DARE2X

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

D6.5 – DARE2X SOCIAL IMPACT POSITIONING: COMMUNICATION GUIDELINES FOR TECHNOLOGY ACCEPTANCE

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Abstract: The acceptance of DARE2X technology was studied using multiple complementary approaches, including Responsible Research and Innovation, a literature review, and an in-depth stakeholder analysis. These efforts informed and supported a survey of 127 respondents from 9 European Union countries and 30 regions, aimed at assessing the social feasibility of establishing decentralised green ammonia production sites integrated with renewable energy sources. The study identified priority concerns for aligning DARE2X with broader societal expectations and the associated communication needs. Key stakeholders in the ammonia industry and local communities were mapped, and their concerns and engagement requirements were determined. The survey revealed an overall positive attitude towards small-scale green ammonia production plants, provided that safety and economic benefits are demonstrated, and—albeit to a lesser extent—that the plants are aesthetically acceptable. The findings highlight both the main concerns and the motivations behind the positive perceptions, offering valuable insights to inform decision-makers, researchers, and industry stakeholders in the implementation of small-scale green ammonia production sites.

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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

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
B2B	Business to Business
BSI	British Standards Institution
CEN	European Committee for Standardisation
DIN	Deutsches Institut für Normung
EC	European Commission
EU	European Union
GA	Grant Agreement
IGC Code	International Gas Carrier Code
IMO	International Maritime Organization
ISO	International Organization for Standardization
JISC	Japanese Industrial Standards Committee
LCA	Life Cycle Assessment
MOF	Metal Organic Framework
NGO	Non-governmental organisation
NIMBY	Not In My Back Yard
OSHA	Occupational Safety and Health Administration
RLR	Rapid Literature Review
RRI	Responsible Research and Innovation
SN	Standards Norway
SOEC	Solid Oxide Electrolyzer Cell
SR	Societal Readiness
SRL	Societal Readiness Level
US	United States

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1. INTRODUCTION

This document provides communication guidelines for raising awareness and informing public opinion when implementing small-scale decentralised green ammonia production projects in European regions.

The plants are coupled directly to renewable electricity generators at or near the point of use. Renewable electricity is used to both make hydrogen (from electrolysis) and to power the process of producing the green ammonia.

The guidelines are based on the results of the societal acceptance and the Societal Readiness (SR) work of the Horizon Europe – funded DARE2X project. DARE2X stands for Decentralised Ammonia production from Renewable Energy utilising novel sorption-enhanced plasma-catalytic Power-to-X technology, which was implemented between October 2022 and September 2025.

The guidelines are meant for ammonia producers and all those who seek to install small-scale ammonia production plants for local use and to decision-makers.

1.1 Why communication guidelines

Although green ammonia offers significant potential for decarbonization, its deployment depends on the willingness of multiple stakeholders - local communities, local policymakers, regulators - to support the establishment of production facilities.

Several studies and a survey conducted in the framework of this project point to the need for providing sufficient and varied information about what green ammonia is and what decentralised green ammonia entails for local communities, so as to prepare public opinion and win the necessary support for the installation of this kind of technologies.

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2. METHODOLOGY

This deliverable is an outcome of ***Task 6.4*** *Social acceptability and readiness of the solution*, led by LOMATOV, and which was implemented between months 6 (March 2023) and 36 (September 2025) of the project life.

The task is described in the project's Grant Agreement as follows:

The possible social effects of DARE2X technology will be thoroughly estimated during the project. To evaluate the societal readiness level (SRL) of DARE2X technology, the tool developed by the EU funded NewHoRRIzon project will be applied and followed during the whole project. Then, DARE2X will analyse concerns and needs of the relevant end-users and societal stakeholders (incl. policy makers, non-governmental organisations (NGOs), large and small companies, investors, general public) using appropriate techniques and methods from social sciences and humanities (e.g., questionnaires, interviews, focus groups, qualitative analysis and indicators), to create awareness, gain feedback on societal impact and advancing society's readiness for the proposed solutions, providing a multi-stakeholder effective communication guide for DARE2X technology.

The execution of the task was guided by the following framework, research methods & techniques, tools and sources of information/informants, of which Table 1 provides a summary.

Table 1. Methodological approach and outcomes.

Framework/ Approach/ method	Technique/Tool	Source of information/ Informants (internal/external to DARE2X)	Outcomes
Responsible Research and Innovation (RRI)	NewHoRRIzon. Societal Readiness (SR) Thinking Tool.	DARE2X consortium members. Internal stakeholders.	Priority concerns for aligning DARE2X with broader societal expectations & resulting communication recommendations.
Rapid Literature Review (RLR)	Literature search & review	Research publications	Factors that can hinder or support the acceptance of local green ammonia production plants – stakeholders involved – key recommendations
Stakeholder Analysis	Individual Stakeholder Analysis matrix	DARE2X consortium members. Internal stakeholders.	List of priority stakeholders – analysis of their impact. Potential strategies for obtaining their support and reducing obstacles
Survey on social feasibility of decentralised green ammonia production	Online questionnaire with closed and open questions	Any citizen in the European Union who is 18+ years old External stakeholders	Factors that influence people's decision to support or oppose the establishment of a green ammonia production plant in their locality

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2.1 Social Readiness Level informed by Responsible Research and Innovation

In this work, we used the definition of the Innovation Fund Denmark for the Social Readiness Level (SRL) as *''a way of assessing the level of societal adaptation of, for instance, a particular social project, a technology, a product, a process, an intervention, or an innovation (whether social or technical) to be integrated into society. If the societal readiness for the social or technical solution is expected to be low, suggestions for a realistic transition towards societal adaptation are required. Naturally, the lower the societal adaptation is, the better the plan for transition must be ''*.

We also used the definition of the NewHoRRIzon Societal Readiness Thinking Tool for Responsible Research and Innovation (RRI) which consists of *''aligning scientific knowledge production with broader societal needs and expectations''* and conferring *''new responsibilities on scientists by committing them to reflect carefully upon the societal implications of their work''*.

The Societal Readiness Thinking Tool of NewHoRRIZON suggests two interrelated approaches to scientists responsibility: conditions and keys.

There are 4 conditions of responsibility:

1. **Anticipation** of intended and possible unintended consequences arising from research activities.
2. **Reflexivity** about own attentive to alternative ways of framing the value and societal impact of their ideas, methods and proposed solutions.
3. **Inclusion** of relevant societal actors in research and innovation activities from an early stage.
4. **Responsiveness** by aligning research and innovation activities with the new perspectives, insights and values emerging through anticipatory, reflexive and inclusion-based RRI processes.

There are 6 keys (also called dimensions) of responsibility:

1. **Ethics**: to prevent unacceptable research practices and the united consequences of research.
2. **Public engagement** of societal actors in the research and innovation process; by societal actors we mean policy makers, business & industry, research and education community and citizens.
3. **Science education** to increase society's general science literacy, the number of researchers and skilled workforce.
4. **Open access** to make research and innovation activities funded with public money, more transparent and easily accessible to the public.
5. **Gender** balanced teams and in the decision-making bodies to improve the quality and social relevance of the results.

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6. **Governance** form to foster and mainstream RRI within a project and in the interaction with other stakeholders.

In terms of the relationship between SRL and RRI, Figure 1 shows how throughout a project life, early implementation of the 4 conditions of RRI leads to a higher level of Social Readiness by the end of the project.

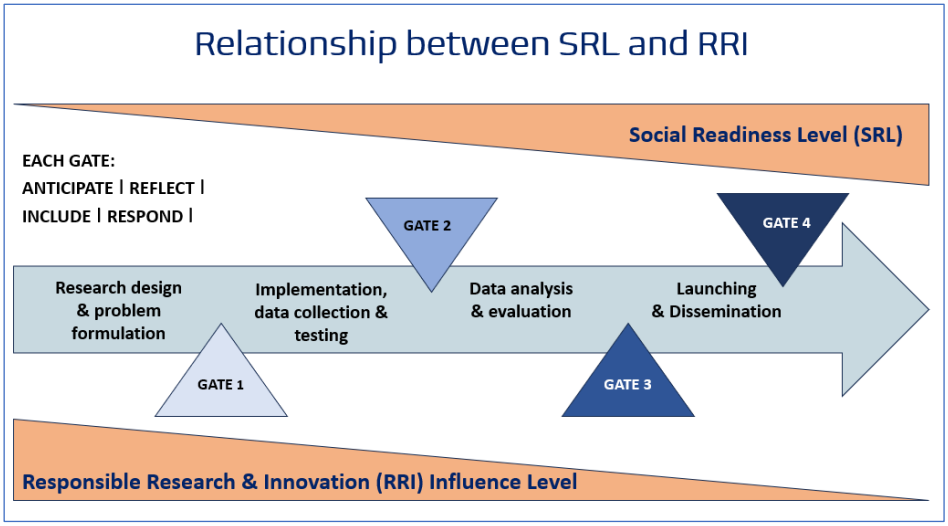

Figure 1. Relationship between SRL and RRI throughout a project life.

