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# PEARL

## Flexible Perovskite Solar Cells with Carbon Electrodes

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### Ethics Plan

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## Executive Summary

This Ethics Plan provides a jointly agreed framework for the PEARL ethics management. The deliverable outlines the ethical issues and procedures related to the research activities to be performed in PEARL. In particular, the Plan details the forthcoming actions and responsibilities for the consortium members to ensure that ethics requirements are carefully fulfilled.

The PEARL project is carried out according to the highest ethical standards and the applicable EU, international and national law on ethical and research integrity principles. Moreover, the beneficiaries are devoted to ensuring the respect of fundamental EU values, such as respect for human dignity, freedom, democracy, equality, and the rule of law and human rights, including the rights of minorities.

In addition to the general ethics principles and relevant legislation, the consortium commits to following the practices jointly agreed in this document. This includes, for example, that all consortium members are responsible for immediately informing the Coordinator if they notice an unexpected or new ethical issue. 'Ethics' will be included as a fixed agenda point for each PEARL General Assembly meeting to ensure that any ethics-related questions and issues raised during the project can be addressed in a timely manner collaboratively by consortium members.

The document is a core part of Task 1.3 (T1.3) *Ethics management* which aims to ensure that the ethics regulations and rules are respected. The task is led by VTT who is also responsible for this deliverable. As task leader, VTT acts as Ethics Mentor, monitoring the ethics issues involved in the project and how they are handled. While VTT coordinates T1.3, all consortium members are responsible for behaving and working according to the highest ethical principles and in good faith.

The text has been developed based on the VTT ethics plan general template.

## Table of Contents

<b>1.</b>	<b>INTRODUCTION.....</b>	<b>5</b>
<b>2.</b>	<b>ETHICAL RESEARCH PRACTICES .....</b>	<b>6</b>
2.1.	RESEARCH ETHICS .....	6
2.2.	RESEARCH INTEGRITY .....	6
2.3.	CONTEXTS OF ETHICAL RESEARCH PRACTICES .....	7
2.4.	NOTES ON COMMUNICATION, PUBLICATION, AND DISSEMINATION ACTIVITIES .....	7
2.5.	RESEARCH MISCONDUCT AND OTHER UNACCEPTABLE PRACTICES.....	8
<b>3.</b>	<b>COMPLIANCE WITH GENERAL ETHICAL PRINCIPLES AND RELEVANT LEGISLATION .....</b>	<b>9</b>
<b>4.</b>	<b>SPECIFIC ETHICAL DIMENSIONS RELEVANT TO PEARL .....</b>	<b>9</b>
4.1.	OVERVIEW .....	9
4.2.	NON-EU COUNTRIES.....	9
4.3.	ENVIRONMENT, HEALTH, AND SAFETY .....	10
<b>5.</b>	<b>ETHICS MANAGEMENT IN PEARL .....</b>	<b>10</b>
<b>6.</b>	<b>CONCLUSIONS .....</b>	<b>12</b>
<b>7.</b>	<b>DEGREE OF PROGRESS.....</b>	<b>13</b>
<b>8.</b>	<b>DISSEMINATION LEVEL.....</b>	<b>14</b>

## 1. Introduction

This Ethics Plan outlines the ethical aspects and procedures related to the research activities to be performed in PEARL project. It also acts as a plan for ethics management for the project. The plan has been prepared by VTT with the guidance of relevant sections from the EC's guide *How to complete your ethics self-assessment*<sup>1</sup>. VTT monitors the ethics processes throughout the project, and the whole consortium is proactively involved in ethics management.

The PEARL project is carried out in line with the highest ethical standards and the applicable EU, international and national law on ethical principles, and the provisions set out in the Grant Agreement. In parallel, the PEARL Ethics Plan is based on the ethical principles and relevant Union, national and international legislation, including the Charter of Fundamental Rights of the European Union and the European Convention on Human Rights and its Supplementary Protocols. In addition, it is expected that the work of the PEARL consortium is carried out in good faith and goodwill.

The following sections of this deliverable address the core aspects of ethics monitoring and management in the PEARL project. We begin by defining general research ethics and research integrity principles. This is followed by a statement of the consortium's compliance with the general principles and regulations. Then, the relevant ethical dimensions identified in the proposal phase of PEARL are addressed. This section is followed by a presentation of the project's ethics monitoring process. Finally, conclusions are presented.

