging results or issues during the implementation. The objectives can be revised, for instance based on projects' unexpected achievements, new technology trends, external inputs (other projects, new calls...).

In particular, the Challenge roadmap/ strategy plan will include activities on the transition to innovation and commercialisation, and to stimulate business opportunities. These activities may be reinforced during the implementation with additional funding and expertise through pro-active management.

Non-exhaustive examples of activities towards the above-mentioned aims are:

- Contributing to understand better/improve the current regulatory framework

- Effectively communicate of any key outcome of the research work of the portfolio members collectively and/or an individual project, to early stage private and corporate investors focused on the same field. Such communication might also be addressed to the general public to increase social acceptance for proposed solutions, or to other researchers and stakeholders through common dissemination activities at scientific conferences or trade-fairs.

- Market analysis: Map the targeted players in a market and exchange the market research analysis results with other the portfolio projects to identify specific players with which the entire portfolio can establish partnership(s) of much higher impact as opposed to that of the individual project.

- Discussions on IP, licensing and business models and commercialisation strategy

- Providing access to Open Innovation Test Beds and other research infrastructure

- Standardisation activities

- Providing access to new markets through multipliers like Enterprise Europe Network

These tasks require the active participation of portfolio members to a series of meetings called for and steered by the Programme Manager. Portfolio projects will be expected to exchange information on the proposed research methodologies, experimental tests, techno-economic

input data and relevant results achieved, in order to collectively use the available resources. This exchange of data between portfolio members can enhance the potential of individual projects, use of results originating from the analysis of common databases, as well as their chances to establish key partnerships. The exchange of information for the purpose of EIC portfolio activities will fall under the conditions and non-disclosure obligations as specified in the EIC Work Programme 2023 (Annex 6, section 2).

Tools though which projects can receive additional support

Projects in the portfolio may be offered additional support, either individually or collectively, in order to reinforce portfolio activities or explore the transition to innovation. Such additional support includes:
- Booster grants of up to €50k (see Annex 5 of the EIC Work Programme)
- Access to additional EIC Business Acceleration Services (see https://eic.ec.europa.eu/eic-funding-opportunities/business-acceleration-services_en)
- Access to the Fast Track to the EIC Accelerator, which would follow a project review (see Annex 3 of the EIC Work Programme)
- The possibility to apply for EIC Transition if your Pathfinder project resulted in an experimental proof of concept (TRL 3), or a technology validated in the lab (TRL 4)
- Access to the EIC Market Place, once operational, to connect with innovators, investors and other selected partners
- Interactions with relevant projects and initiatives outside the portfolio, including other EU funding initiatives as well as those supported by national, regional or other international bodies.