To implement this approach, a 2-hour online workshop on Responsible Research and Innovation was organised with 12 members of the DARE2X consortium, each partner being represented by at least one participant .

The RRI workshop had 3 objectives: 1) to introduce the RRI framework, how it works and its importance for achieving societal acceptance and awareness; 2) to build common ground for a shared vision of RRI in the consortium; 3) to identify opportunities for embedding RRI in the project's research and scientific work.

A set of reflective questions was pre-prepared (for anticipation & reflectivity) and administered in the form of Q&A during the workshop for which the participants made proposals of actions to include and respond to (Figure 2).

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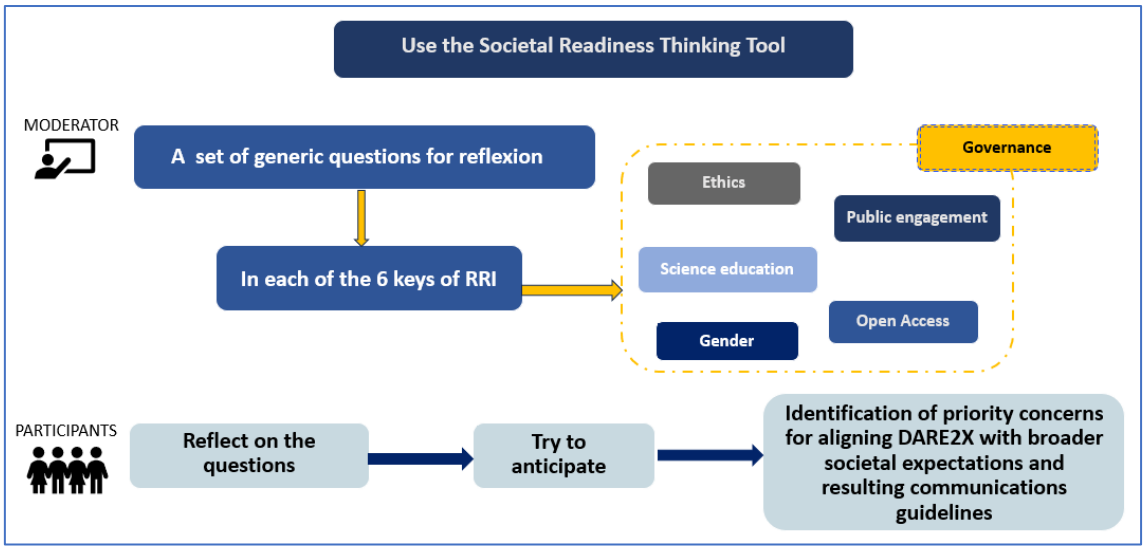

Figure 2. RRI workshop in DARE2X.

An in-depth analysis of the RRI workshop's results to extract actionable conclusions was undertaken, discussed and validated with the members of the consortium regarding priority concerns for aligning DARE2X with broader societal expectations and how these can inform the communication guidelines to be produced. These are detailed in Chapter 3.5.

2.2 Rapid Literature Review

Since DARE2X technology is about a decentralised production of green ammonia, acceptance of these plants by local communities, farmers and ports is fundamental to their successful implementation.

Hence, we distinguished two types of literature review:

a) Review of the **situational acceptance** of decentralised green ammonia plants: in the places where they are installed, i.e., coupled with renewable electricity from solar or wind.
b) Review of the acceptance of green ammonia as a **product** for two selected markets/uses: maritime shipping and agriculture.

The literature review focused on answering 3 key research questions:

1. What factors can hinder or support the acceptance and use of green ammonia?
2. Who are the stakeholders that could influence the acceptance of green ammonia (analysing their roles, interests, and concerns regarding green ammonia production and end use)?
3. What strategies of awareness raising and communication are needed to support the acceptance of green ammonia production technologies such as DARE2X? What recommendations are in the literature?

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To do the literature search, specific key words were used in each case. For the situational acceptance of green ammonia, keywords like *"green ammonia"*, *"green ammonia acceptance"*, *"ammonia public opinion"*, *"public acceptance"*, *"local communities"* and *"land use"* were used. For the acceptance of ammonia as a maritime fuel, the search was narrowed down to keywords such as *"ammonia fuel"* or *"maritime green ammonia"*. And for the acceptance of green ammonia as fertiliser, key words like *"green ammonia fertilizer"*, *"farmers"*, *"green ammonia agriculture"* were used.

Since literature on decentralised green ammonia production is still relatively scarce, information was drawn from studies of green hydrogen adoption, conventional ammonia adoption, clean ammonia acceptance, and ammonia as an energy vector. These sources provided valuable information that can be applied to the context of decentralised green ammonia production.

A total of 21 sources were reviewed. The full list is available in Chapter 6 References, and the main outcomes from the review are compiled in Chapter 3.2.

2.3 Stakeholder Analysis

A second stakeholder analysis exercise was conducted individually by each member of the DARE2X project, using a matrix tailored for such purpose. Selected stakeholders were those in the project's Grant Agreement, which were organised by the order of priority agreed by the DARE2X members. The objectives of the analysis for each one of the 4 stakeholder groups are described in Table 2.

Table 2. Objectives of the individual stakeholder analysis exercise.

STAKEHOLDER GROUP by order of priority	OBJECTIVE
1. **INDUSTRY & INVESTORS**	Attract potential users and customers for commercialisation purposes.
2. **POLICY MAKERS & STANDARDISATION BODIES**	Inform the potential supporters so they endorse the necessary measures and infrastructure for the successful deployment of the decentralised ammonia production technology, i.e., removing and/or mitigating barriers that are external to the project itself.
3. **CIVIL SOCIETY & MEDIA**	- Increase awareness among a wider community of the impact of EU research on carbon-free fuels and their potential for green energy transition. -Inform and improve the public image of the use of ammonia solutions.
4. **RESEARCH & EDUCATION COMMUNITY**	Share knowledge and research outputs.
ALL STAKEHOLDERS	Take into account stakeholders perspectives and needs for DARE2X technology deployment.

Said exercise consisted in analysing for each one of the 4 stakeholder groups: (a) who are the specific stakeholders and what is their relative priority, (b) what is their interest in DARE2X technology, (c) what impact can they have, and (d) how to approach them to obtain support or reduce obstacles, i.e., what motivates them (see Table 3).

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Given that DARE2X consortium is made up of different types of organisations – academia, research institutes and private companies – each member of the consortium completed the matrix for the stakeholder groups that are most relevant to them.

Table 3. Example of the stakeholder analysis matrix for the industry stakeholder group

INDUSTRY				
Stakeholder	**Stakeholder interest in DARE2X technology**	**Assessment of impact**	**Relative prioritisation** 1 Relevant 2 Very relevant 3 Fundamental	**Potential strategies for obtaining support or reducing obstacles**
List names of companies operating in the ammonia & green ammonia sectors.	Analyse for each stakeholder: -How does DARE2X technology concern them? -How are the issues addressed by DARE2X relevant to their priorities? -What is the DARE2X benefit (s) to them? -What aspects of DARE2X might cause conflict for them?	Assess for each stakeholder: How important are these companies' interests to the success of DARE2X? -The role these companies must play for DARE2X to be successful, and the likelihood that these companies will play this role.	Prioritise the stakeholders: From 1 to 3, how important is it to involve each of these companies in DARE2X?	Think of how you might approach each of these companies, i.e.: -Do you have contact with this company? -What motivates them? What kind of information will they need? -What could be their expectations from DARE2X?