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<sup>1</sup> How to complete your ethics self-assessment, Version 2.0, 13 July 2021, [https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/how-to-complete-your-ethics-self-assessment\\_en.pdf](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/how-to-complete-your-ethics-self-assessment_en.pdf)

## 2. Ethical research practices

### 2.1. Research ethics

The term *research ethics* is a general concept that covers all ethical viewpoints and evaluations that are related to science and research. In general, ethics are norms of conduct that distinguish between acceptable and unacceptable behaviour. As people can interpret ethical norms in different ways based on their own values and life experiences, it is necessary to establish common definitions and rules in the framework of the project.

In the PEARL project, ‘ethics’ is perceived as defined by the European Commission (EC)<sup>2</sup> according to which, ethics:

“includ[e] questions of legal and regulatory compliance as well as a branch of philosophy. It is part of a process of ‘governance’. The consideration of ethical issues, starting at the conceptual stage of a proposal, enhances the quality of research, increases its likely social impact, promotes research integrity, promotes a better alignment of research with social needs and expectations and, finally, supports the societal uptake of the fruits of research because high ethical standards generally merit public trust. In this spirit, the Commission aims to build a relationship between the research process and ethics that is collaborative and constructive (rather than negative and inhibitive).”

The PEARL consortium acts in line with this notion and sees complying with research ethics as the core for conducting high-quality research. In particular, the ethical norms sustained in PEARL are **Impartiality, Reliability, Integrity, and Responsibility**. These norms stress the importance of good and responsible practices and lay the foundations for sincere, reliable, and confidential cooperation among the consortium members and other stakeholders. The norms are closely tied with the notion of research integrity which is addressed next.

### 2.2. Research integrity

In addition to research ethics, good research practices are based on fundamental principles of *research integrity*. Research integrity emphasises the honesty and integrity that all researchers are required to adopt in their research activities. The research integrity principles guide researchers in their work as well as in their engagement with the practical, ethical, and intellectual challenges inherent in research.

The beneficiaries are committed to respecting the fundamental principle of research integrity as set out in the *European Code of Conduct for Research Integrity*<sup>3</sup> document provided by ALLEA - All European Academies -group. The ALLEA document states that “good research practices are based on fundamental principles of research integrity. They guide researchers in their work as well as in their engagement with the practical, ethical, and intellectual challenges inherent in research”.

According to the European Code of Conduct for Research Integrity, the fundamental principles of research integrity are:

- Reliability in ensuring the quality of research reflected in the design, the methodology, the analysis, and the use of resources.
- Honesty in developing, undertaking, reviewing, reporting, and communicating research in a transparent, fair, full, and unbiased way.
- Respect for colleagues, research participants, society, ecosystems, cultural heritage, and the environment.

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<sup>2</sup> Roles and Functions of Ethics Advisors/Ethics Advisory Boards in EC-funded Projects.

[https://ec.europa.eu/research/participants/data/ref/h2020/other/hi/ethics-guide-advisors\\_en.pdf](https://ec.europa.eu/research/participants/data/ref/h2020/other/hi/ethics-guide-advisors_en.pdf)

<sup>3</sup> European Code of Conduct for Research Integrity of ALLEA (All European Academies)

<https://www.allea.org/wp-content/uploads/2017/05/ALLEA-European-Code-of-Conduct-for-Research-Integrity-2017.pdf>

- Accountability for the research from idea to publication, for its management and organisation, for training, supervision, and mentoring, and for its wider impacts.

In addition to the European Code of Conduct for Research Integrity, the beneficiaries are committed to following other relevant international and national research integrity guidelines. For example, VTT has committed to complying with the guidance of The Finnish National Board on Research Integrity TENK's Responsible Conduct of Research, RCR<sup>4</sup>. VTT expects all beneficiaries to respect ethical principles and advices in ethical questions.

### 2.3. Contexts of ethical research practices

Good research practices – which are based on the previously addressed research ethics and research integrity – apply to different contexts of the project's processes. These contexts are defined by ALLEA as follows:

- Research Environment
- Training, Supervision and Mentoring
- Research Procedures
- Safeguards
- Data Practices and Management
- Collaborative Working
- Publication and Dissemination
- Reviewing, Evaluating and Editing

Continuous supervision and guidance are done by the management of the project to ensure that good research practices are sustained in all these contexts. Notably, all participating organisations as well as individual researchers and management staff are responsible for following good research practices in all of the relevant contexts. This includes reporting of any misconduct that might be detected (addressed in more detail in Section 2.5).

