

DARE2X

Decentralised Ammonia production from Renewable Energy utilising novel sorption-enhanced plasma-catalytic Power-to-X technology

D1.5 - Ethics Protocol (Final Version)

Lead beneficiary: Danish Technological Institute

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Abstract:

In this document the main ethics aspects of the DARE2X project are described through the following general areas.

- The main research objectives of the project are listed along with the economic, scientific and societal impacts. The main aim of the project is the development of novel technology for green NH₃ production based on plasma catalysis.
- The project complies with GDPR rules for informed consent & privacy and general treatment of personal data.
- The project complies with legal and ethical standards for research, safety and personal data protection.
- The environmental impact of DARE2X is being assessed throughout the project by conducting LCA and LCC analyses, which help guide the technical development.
- The consortium is committed to the importance of impartiality in research and avoiding & informing of conflict of interests.
- Note: This is an updated version of the initial ethics protocol in D1.3. It has not been deemed necessary to change any specific part of the protocol.



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¹ R: Document, report; DEM: Demonstrator, pilot, prototype; DEC: Website, video etc., DATA: Data sets; DMP: Data management plan; ETHICS; SECURITY; Other: Software, technical diagram, algorithms, models etc.

² PU: Public, fully open; SEN: Sensitive.

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ABBREVIATIONS AND ACRONYMS

EC	European Commission	CA	Consortium Agreement
GA	Grant Agreement	GDPR	General Data Protection Regulation



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1. Introduction

This is the final ethics protocol for the DARE2X project. This is based on the ethics self-evaluation performed in the proposal as well reviews performed with the project consortium during the project. It covers the impacts of the project, the protocols for informed consent and data collection. The environmental impact, compliance with legal and ethical standards as well as handling of conflicts of interest and performing ethical review.

Update: This deliverable is an updated version of D1.3 (initial ethics protocol). The text has been updated to reflect this but if was not deemed necessary to make any specific changes to the protocol.

2. Research Objectives and Potential Impacts

Two main objectives comprise the foundation of the DARE2X project, as outlined in the grant agreement:

1. Development of highly efficient catalysts and sorption materials, to provide means of converting renewable H_2 into NH_3 at ambient conditions, and effectively collect/separate NH_3 while promoting a higher system efficiency, respectively.
2. Development of a novel sorption-enhanced reactor using plasma-catalytic technology, with a scalable design. The integration of sorption materials will allow the immediate separation of the produced NH_3 . This single stage configuration will be evaluated in comparison with the competitive efficiency levels of the industrial Haber-Bosch process. NH_3 synthesis will have target operation conditions of $30\text{ }^\circ\text{C}$ and 1-3 bar, powered directly by an electricity supply, and therefore compatible with green renewable sources.

The fulfilment of these objectives is expected to lead to a number of impacts for European society, both economic, scientific and for the general society. It should be noted that DARE2X is a low-TRL project that aims to end at TRL 4. Therefore, many impacts will first be unlocked in the case of future commercialisation of the technology, such as the economic ones. Other impacts, e.g. generation of knowledge in the scientific field, are generated as a direct result of the project.

Scientific: DARE2X gathers a trans-European consortium to lay the scientific foundations for the disruption of green NH_3 production by bringing plasma-catalytic NH_3 production multiple steps forward toward commercialisation. Due to the freedom to operate within this field, the project will foster a very high degree of European scientific leadership within this potentially ground-breaking technology. This will lead to European scientific excellence, first at the project partners, while at the same time the knowledge will be filtered out into the rest of the European scientific society through dissemination and separate collaborations. Although DARE2X is focused on green NH_3 production, commercialisation of plasma catalysis would more generally open for similar advances in a wide range of other Power-to-X processes that



are crucial for the green transition, i.e., direct production of industrial chemicals and fuels from renewable electricity.

Economic: In case of future commercialisation of DARE2X plasma-catalytic NH_3 production, the process developed in the project will provide decentralised and scalable NH_3 production at a lower cost than centralised production. The European technological excellence that will be achieved through of DARE2X can therefore give the EU a leadership position within the huge future market for green NH_3 and will create a European innovation base spawning new innovation-based companies and creating jobs. The production of NH_3 for the EU inner market will create a large number of jobs, in particular in rural and other less densely populated areas where renewable electricity production is typically taking place. In addition to securing the European supply, a huge export market will open up, with the potential to bring significant revenue and jobs. On the other hand, development of this novel NH_3 production technology could give strong competition for the traditional chemical industry where NH_3 production is a main pillar, resulting in loss of market share for current large stakeholders. However, the boom in NH_3 demand expected from its key role in the green transition will most likely result in an important market role for both traditional and emerging technologies.

Societal: With the prospect of successful commercialisation of the DARE2X technology and European leadership in green NH_3 production, comes a great shift in power within the energy field. While the EU currently relies on imports for 61% of its energy consumption, competitive and decentralised production of this future fuel will be important for Europe to gain energy independence – a vital step towards future strategic autonomy of the European society. Furthermore, by playing a key role in the decarbonisation of Europe, the plasma-catalytic NH_3 production will lead to cleaner air and reduction of the damage done by climate change, significantly increasing future living conditions for the European population. There are potential negative implications of widespread future application of decentralised NH_3 production. NH_3 is highly toxic both to humans and the environment, and any spills and leaks would be harmful. This is a key focus area for the NH_3 field in general, and also for DARE2X. The project will work with relevant stakeholders to ensure adequate regulation and safety procedures and training is available to mitigate these adverse effects of the technology.