2.4 Survey on social feasibility of decentralised green ammonia production

An online survey was conducted between the months of July and August 2025. Its objective was to assess the social feasibility of establishing small-scale decentralised green ammonia production sites, integrated with renewable energy sources in some EU regions. The survey was informed by recommendations from previous research and from the literature review and stakeholder analysis described above.

What the survey sought to measure:

- Awareness of green ammonia
- Attitudes toward decentralised green ammonia production.
- Perceived impacts – economic benefits, safety, aesthetics.
- Willingness to have a plant nearby - NIMBY (Not In My Back Yard) effects - , i.e., the factors that influence the decision to support or oppose a green ammonia plant in the vicinity.

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The research questions of the survey were:

1. To what extent are people willing to support or oppose the establishment of a green ammonia production plant in their locality?
2. What factors influence people's decision to support or oppose the establishment of a green ammonia production plant in their locality?
3. DARE2X technology uses renewable energy sources to produce the hydrogen needed for the production of the green ammonia and to power the process. A green ammonia production plant is typically located near a solar or wind farm to minimise energy transmission losses and CAPEX, and to increase energy reliability and efficiency:
    - Does living near a wind and/or solar farm makes people more supportive or more opposing of the establishment of a green ammonia production plant in the same area?
    - How much are people willing to support the implementation of solar and wind farms in their localities for green ammonia production?

The survey had 31 questions organised in 4 main sections: Demographics; Energy and the environment; Knowledge of green ammonia and its decentralised production; and local Green ammonia production. The complete questionnaire schedule is provided in ANNEX 1.

The survey was administered in English, Spanish and German via the DARE2X project website and LinkedIn channel, and through DARE2X consortium own communication channels. It was also shared by DARE2X staff with colleagues, neighbours, family and friends. In addition, in Spain, it was distributed to port authorities and farmers associations.

127 respondents from 9 European Union countries and 30 Regions answered the survey.

Framing the technology in the survey:

An infographic (Figure 3) was designed in order to provide the respondents of the survey with information about decentralised green ammonia, with the aim of staying neutral. The infographic does not specify or name the DARE2X project. It provided basic information about green ammonia meaning and decentralised production. It used the word ''utility'' of decentralised green ammonia production, instead of ''advantages'' and it presented what decentralised green ammonia production requires – renewable electricity, water and strict safety measures due to its toxicity – so as to do not influence the answers.

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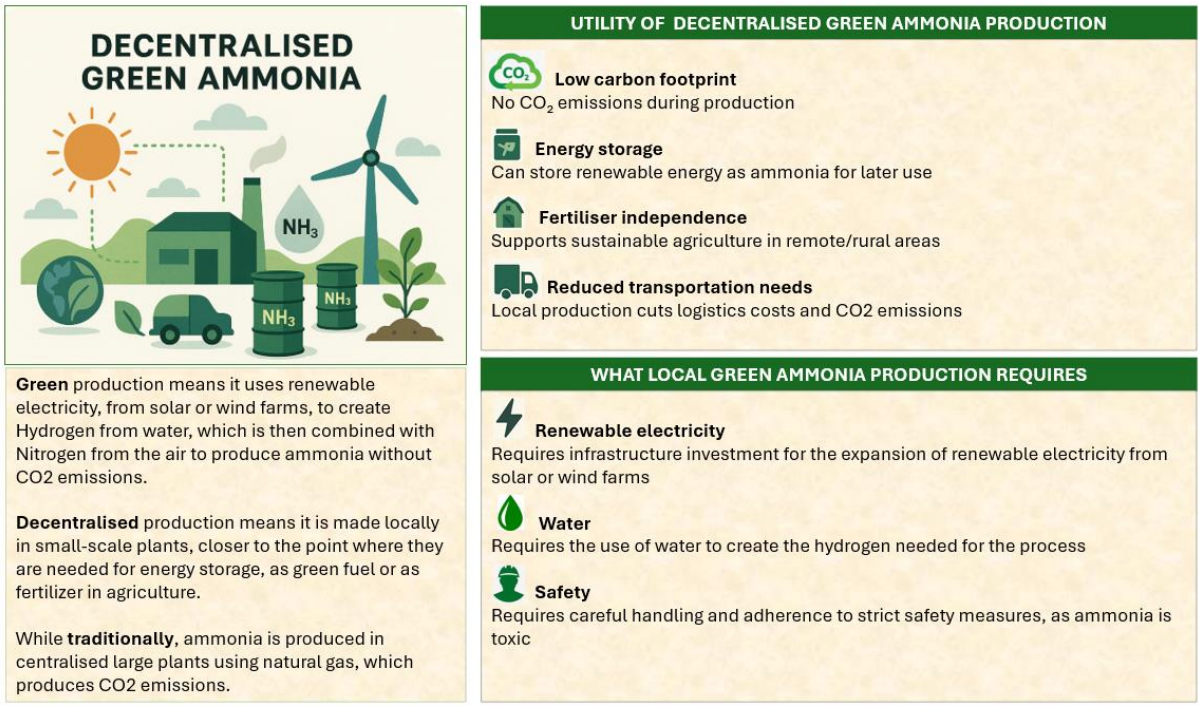

Figure 3. Infographic on decentralised green ammonia used in the survey.

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3. ANALYSIS AND FINDINGS

3.1 Societal concerns and resulting communication needs

The following priority concerns were identified for each key of Responsible Research and Innovation – Ethics, Public engagement, Science education, Gender and Governance. They are translated into actions that the DARE2X consortium needs to implement to ensure alignment with broader societal needs and uptake of the technology. As a result, inwards and outwards communication needs were also identified. These and the alignment actions are outlined in Table 4.

Table 4. Priority concerns for aligning DARE2X with broader societal needs & resulting communication needs

RRI Keys	PRIORITY CONCERNS IDENTIFIED FOR ALIGNING DARE2X WITH BROADER SOCIETAL EXPECTATIONS AND RESULTING COMMUNICATION NEEDS
ETHICS	• Build Ammonia safety arguments for the external audience & right messages. • Ensure the roadmap for Standardisation and Certification roadmap of DARE2X produces recommendations for guidelines for future green ammonia manufacturers and end-users to include safety issues and communicate about them. • Build arguments about the reduction of the environmental impacts, assessed through LCA. • Build arguments about good use of water in the process, through the LCA assessment. • Explain this is the best option for storing and transporting renewable energy which is actually a solution for the usage of renewable energy (ammonia being an energy carrier) • Fertilisers: explain that the main goal of DARE2X is to develop a novel technology for production of green ammonia for agriculture, which presently is based on fossil fuels and thus provides significant reductions in CO_2 emissions.
PUBLIC ENGAGEMENT	• Make guidelines to communicate with each one of most important stakeholders identified & specialised platforms for researchers. • Use a language for each stakeholder group in regard to technical terms and acronyms, while keeping all the different messages coherent among themselves. • Arguments regarding how different stakeholders will benefit from DARE2X need to be tailored to each specific group of stakeholders. • Explain why local production of green ammonia is desirable: what are the advantages and disadvantages of the 2 systems: conventional methods and DARE2X and why is DARE2X approach desirable.
SCIENCE EDUCATION	• Put forward new scientific knowledge and know-how that the project will generate. Explain how the project is contributing to increasing knowledge. • Disseminate project publications. • To support this, DARE2X partners explain in a non-specialist language what they are trying to achieve. Partner' interviews and the promotional video of DARE2X are used for this.

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RRI Keys	PRIORITY CONCERNS IDENTIFIED FOR ALIGNING DARE2X WITH BROADER SOCIETAL EXPECTATIONS AND RESULTING COMMUNICATION NEEDS
GENDER	• Visibility: ensure gender implications in the dissemination activities to encourage female scientists to access and disseminate the outcomes, and to increase their visibility in the chemical/energy industry. • Monitor implementation of work-life balance approach. • If DARE2X's research results can differently affect genders, these aspects will be taken into consideration mainly in the drafting of the exploitation and business strategy of the project.
GOVERNANCE	• Undertake a stakeholder analysis to find out more from these stakeholders about perceptions of and barriers to decentralised green ammonia production. • Review literature about acceptance of green ammonia production. • Find out fast stakeholders and societal effects in demonstration sites of DARE2X: Liverpool and/or Malmo.