### 2.4. Notes on communication, publication, and dissemination activities

The PEARL general communication, publication and dissemination principles are based by design on high ethical conduct. The basic principles of these activities are defined in the Deliverable *D1.1 Project Quality Management Plan* which was completed and submitted in November 2023. The details of these principles are addressed in depth in the Deliverable *D7.1 Dissemination and Communication* of which the first version is to be submitted to the EC by the end of December 2023. Therefore, in this section, we limit to mention a few fundamental aspects of ethics in the communication, publication, and dissemination activities of the project.

Regarding the content of research, the PEARL researchers acknowledge that, unless otherwise specified, they are fully responsible for it from the beginning to publication. The authors should ensure that their work is made available to colleagues in a timely, open, transparent, and accurate manner, unless otherwise agreed. When communicating with the general public and the media, the PEARL consortium members are fully committed to honesty and impartiality.

Regarding authorship, the PEARL researchers have committed to acknowledging that authorship itself is based on a significant contribution to the design of the research, relevant data collection, or the analysis or interpretation of the results. The consortium members must acknowledge the work and intellectual contributions of others, including collaborators, assistants, and funders.

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<sup>4</sup> The official website of the Finnish National Board of Research Integrity TENK for the Responsible Conduct of Research (RCR) <https://tenk.fi/en/research-misconduct/responsible-conduct-research-rcr>

In this line, all communication, publication, and dissemination activities must include (whenever possible) the following EC acknowledgement of funding including the following disclaimer(s):

*This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101122283, project PEARL.*

*The disseminated results reflect only the authors' view and the European Commission, or European Climate, Infrastructure and Environment Executive Agency (CINEA) is not responsible for any use that may be made of the information.*

The texts should be translated into local languages, where appropriate.

In addition to acknowledging the received funding and the contribution of fellow researchers and sources of information, the PEARL consortium members have committed to disclosing any conflicts of interest and financial or other types of support for the research or for the publication of its results.

## 2.5. Research misconduct and other unacceptable practices

The PEARL consortium has a zero-tolerance policy for research misconduct, disregard for responsible conduct of research and other unacceptable practices in research.

Research misconduct can be, for example (the list is not exhaustive):

- Fabrication, i.e., making up results and recording them as if they were real.
- Falsification, i.e., manipulating research materials, equipment or processes or changing, omitting, or suppressing data or results without justification.
- Plagiarism, i.e., using other people's work and ideas without giving proper credit to the original source, thus violating the rights of the original author(s) to their intellectual outputs.
- Misappropriation, i.e., unlawful presentation of another person's result, idea, plan, observation, or data as one's own research.

Sometimes, research violations are not as distinct in which cases they can be seen as disregarding the responsible conduct of research. Examples of these can be (the list is not exhaustive):

- Denigrating the role of other researchers in publications.
- Reporting results and methods in a careless manner, resulting in misleading claims.
- Inadequate record keeping and storage of results and data.
- Publishing the same results many times as novel results (self-plagiarism).
- Misleading the research community in other ways.

In addition, there are other unacceptable research practices practised which are condemned. These can be, for instance:

- Manipulating authorship.
- Exaggerating one's own achievements (e.g., in CV).
- Re-publishing substantive parts of one's own earlier publications without duly acknowledging it ('self-plagiarism').
- Citing selectively to enhance own findings or to please editors, reviewers, or colleagues.
- Withholding research results.
- Delaying the work of other researchers e.g., in the peer-review process.
- Allowing funders/sponsors to jeopardise independence in the research process or reporting of results.
- Accusing a researcher of misconduct or other violations in a malicious way.
- Exaggerating the importance and practical applicability of findings.



To prevent any kind of misconduct, disregard, or other unacceptable practice to take place, the PEARL consortium expects responsible behaviour and work from all its researchers and implements clear ethics monitoring processes. These are defined in Section 5 of this document.

### 3. Compliance with general ethical principles and relevant legislation

In line with Article 14 of the Grant Agreement, the project is carried out according to the highest ethical standards and the applicable EU, international and national law on ethical and research integrity principles. This includes the EU Charter of Fundamental Rights and the European Convention for the Protection of Human Rights and Fundamental Freedoms and its Supplementary Protocols. Moreover, the beneficiaries are devoted to ensuring the respect of basic EU values (such as respect for human dignity, freedom, democracy, equality, the rule of law and human rights, including the rights of minorities).