3. Informed Consent and Privacy

The project will encounter people outside the consortium in connection with workshops, conferences, courses, and surveys where personal data may be collected. The DARE2X partners are aware of the need to protect the personal data for the participants. Data collection and storage will follow the rules laid out in the General Data Protection Regulation (GDPR). All participants must give informed consent before data is collected. Typical data that would be collected is name, email address and company which are used in connection with workshops/conferences/courses.

Additionally, if surveys are conducted the participants must be informed of the purpose and how the data will be used before signing up. Surveys should collect as little personal data as



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possible. Surveys are mainly foreseen to be used in connection with social acceptance studies of the ammonia synthesis technology.

4. Data collection

Possible ethical issues for data collection in the project have been considered in the data management plan (D.1.2) and is repeated below:

The DARE2X project has no ethical nor legal issues that could have an impact on data sharing at the current stage. In Article 14 of the DARE 2X GA, the principles of ethics and research integrity are defined. All the DARE2X partners must carry out the activities in compliance with:

- **Ethical principles.** This includes the fundamental principle of research integrity, set out in the EU Code of Conduct for Research Integrity³:
 - Reliability in ensuring the quality of research reflected in the design, methodology, the analysis and use of resources;
 - Honesty in developing, undertaking, reviewing, reporting and communicating research in a transparent, fair, and unbiased way;
 - Respect for colleagues, research participants, society, ecosystems, cultural heritage and the environment;
 - Accountability for the research from idea to publication, for its management and organisation, for training, supervision, and mentoring, and for its wider impacts.
- **Applicable EU, international, and national law.**

5. Compliance with Legal and Ethical Standards

The DARE2X consortium has committed through the Grant Agreement to comply with EU legal and ethical regulations, standards and guidelines. Three areas of particular relevance to the project have been identified: (i) chemical safety, (ii) ethical research and (ii) GDPR compliance.

The partners DTI, NIC, HCE and UoL perform experimental development/research that involves the use of chemicals. All of these partners have vast experience with the use of hazardous chemicals and comply with national and EU safety regulations and standards for laboratory work. This includes but is not limited to the development of new or use of existing procedures, use of safety equipment and proper disposal of chemical waste. Particular attention is put on the use of concentrated ammonia gas due to its combination of toxicity and flammability.

The consortium also is committed to commit ethical research by complying with the European Code of Conduct for Research Integrity³. As an example, this means that the partners provide a proper work environment for all students and employees involved in the project, and that the partners commit to ethical publication and dissemination of results, among other focus areas.

³ ALLEA – All European Academies, 2017 – The European Code of Conduct for Research Integrity, <https://www.allea.org/wp-content/uploads/2017/05/ALLEA-European-Code-of-Conduct-for-Research-Integrity-2017.pdf>

While the project is related to inorganic chemistry and no research on human and animal subjects is undertaken, some personal data may be collected from interviews in relation to the social acceptance study in WP6. The amount of data retrieved will be kept at a minimum and will be treated in compliance with the EU General Data Protection Regulation (GDPR), as elaborated in Section 3 of this deliverable.

6. Environmental Impact Assessment

Ammonia is toxic and a hazard to the environment. In the project only small amounts will be produced which can be handled in a laboratory setting with fume hoods. Each partner who produces or handles ammonia in the project will conduct a safety evaluation of their setup. The produced ammonia will either be combusted or neutralised with water, after which it will be sent to appropriate waste treatment plants.

The catalyst candidates include cobalt and nickel which are allergens and carcinogenic. Only trained personnel will come in contact with these metals and their precursors to avoid any exposure or spills into the environment. The used catalyst materials will be collected and sent to appropriate waste treatment plants.

To reduce overall adverse environmental effects, life cycle assessments will be performed during the project to guide the technology development as the overall system and its lifetime must be considered. The main goal of the project is to develop novel technology for production of green ammonia for agricultural and fuel, which currently are based on fossil fuels and thus provide significant reductions in CO₂ emissions.

7. Ethical Review and Oversight

A preliminary ethical review was conducted during the proposal phase of the project where potential issues with work environment safety and environmental harm was identified and addressed. The project plan also includes a task (1.4) which develop and updates the ethics protocol for the project and monitors for any ethics issues throughout the project. An initial version of the ethics protocol was delivered in month 12 of the project and is updated (this deliverable) in month 24 of the project.

The ethical oversight will be performed by the coordinator together with the consortium and will be specifically addressed at general assembly meetings every 6 month and when necessary. Any ethical review will be considered as a minimum the sections listed in this document.

8. Conflict of Interest

The partners acknowledge the importance of impartiality in conducting the research and are also obligated to avoid and inform of conflict of interest through the Consortium and Grant agreements. Monitoring for conflicts of interest is also part of the work in Task 1.4.