In Table 4, we distinguish inwards communication, meant for the members of the DARE2X consortium to aim for higher levels of alignment of their technology development with the priority societal concerns identified, and outwards communication meant for external stakeholders, in particular those most relevant to the uptake of decentralised green ammonia production technologies. The latter is primarily about building the right arguments for communicating the right messages:

Arguments for communication:

- Reduction of environmental impacts.
- Responsible use of water in the production process.
- An environmental option for storing energy.
- An environmental option for fertilisers, which presently are based on fossil fuels.
- Why local production of green ammonia is desirable, what are the advantages and disadvantages of the 2 systems of producing ammonia, i.e. the conventional and DARE2X one, and why is DARE2X approach desirable.

Stakeholders and targets:

- Arguments about how different stakeholders will benefit from DARE2X need to be tailored to each specific group of stakeholders.
- Use a language for each stakeholder group in regard to technical terms and acronyms, etc, while keeping all the different messages coherent among themselves.
- Explain in a non-specialist language what DARE2X technology is trying to achieve.

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3.2 Social acceptance of green ammonia production in the literature

The following findings were extracted from studies on green hydrogen adoption, conventional ammonia adoption, clean ammonia acceptance and ammonia as an energy vector. This is due to the scarcity of sources on decentralised green ammonia production as such; however, they provide valuable information that can be easily applied to the context of decentralised green ammonia production.

3.2.1 Situational acceptance of decentralised green ammonia production plants

The acceptance of decentralised green ammonia production plants is shaped by various factors. While green ammonia offers significant potential for decarbonisation, its deployment depends on the willingness of multiple stakeholders - local communities, local policymakers, regulators - to support the establishment of production facilities.

Perceived risks strongly influence public attitudes

Studies on hydrogen energy technologies (Scovell, 2022) suggest that psychological factors such as perceived risks, benefits, and costs strongly influence public attitudes towards emerging energy infrastructure. While hydrogen and ammonia could differ in their applications, they share common challenges related to storage, transportation, and safety concerns. The perception of risk plays a critical role in local opposition to hydrogen-based facilities, with concerns about explosion hazards and infrastructure safety shaping community responses.

These findings align with research on ammonia safety, as exposure to ammonia vapor can pose severe health risks, including respiratory distress and liquid ammonia can cause chemical burns (Tubben et al., 2024).

Proximity to production sites raises concerns about land use, smell, noise, increased industrial activity and decline in property value.

Studies on hydrogen fuel stations (Baur et al., 2022) suggest that proximity to infrastructure correlates with greater opposition, as individuals living near proposed sites are more likely to perceive personal risks than those living further away.

According to Huijts and van Wee (2015), citizens living nearer to an ammonia production site location are more negative about the placing of a production site there than citizens living further away. Concerns about land use, smell, noise, increased industrial activity, and potential declines in property values frequently arise in opposition to energy infrastructure projects, particularly when communication between developers and residents is lacking.

Inhabitants living near proposed facilities are key stakeholders and potential sources of resistance, as they bear the risks associated with industrial development while receiving limited or no direct benefits (Bennani et al., 2016).

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Trust in public authorities and industry responsible for project implementation shapes public acceptance.

Trust in government and municipalities also emerges as a crucial factor in shaping public acceptance of infrastructure. Research on hydrogen fueling stations in Germany (Emmerich et al., 2020) reveals that while general environmental attitudes can drive support for clean energy technologies, local acceptance is often influenced by trust in the authorities responsible for project implementation. When municipalities fail to address public concerns, opposition to new energy projects increases, even among environmentally conscious individuals.

Similarly, the study on public perception of ammonia energy technologies (Guati Rojo, 2021), highlights the importance of trust, finding that stakeholders who perceive government agencies and industry players as transparent and reliable are more likely to support green ammonia initiatives. However, trust is not uniform across regions. In fact, cross-cultural studies indicate that in countries with lower trust in government, such as Mexico, scepticism toward green ammonia projects may be more pronounced.

Selection of production locations must acknowledge the water factor in dry regions.

Incer-Valverde et al. (2022) also presents the argument considering the freshwater needed for hydrogen production through electrolysis and the water footprint of the process. In dry and water-scarce regions, large-scale hydrogen production could put extra pressure on already limited water resources. Despite this information, the authors have a positive outlook on green hydrogen production. However, the importance of carefully selecting production locations to mitigate these challenges is important and the developers have to select the production sites acknowledging these factors.

The benefits of decentralised production versus global ammonia markets.

In addition to safety and local opposition, economic considerations play a significant role in the acceptance of decentralised green ammonia production. The cost of green ammonia remains a major barrier, as it is currently more expensive to produce than conventional ammonia derived from fossil fuels (Incer-Valverde et al., 2022). However, economic viability is also influenced by geographical and geopolitical factors.

Studies on green hydrogen production in North Africa indicate that producing ammonia from imported green hydrogen may be cheaper than domestic production in Europe (Incer-Valverde et al., 2022). This could raise questions about whether decentralised production models can compete with large-scale, centralised production and international trade. While decentralised production offers benefits such as reduced transportation emissions and enhanced energy security, these advantages must be weighed against the economic realities of global ammonia markets.

Government role is central to fostering greater confidence in the long-term viability of green ammonia solutions.

The role of government policy and regulatory frameworks is another key determinant of situational acceptance. Policymakers influence acceptance not only through direct regulation

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but also through subsidies, incentives, and permitting processes that shape the feasibility of green ammonia projects (Bennani et al., 2016). Governments are responsible for ensuring that safety standards are met, environmental regulations are enforced, and community concerns are addressed, making their role central to the development of decentralized production. Furthermore, studies on the public perception of ammonia energy technologies suggest that regulatory clarity can help alleviate uncertainty among stakeholders, fostering greater confidence in the long-term viability of green ammonia solutions (Guati Rojo, 2021).

Presenting green ammonia as a solution to climate change and addressing misconceptions enhances public support.

The framing of green ammonia within public discourse and policy narratives also affects its acceptance. Studies on hydrogen and ammonia energy systems emphasize that presenting these technologies as solutions to climate change enhances public support, as people are more likely to endorse innovations that align with broader environmental goals (Guati Rojo, 2021).

However, the same study cautions that initial public associations with ammonia—often tied to its industrial use and hazardous properties—can lead to scepticism, requiring targeted communication strategies to address misconceptions and emphasize the safety measures in place.

3.2.2 Acceptance of green ammonia as a fuel in maritime shipping

The adoption of green ammonia as a fuel in the maritime sector is gaining attention due to its potential to decarbonise shipping, one of the hardest-to-abate industries. Ammonia has been transported and used in agriculture for decades, but its role as a marine fuel is still in its early development stages. Shipping companies are hesitant to transition to ammonia-fueled vessels due to uncertainties such as safety regulations and technological advancements.

The lack of regulatory clarity to facilitate safe implementation is one of the main obstacles to widespread use.

Concerns over ammonia's toxicity, the absence of universal safety standards, and the need for specialised infrastructure and crew training have slowed its adoption (Nair, 2022). International organizations such as the International Maritime Organization (IMO) and the International Organization for Standardization (ISO) must establish uniform regulations to facilitate its safe implementation, as the lack of regulatory clarity is one of the main obstacles to widespread use (Mallouppas et al., 2022).

Infrastructure in terminals and onboard need to be adapted.

One of the key challenges in using ammonia as a shipping fuel is the lack of dedicated infrastructure. While ammonia can technically be loaded and unloaded at terminals, as is currently done for industrial purposes, the process presents operational challenges when applied to bunkering ships (Slater et al., 2023). Vessel design must prioritise minimising crew exposure risks in case of leaks, particularly since ammonia is considered a toxic gas under the

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IGC Code, which will require amendments before its use as a fuel is fully accepted (Mallouppas et al., 2022). Onboard infrastructure will also need to be adapted, as ammonia's storage requirements differ from those of conventional fuels. Training programs for handling ammonia as a fuel will be essential, as the skill set required differs significantly from handling it as a commodity (Fullonton et al., 2024).

High costs of transitioning to alternative fuels and the slow rate of fleet renewal discourage manufacturers.