Throughout the project lifecycle, the beneficiaries are committed to paying particular attention to the principle of proportionality (no harm approach), the right to privacy, the right to the protection of personal data, the right to the physical and mental integrity of persons, the right to non-discrimination, the need to ensure the protection of the environment, and high levels of human health protection. The beneficiaries must ensure that the activities under the action have an exclusive focus on civil applications.

### 4. Specific ethical dimensions relevant to PEARL

#### 4.1. Overview

In the evaluation phase, the PEARL proposal was classified as “ethics ready” and was therefore approved for granting without further ethics clarification requests. However, in the project preparation phase, specific ethical dimensions relevant to PEARL were identified. These will be taken into particular consideration during the lifetime of the project. The identified dimensions are:

- Non-EU countries
- Environment, health and safety

These aspects are addressed separately in the following sub-sections of this deliverable. If other ethics dimensions are identified by any consortium member throughout the lifetime of the project, they are requested to contact the Coordinator immediately and take action as defined in Section 5 of this document.

#### 4.2. Non-EU countries

Two of the PEARL partners, **FACHHOCHSCHULE NORDWESTSCHWEIZ (FHNW)** and **DYCOTEC MATERIALS LTD (DYCOTEC)**, are from non-EU countries. FHNW is from Switzerland and DYCOTEC is from the United Kingdom. Activities undertaken in Switzerland and in the United Kingdom do not raise any potential ethical issues in the project. As defined in the Grant Agreement Article 10.1, FHNW and DYCOTEC will “undertake to comply with their obligations under the Agreement and:

- to respect general principles (including fundamental rights, values and ethical principles, environmental and labour standards, rules on classified information, intellectual property rights, visibility of funding and protection of personal data)
- for the submission of certificates under Article 24: to use qualified external auditors which are independent and comply with comparable standards as those set out in EU Directive 2006/43/EC<sup>5</sup>
- for the controls under Article 25: to allow for checks, reviews, audits and investigations (including on-the-spot checks, visits and inspections) by the bodies mentioned in that Article (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.).”

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<sup>5</sup> Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts or similar national regulations (OJ L 157, 9.6.2006, p. 87).

If any ethical issues arise unexpectedly during the project, these will be handled according to the ethics monitoring processes defined at the end of this document.

#### 4.3. Environment, health, and safety

The health and safety of the environment and humans is a priority in the PEARL project. Since the PEARL research activities may adversely affect the environment, or the health and safety of the persons involved, special consideration must be taken.

The goal of PEARL is to minimize the usage chemicals and compounds harmful to environment or humans. In case the handling of such substances cannot be avoided, appropriate occupational health and safety will be followed by all participants in PEARL project. VTT (Coordinator) complies with National and European legislation on Protection of Environment and Occupational Safety and VTT's occupational health and safety management system is ISO 45001:2018 certified. Thus, all activities in the solar cell fabrication are aimed to ensure a high level of protection of human health and the environment: chemical handling, performed safety in the workplace and training for employees will be based on OSHA's Hazard Communication Standard (HCS), ECHA and REACH Regulations. All personnel must partake occupational health and safety training regularly and work safety is mandatory part of onboarding of new employees. Additionally, all safety observations and incidents are thoroughly investigated for continuous improvement in order to avoid similar issues in the future.

The PEARL research staff will use mandatory air controlling of chemical vapours in case of new production equipment/line implementation and/or process change, following the safety data sheet requirements for the chemicals. In case handling of hazardous chemicals cannot be avoided by technical solutions or alternative chemicals, the usage of personal protective equipment (PPE) is mandatory for employees (hand and body protection, respiratory protection, eye protection) handling the hazardous chemicals.

The workplaces where hazardous chemicals are handled, are equipped with necessary protective equipment (exhaust ventilation system, fume cupboards and gloveboxes). All PEARL chemicals will be stored in special cabinets in appropriate conditions. All chemical waste and residues sorting and treatment, their collection and disposal will be done in accordance with local requirements according to the procedures, which are already in place at the perovskite solar cell processing partners.