The economic viability of ammonia-fueled ships is another major consideration. The maritime industry has been slow to adopt new technologies due to the high costs of transitioning to alternative fuels. Shipping stakeholders may not want to invest in technology or scenarios that are unproven/too far in the timeline. Industry is waiting because cost of initiation is high - there is anxiety about being the first mover (Fullonton et al., 2024). Additionally, the rate of fleet renewal is slow, discouraging manufacturers from developing ammonia-specific engines. The issue of who will be the "first mover" remains a challenge, as investors and corporations remain cautious about floating assets and the lack of precedent in ammonia-fuelled vessels (Fullonton et al., 2024). However, ammonia remains one of the most competitive options for deep-sea shipping, particularly given its dual role as a hydrogen carrier, making it a versatile solution in the broader clean energy transition (MacFarlane et al., 2020).

Fuel flexibility in ship engines is essential in the context of international trade.

Policy incentives and regulatory frameworks will be critical in driving the adoption of ammonia as a marine fuel. The implementation of a bunker levy or tax on conventional fuels could provide financial motivation for shipping companies to transition to ammonia (Fullonton et al., 2024). However, scaling up ammonia production and distribution remains a challenge due to the high costs associated with developing the necessary infrastructure. This is especially significant in the context of international trade, where fuel availability and geopolitical considerations can influence shipping routes and operational costs. Fuel flexibility in ship engines is essential, particularly in scenarios where geopolitical tensions or supply chain disruptions might impact ammonia availability (Fullonton et al., 2024).

Current maritime regulations prohibit the use of toxic gases as fuel.

Safety concerns also play a significant role in the acceptance of ammonia as a shipping fuel. While ammonia offers a lower environmental impact compared to traditional fuels, (MacFarlane et al., 2020), its toxic nature poses risks that must be carefully managed. Current maritime regulations prohibit the use of toxic gases as fuel, meaning amendments to the IGC Code - The International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk - and other international safety frameworks will be necessary. Until new regulations are in place, ammonia-powered vessel designs will need to undergo alternative design assessments to meet safety standards set by IMO and other regulatory bodies (Mallouppas et al., 2022).

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It is technically possible for ammonia-fueled ships to be commercially viable.

Despite these challenges, there are significant opportunities for ammonia as a marine fuel. Recent IMO mandates to reduce sulphur content in fuels and achieve full decarbonisation of the shipping sector by 2050 have increased interest in alternative fuels, including ammonia (Mallouppas et al., 2022). As engine designs become increasingly modular, it is technically possible for ammonia-fueled ships to be commercially viable under current conditions.

Regulatory and infrastructure challenges can be overcome.

Furthermore, ammonia's existing production and large-scale use in other industries indicate that regulatory and infrastructure challenges can be overcome with sufficient investment and collaboration (Fullonton et al., 2024). However, for ammonia to become a widely adopted shipping fuel, collaboration between regulatory actors, engine manufacturers, and industry stakeholders will be essential to develop the necessary safety measures, infrastructure, and economic incentives (Mallouppas et al., 2022).

3.2.3 Acceptance of green ammonia as fertiliser

Green ammonia is being considered as a promising alternative for fertiliser production due to its potential to decarbonise the agricultural sector. Traditional ammonia production is heavily dependent on fossil fuels, contributing to greenhouse gas emissions. Transitioning to green ammonia, produced using renewable energy, could significantly reduce agricultural emissions (Bora et al., 2024).

Governments are planning schemes to reduce the production costs of green ammonia.

The production of green ammonia is currently more expensive than conventional ammonia due to the high cost of renewable energy and electrolysis. This increase in production cost would either require additional government subsidies or higher retail prices for farmers (Goel & Sen, 2025). Reports indicate that governments are planning schemes to reduce the production costs of green hydrogen and green ammonia, including viability gap funding, with the expectation that costs will decrease over the next five to seven years (Goel & Sen, 2025).

Decentralised green ammonia production could mitigate exposure to fertiliser price fluctuations and improve the distributional equity of fertiliser access.

The restructuring of the ammonia production industry towards renewable and decentralised production could also impact the fertiliser supply chain. Currently, 8% of global food demand relies on ammonia produced from imported natural gas, while an additional 12% depends directly on ammonia imports (Tonelli et al., 2024). This reliance on global markets exposes fertiliser prices to fluctuations in fossil fuel prices and transportation costs. Decentralised green ammonia production could mitigate these risks by reducing dependence on imported ammonia, stabilising fertiliser prices, and increasing food security. Moreover, small-scale modular green ammonia synthesis using renewable hydrogen could improve the distributional equity of fertiliser access, particularly in regions vulnerable to supply disruptions (Bora et al., 2024).

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Understanding farmers' perspectives on green ammonia, their concerns about pricing, and their expectations regarding government support is essential to ensure a smooth transition.

Despite the potential benefits of green ammonia, there are not enough available studies on farmers' opinions regarding its use as a fertiliser. The transition to green ammonia-based fertilisers could lead to higher input costs for farmers, yet there is little information on their willingness to adopt these alternatives. The possible economic implications for farmers remain largely unexplored. Since fertilisers are heavily subsidised in many regions, any increase in cost could significantly affect farmers' purchasing decisions and agricultural productivity (Goel & Sen, 2025). Understanding farmers' perspectives on green ammonia, their concerns about pricing, and their expectations regarding government support is essential to ensure a smooth transition. However, there are currently very few studies that examine these factors, creating a gap in the existing research on the adoption of green ammonia in agriculture.

3.3 The stakeholders of green ammonia & decentralised green ammonia production

As a result of the stakeholder analysis conducted, the following stakeholders have been identified as the most relevant for DARE2X technology. The are presented in the order of priority identified by DARE2X members.

1. Industry stakeholders:

Centralised ammonia producers:

LARGE-SCALE AMMONIA PRODUCERS	INTERESTS & MOTIVATIONS
CASALE: Leading EU ammonia producer with experience in large-scale grey, blue, and green ammonia. **IBERDROLA**: Active in Spain's largest hydrogen project; collaborating with fertiliser producer Fertiberia. **NORTH AMMONIA**: Produces green ammonia for maritime fuel in strategic Norwegian ports. **OCI GLOBAL**: One of the world's largest ammonia producers with green ammonia facilities in Egypt, Africa, and USA. **THYSSENKRUP**: Over 500 global projects, Works with scalable electrolysers for green ammonia. **YARA INTERNATIONAL**: Global ammonia distribution network. **FIRST AMMONIA**: Pioneering commercial SOEC electrolysis plants for hydrogen. Building ammonia combustion engines.	• Receive feedback to refine DARE2X technology to meet industrial-scale needs. • Validate DARE2X technology through pilot projects. • Adopt DARE2X technology to decarbonise their production processes and transition to green ammonia. • Provide partnerships and investment opportunities to help commercialise DARE2X. • Use their market credibility and global distribution networks to promote DARE2X. • Collaborate on large green ammonia projects, increasing scale of plasma-based synthesis.

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Small-Scale / Decentralised Ammonia Producers:

SMALL-SCALE AMMONIA PRODUCERS	INTERESTS & MOTIVATIONS
AMMPOWER: Offers small-scale Haber-Bosch systems. **ATMONIA**: Developing electrochemical ammonia production with novel catalysts. **NIUM:** Nano-catalytic, low-pressure/temperature, flexible ammonia production. **NITROVOLT**: Advancing lithium-mediated ammonia synthesis (patent-pending reactor). **PLASMA2X**: Plasma reactor green ammonia synthesis. **PLASMALEAP**: Plasma reactor ammonia synthesis technology.	• Provide insights on market entry challenges and feasibility. • B2B exchange about business models, commercialization strategies, and B2B information exchange relevant to small-scale production. • Offer perspective on future market trends and adoption pathways for decentralised green ammonia innovations. • Offer perspectives about possible interesting zones (like agricultural) that could be good locations to search clients.

Catalyst material producers:

AMMONIA SYNTHESIS CATALYSTS	INTERESTS & MOTIVATIONS
ATMONIA: They research and discover new cost-effective catalysts for decentralized ammonia production. **BASF**: As a major chemical producer, they also produce custom-made catalysts and engage in strategic partnerships. **Johnson Matthey**: They are a leading catalyst company, manufacturing catalysts for both ammonia synthesis and ammonia cracking, and are involved in projects for lower-temperature catalysts. **TOPSOE**: They are known for their iron-based catalyst, used in almost half of the world's ammonia plants, and they create tailor-made catalysts for green ammonia producers.	• Develop and commercialise high-performance catalysts optimized for plasma-catalytic reactors. • Establish partnerships as key players in the catalyst supply chain. • Engage on the supply and large-scale reproduction of catalysts specifically designed for DARE2X plasma reactors. • Explore and evaluate other types of catalysts that perform efficiently under plasma conditions. • Collaborate on the development of new catalysts for ammonia synthesis tailored to green & decentralised production methods. • Gain understanding of how catalyst companies view decentralised green ammonia production.

Ammonia cracking catalysts

AMMONIA CRACKING CATALYSTS	INTERESTS & MOTIVATIONS
H2SITE: They develop ammonia cracking membrane reactor technology for on-board ammonia cracking, focusing on ammonia's role as a hydrogen carrier. **Neology**: This company specializes in thermochemical cracking of ammonia for hydrogen production across various applications.	• Discuss the role of DARE2X technology as a promising option for producing ammonia as a hydrogen carrier. • Exchange insights on ammonia cracking catalysts, expanding discussions beyond synthesis to include hydrogen extraction.

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AMMONIA CRACKING CATALYSTS	INTERESTS & MOTIVATIONS
OXGRIN: They develop the Zero-Ammonia Power Generator, which is powered by efficient ammonia-cracking catalysts for high system efficiency.	

Adsorption material producers

ADSORPTION MATERIAL	INTERESTS & MOTIVATIONS
BASF: Production of zeolites for various industrial sorption applications. **Clariant**: Production of zeolites for various industrial sorption applications. **NovoMOF**: Development and commercialisation of customizable MOFs for separation and purification. **Chemiewerk Bad Köstritz GmbH**: Production of zeolites for a wide range of industrial applications.	• Scale up the production capacity of DARE2X sorption materials to meet industrial demand. • Form partnerships as essential players in the DARE2X supply chain. • Leverage their expertise in producing tailor-made zeolite and MOF materials. • Establish strategic partnerships to ensure reliable, scalable sourcing of sorption materials.

Producers of technologies based on Cold Plasma

PLASMA REACTOR	INTERESTS & MOTIVATIONS
PLASMA2X & PLASMALEAP (see Small-Scale / Decentralised Ammonia Producers above). Plus, companies that work with plasma technologies: **Plasmawise**: This company specializes in cold atmospheric plasma technologies, offering various applications and customized solutions. **Europlasma**: They focus on cold pressure plasma for nanocoating solutions and participate in the EU project SuperClean. **Terraplasma**: A German company specializing in cold plasma applications, they offer patented innovations ranging from disinfection to specialized plasma sources. **AFS**: This is a large company that uses cold plasma for surface treatment and has a trademark technology for producing plasma without a vacuum.	They may offer useful insights on the industrial scaling, engineering, and deployment of plasma systems in general.

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2. Policy makers & regulators:

STAKEHOLDER	CONCERNS/BENEFITS/ROLE & LIKELIHOOD OF PLAYING THIS ROLE
Local Government Authorities	**How does DARE2X technology concern them?** Responsible for local regulation, community welfare, and economic development. They need to ensure that DARE2X complies with local laws and contributes positively to the community. **How are the issues addressed by DARE2X relevant to their priorities?** Balancing economic development with environmental protection and public health aligns with their governance responsibilities. **What is the DARE2X benefit(s) to them?** Economic development through job creation and potential improvements in local infrastructure and sustainability. **What aspects of DARE2X might cause conflict for them?** Issues could arise if there are delays, regulatory non-compliance, or negative community feedback. **Role:** Regulatory approval, facilitating community engagement, and ensuring project benefits align with local policies. **Likelihood of Engagement:** High, given their governance role and community impact.
Public Health Organizations	**How does DARE2X technology concern them?** Focused on ensuring that technological developments do not negatively impact public health through emissions or other risks. **How are the issues addressed by DARE2X relevant to their priorities?** Aligns with their goals of protecting public health and ensuring that new technologies are safe and beneficial for communities. **What is the DARE2X benefit(s) to them?** Potential for improved health outcomes through cleaner technology and reduced emissions. **What aspects of DARE2X might cause conflict for them?** Possible health risks if safety measures are insufficient or if there are unexpected adverse health impacts from the technology. **Role:** Assessing and ensuring that the technology does not pose health risks, advocating for public health considerations. **Likelihood of Engagement:** High, due to their commitment to public health.

Standardisation bodies:

STAKEHOLDER	INTERESTS & MOTIVATIONS
International Organization for Standardization (ISO)	ISO's global standards are critical for ensuring international acceptance and market integration of DARE2X technology. Involvement in the development and updating of ISO standards would be fundamental for DARE2X's success on a global scale.
European Committee for Standardisation (CEN)	As a key standardization body for the European market, CEN's involvement is crucial for ensuring compliance with EU regulations and for facilitating market entry within Europe. This involvement is essential for DARE2X's success in the European context.

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STAKEHOLDER	INTERESTS & MOTIVATIONS
American Society of Mechanical Engineers (ASME)	ASME standards are important for engineering practices and safety in mechanical systems. While not as globally influential as ISO or CEN, ASME's standards are very relevant for ensuring the safety and reliability of the mechanical aspects of the technology, especially if DARE2X is applied in the U.S. market.
American National Standards Institute (ANSI)	ANSI's role is important for ensuring that technology meets U.S. standards and regulations. Its involvement is very relevant if DARE2X targets the U.S. market or needs to align with ANSI standards for certification and compliance.
International Maritime Organisation (IMO)	IMO's standards are relevant if ammonia is used as a marine fuel or transported by sea. This is less central to the core technology but relevant for specific applications or market segments.
Occupational Safety and Health Administration (OSHA)	OSHA's standards are crucial for ensuring the safety and health of workers involved in ammonia production. Compliance with OSHA standards is fundamental to the technology's implementation in the U.S. and potentially other regions with similar regulations.
British Standards Institution (BSI)	BSI standards are important for market access in the UK and can influence broader standards. Involvement with BSI would be very relevant for DARE2X's success in the UK and potentially for influencing European standards.
Danish Standards (DS)	DS standards are relevant for the Danish market and the broader Nordic region. Involvement is relevant if DARE2X has significant operations or market presence in Denmark.
Deutsches Institut für Normung (DIN)	DIN standards are influential in Germany and can impact European and international standards. Their involvement is fundamental for ensuring compliance and market access in Germany.
Japanese Industrial Standards Committee (JISC)	JISC's standards are important for market entry and compliance in Japan, which is a significant market for technology. Their involvement is very relevant if DARE2X aims to enter the Japanese market or collaborate with Japanese partners.
Standards Norway (SN)	Standards Norway is relevant for the Norwegian market. Involvement is important if DARE2X operates or has market interests in Norway

3. Civil society

STAKEHOLDER	CONCERNS/BENEFITS/ROLE & LIKELIHOOD OF ENGAGEMENT
1. Local Communities	**Concerns:** Environmental impact (e.g., air quality, noise), safety issues, and changes in local infrastructure and traffic due to construction and operation. **Relevance:** Local communities prioritise environmental safety, health, and the economic impact of new projects. DARE2X's focus on sustainable ammonia production and reduced emissions aligns with these priorities. **DARE2X Benefit(s):** Economic Development: Job creation and potential local business opportunities. Environmental Improvement: Reduced greenhouse gas emissions compared to traditional methods, leading to better local air quality.