### 5. Ethics management in PEARL

Ethics management is a horizontal theme that pierces all activities of the PEARL project throughout its lifespan. Ethical compliance is monitored, in particular, through Task 1.3 *Ethics Management* which is led by VTT and supported by all project partners. The aim of all ethics activities in the project, including this Ethics Plan, is to ensure that the provisions of ethics regulations and rules are respected.

The central ethics monitoring tools and activities of PEARL are as follows:

1. **Ethics Plan:** The document at hand serves as the main tool for all members of the consortium to 1) familiarise themselves with the ethical principles and regulations that the consortium is committed to as well as the ethics issues that need particular attention in the project, and 2) refer to jointly agreed ethics monitoring activities and guidelines.
2. **Ethics mentor:** PEARL consortium will nominate Veikko Ikonen as an independent ethics mentor (EM). He currently works as a Manager at VTT in Corporate Sustainability and Responsibility team, focusing on integration of RRI (Responsible Research and Innovation) approach into the organisational and project level. He is acting as an ethics manager or an ethics advisor in several EU projects where VTT is as a coordinator or partner. He is member of The Finnish National Board on Research Integrity TENK, appointed by the Ministry of Education and Culture, which promotes the responsible conduct of research, prevents research misconduct, promotes discussion and spreads information on research integrity in Finland. He is also member of VTT's ethical committee and The Ethics Committee of the

Tampere Region. As an ethics mentor, he will attend project meetings when necessary and will be consulted on all ethical issues.

3. **Shared and personal responsibility:** While VTT leads the ethics management task, each PEARL consortium member is responsible for complying with the set ethical principles and relevant legislation. Moreover, everyone is expected to report on any new ethical issues they might come across during the course of the project. As mentioned above, VTT acts as Ethics Mentor to the consortium members on a need basis.
4. **Regular meetings:** Ethics will be a fixed topic in each General Assembly meeting of the project and ethical issues are going to be discussed in the more frequent Management Committee meetings whenever necessary. VTT's ethics mentor Veikko Ikonen will organize a session on the ethics issues in the M6 consortium meeting followed by an updated session in M24 or M30 consortium meeting. Further meetings will be organized as appropriate.
5. **Project Quality Management Plan (PQMP):** The PQMP (D1.1) was developed in order to ensure (i) the management of project-related documentation, (ii) monitoring and quality control of project deliverables and milestones, and (iii) risk contingency management. Acting according to the agreed principles is crucial for ensuring that the PEARL project is executed in a high-quality, timely, and ethical way.
6. **Data Management:** Data management is closely connected to the ethical conduct of research and therefore the **Data Management Plan (DMP)** acts as an important tool for ensuring good ethics practices as well. The DMP is updated regularly throughout the project. The **Data Manager**, appointed to the position by the PEARL General Assembly, will monitor the project data management as a whole.
7. **Risk Management Plan:** Risk management is also tied closely to ethics management. The project risks are addressed as a fixed agenda point in the General Assembly meetings.
8. **Process for handling allegations of research misconduct:** As stated earlier in this document, the PEARL consortium has a zero-tolerance policy for research misconduct, disregard for responsible conduct of research and other unacceptable practices in research. Should any consortium member detect such activity, they must inform the Coordinator without delays. The Coordinator then investigates the matter and takes necessary actions to make sure that any potential risks, breaches of information, or harm are minimised. If necessary, the Coordinator informs the CINEA Project Officer.
9. **Record keeping:** the consortium maintains detailed records of all ethical decisions and actions taken during the project, including minutes of consortium body meetings, reports on any ethical breaches, and documentation of any modifications made to the ethics plan.

Overall, the monitoring and oversight of ethics is an ongoing and **dynamic process** that should be tailored to the specific ethical issues and risks associated with the research project. It is essential to **maintain open communication** within the consortium and with stakeholders and to respond promptly to any ethical concerns that may arise.

## 6. Conclusions

This document has addressed the main ethical aspects related to the PEARL project, from the principles of Responsible Conduct of Research and the consortium's compliance with general ethical requirements and specific ethical dimensions relevant to the project to the ethics monitoring process.

All beneficiaries commit to complying with the set requirements, regulations, and processes. If any member of the consortium sees the need to update this document, they may contact the Coordinator who takes adequate actions.

## 7. Degree of progress

The degree of progress of this Deliverable is 100%.

## 8. Dissemination level

PU = Public, fully open