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STAKEHOLDER	CONCERNS/BENEFITS/ROLE & LIKELIHOOD OF ENGAGEMENT
	Conflict: Disruption: Potential construction and operational disruptions (noise, traffic). Health Risks: Concerns over any unforeseen environmental or health impacts from the new technology**.** **Role:** Active involvement in public consultations, providing feedback on environmental and safety concerns, and supporting or opposing the project based on perceived benefits and risks. **Likelihood:** Likely to be engaged, especially if there are visible impacts or changes in their local environment.
2. **Age groups**	
Children and Youth:	**Concerns** Children and youth are particularly concerned with long-term health and environmental sustainability. **DARE2X Benefit(s): Environmental Health:** Cleaner air and reduced pollution contribute to a healthier environment for future generations. **Conflict: Perception of Risk:** Potential concerns about environmental risks and health impacts if not properly communicated. **Role:** Advocacy through educational programs, influencing family opinions, and participating in community discussions. **Likelihood:** Less direct influence but important for long-term public support and education.
Working Adults:	**Concerns:** Job security, economic opportunities, and local environmental conditions. **Relevance:** Working adults are concerned with employment opportunities and the economic benefits of new technology, as well as its impact on their daily lives. **DARE2X Benefit(s): Employment Opportunities:** New job creation in the local area. **Economic Growth:** Potential for increased local business and economic activities. **Conflict: Job Displacement:** Possible shifts in job markets or industries. **Economic Disruption:** Short-term economic disruptions due to construction or operational adjustments. **Role**: Participation in public discussions, employment in related sectors, and advocacy based on job and economic impact. **Likelihood:** High likelihood of engagement, especially if job creation and economic benefits are clear
Elderly:	**Concerns:** Health impacts, stability of local services, and quality of life. **Relevance:** The elderly are focused on health and safety, and the stability of local services and infrastructure. **DARE2X Benefit(s): Improved Air Quality:** Reduced emissions contribute to better health outcomes. **Local Development:** Economic growth can enhance local services. **Conflict: Health Risks:** Potential health risks from environmental changes or technology implementation. **Service Disruption:** Potential changes or disruptions in local services during construction. **Role:** Advocacy for health and safety considerations, participation in community feedback. **Likelihood:** Moderate likelihood, depending on perceived impacts on health and local services.

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STAKEHOLDER	CONCERNS/BENEFITS/ROLE & LIKELIHOOD OF ENGAGEMENT
3. Socioeconomic Status	
Low-Income Communities:	**Concerns:** Accessibility to economic benefits, environmental impacts, and affordability of local services. **Relevance:** Low-income communities are concerned with economic opportunities and the direct impact of environmental changes. **DARE2X Benefit(s): Job Creation:** New job opportunities can help improve economic conditions. **Environmental Benefits:** Cleaner air contributes to better health. **Conflict: Affordability:** Potential increases in living costs or changes in local service affordability. **Equitable Benefits:** Ensuring that economic benefits are distributed fairly. **Role:** Advocacy for fair economic benefits, environmental justice, and monitoring local impacts. **Likely** to be engaged, particularly if there are clear economic or environmental changes.
Middle-Income Families:	**Concerns:** Economic growth, property values, and environmental quality. **Relevance:** Middle-income families are interested in the overall economic impact and how environmental changes affect their quality of life. **DARE2X Benefit(s): Economic Growth:** Increased property values and local business opportunities. **Environmental Improvement:** Better air quality and a healthier environment. **Conflict: Property Value Fluctuations:** Potential fluctuations in property values due to local developments. **Economic Inequities:** Concerns over whether economic benefits are equitably shared. **Role:** Involvement in community discussions, providing feedback on economic and environmental impacts. **Likelihood:** High likelihood of engagement, especially if impacts are noticeable.
High-Income Individuals:	**Concerns:** Investment opportunities, property values, and local infrastructure changes. **Relevance:** High-income individuals are focused on investment potential, property values, and the overall impact on their high-quality living environment. **DARE2X Benefit(s): Investment Opportunities:** Potential for profitable investments and business opportunities. Enhanced Infrastructure: Improvements in local infrastructure and services. **Conflict: Investment Risks:** Potential risks associated with the new technology's performance and market acceptance. Property Value **Impact: Possible negative impacts on property values during initial phases.** **Role:** Investment, advocacy for property value protection, and support for business opportunities. **Likelihood:** Moderate likelihood, depending on how the project affects their investments and property values.

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STAKEHOLDER	CONCERNS/BENEFITS/ROLE & LIKELIHOOD OF ENGAGEMENT
4. Educational Backgrounds	
General Public:	**Concerns:** Understanding of the technology's benefits and risks, and its impact on daily life. **Relevance:** The general public is interested in the practical benefits and risks of new technologies and how they affect their lives. **DARE2X Benefit(s): Informed Choices:** Provides information and potential improvements to quality of life. **Conflict: Misinformation:** Potential misunderstandings or misinformation about the technology's impact. **Role:** Participation in public forums, providing feedback, and influencing overall perception. **Likelihood:** Moderate, with variability depending on outreach and education efforts.
Environmental and Health Advocates:	**Concerns:** Environmental sustainability, health impacts, and compliance with safety standards. **Relevance:** Their priorities include ensuring that new technologies meet high environmental and health standards. **DARE2X Benefit(s): Sustainability:** Promotes environmentally friendly technology and reduced emissions. **Health Safety:** Adherence to high safety standards. **Conflict: Environmental Impact:** Concerns about whether the technology meets all environmental safety expectations**.** **Role:** Advocacy, scrutiny of environmental and health impacts, and influencing public and regulatory opinions. **Likelihood:** High, especially if there are significant environmental or health concerns.
Industry Professionals and Experts:	**Concerns:** Technical performance, safety, and integration with existing technologies. **Relevance:** Industry professionals are focused on technical details, safety, and practical application. **DARE2X Benefit(s):** Innovation: Provides advanced technology and new industry standards. Professional Growth: Opportunities for professional involvement and advancement. **Conflict:** Technical Challenges: Issues related to technical performance or integration with current systems. **Role:** Technical evaluation, optimization, and providing feedback on practical applications. **Likelihood:** High, given their role in ensuring the technology meets industry standards and performs as intended.

4. Academic and Research institutions:

STAKEHOLDER	CONCERNS/BENEFITS/ROLE & LIKELIHOOD OF PLAYING THIS ROLE
Academia and Research Institutions	**How does DARE2X technology concern them?** Interested in the scientific and technical aspects of the technology for research and development purposes.

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STAKEHOLDER	CONCERNS/BENEFITS/ROLE & LIKELIHOOD OF PLAYING THIS ROLE
	How are the issues addressed by DARE2X relevant to their priorities? Opportunities for research collaboration, innovation, and advancing scientific knowledge align with their goals. **What is the DARE2X benefit(s) to them?** Access to cutting-edge technology for research, potential collaborations, and academic contributions to the field. **What aspects of DARE2X might cause conflict for them?** Concerns might include insufficient research data or lack of transparency in research findings. **Role:** Conducting research, providing technical expertise, and contributing to the technology's development. **Likelihood of Engagement:** High, as they are interested in advancing scientific knowledge and collaboration.

3.4 Public perceptions of local green ammonia production

The findings on public perceptions presented in this chapter are the result of the survey (Chapter 2.4) that was conducted with 127 respondents living in 9 EU members states. The great majority of the respondents (75.6%) live in Spain (see Table 5), which does not allow for any comparative analysis between countries. The high number of respondents from Spain is explained by the fact that the researchers themselves live in Spain, which facilitated recruiting more participants there.

Table 5. Countries of residence of the survey participants.

EU COUNTRY	NUMBER OF RESPONDENTS
Austria	1
Czech Republic	1
Denmark	5
Germany	8
Greece	8
Netherlands	5
Poland	1
Portugal	2
Spain	96
TOTAL	127

The demographic and socioeconomic profile of the survey respondents is presented in ANNEX 2 (Table 8).

Green ammonia

More than half the participants (57%) who were asked if they heard of green ammonia before said they did not, while the remaining 43% -who heard of green ammonia before - show high levels of confidence in their knowledge (18% extremely confident and 29% very confident, see Figure 4). This may suggest that although most people haven't heard of green ammonia before, those who did hear about it seem to have a good knowledge of the subject.

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The very confident and extremely confident have the highest levels of education: postgraduate level for the first one and university degree for the second, and work in the Low or Zero Carbon Fuels sector (6 extremely confident, 7 very confident).

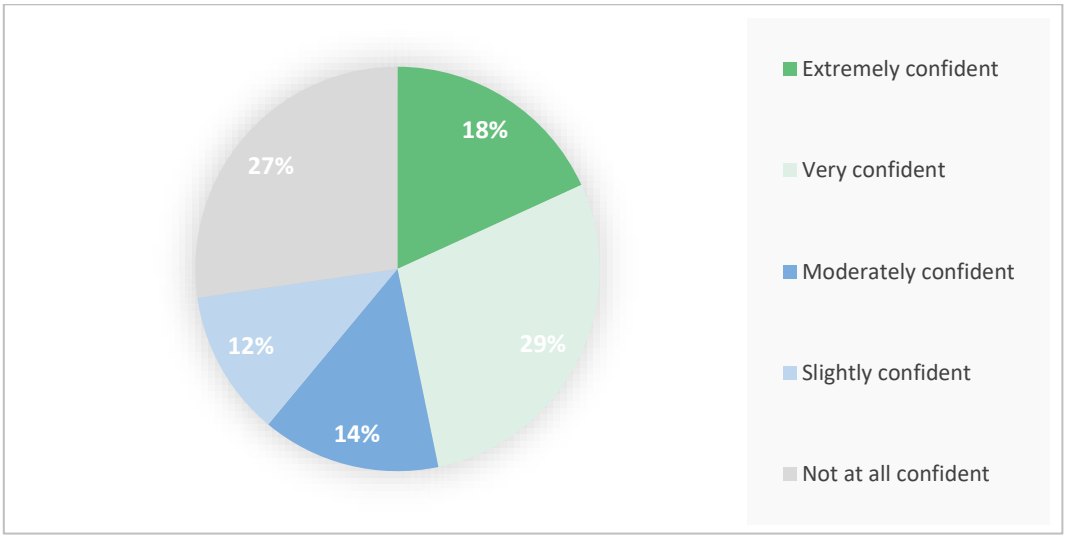

Figure 4. Confidence in understanding green ammonia (if the respondent has heard of it).

Decentralised green ammonia production:

The majority of respondents (68%) are not at all familiar with the concept of decentralised green ammonia production (Figure 5). Those who described themselves as extremely familiar (6%) and very familiar (8%) with decentralised green ammonia production said, respectively, that they were extremely confident and very confident about their understanding of decentralised green ammonia production.

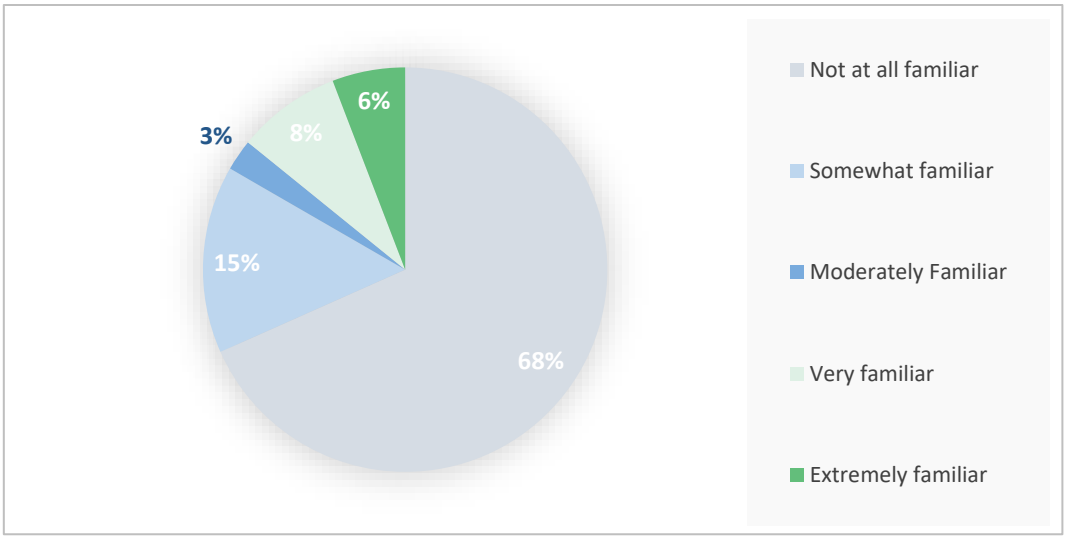

Figure 5. Familiarity with the concept of decentralised green ammonia production.

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Feeling about installing small-scale plants to produce green ammonia locally

Green ammonia framing and feeling

After asking the respondents to read the infographic on decentralised green ammonia (see Figure 3) to explain what green ammonia means, what decentralised green ammonia production means and what is its utility, and what decentralised production requires. The following answers were obtained (Figure 6). Most respondents (67%) reported feeling positive about having a small-scale green ammonia production plant in their locality, with the majority (29%) of them feeling very positive, 25% positive and 13% somewhat positive.

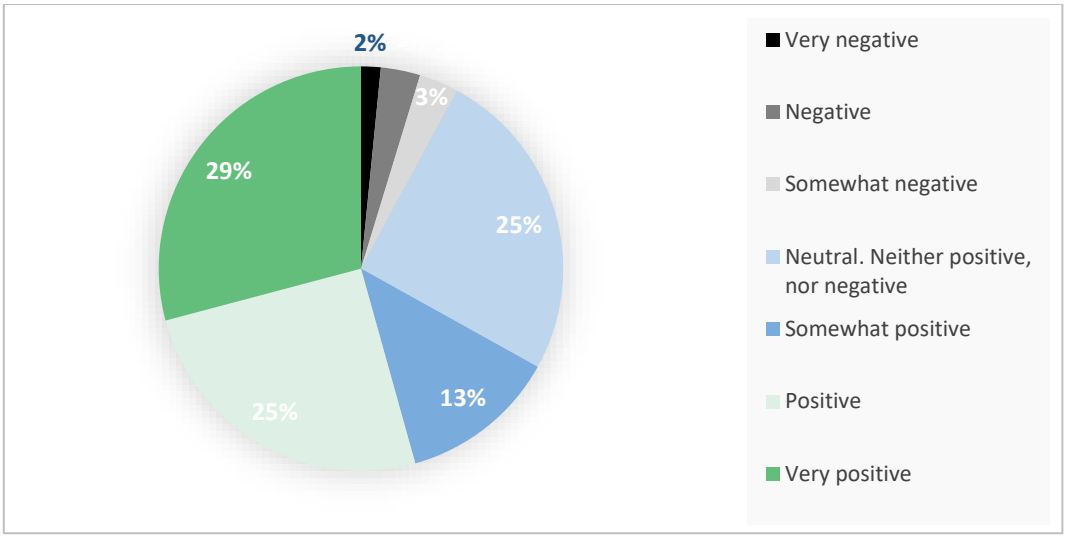

Figure 6. Feeling about having a small-scale green ammonia production plant in respondents´ locality.

Among the main reasons the respondents gave about their **positive feeling** are:

- It relieves the energy and transport networks.
- It allows energy storage over a longer period of time.
- It benefits the environment.
- It is tied with local production and employment generation.
- It is safe.

Although some respondents said they had a positive feeling, they raised the following issues:

- This information (*the infographic*) is useful but I would need more to have a clearer opinion.
- Need more reassurance on safety and pollution.
- Decentralised green ammonia production not a priority: residential and industrial heating are more urgent areas for decarbonisation.

The reasons the respondents gave about their **negative feeling** are:

- Safety.
- Association of the word ''ammonia'' with something ''bad''.
- Concern over resources (water use, rare earths use, electricity use).

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- Economies of scale of large facilities are very difficult to overcome.
- Technical feasibility: Not easy to be done.

More women expressed a positive feeling (49 respondents) than men (34). More respondents in the age group 25–34 expressed a positive feeling. Positive feelings for decentralised green ammonia are strongest among those holding a postgraduate degree (47 positive) and university degree (29 positive). Positive feeling is also higher among those who said they didn't work in any of the sectors mentioned in the survey (39 positive).

Proximity to and support of Wind/solar energy farms and feeling

According to Table 6, people living near wind or solar energy farms tend to have more mixed feelings about having a decentralised green ammonia production in their local area, with 42 expressing positive feelings, 20 neutral, and 9 negative. In contrast, those not living near such farms are overwhelmingly positive (43 positive vs. only 1 negative), with fewer neutral responses (12).

Support for renewable energy expansion aligns with positive feelings towards green ammonia projects. Among the respondents (62%) who support expansion 59 expressed positive views, compared to only 10 neutral and 8 negative. Respondents who opposed expansion were fewer and more divided (7 positive, 5 neutral, 1 negative), while those unsure showed more mixed attitudes (19 positive, 14 neutral, 1 negative).

Table 6. Relation between supporting expansion of wind/solar plants and feeling about decentralised green ammonia.

Support expansion of wind/solar in the area	Positive	Neutral	Negative
YES	59	10	8
NO	7	5	1
Maybe/Not sure	19	14	1

Willingness to have a green ammonia plant in one's local area:

Benefits people expect from the establishment of a green ammonia production plant in their locality:

Local energy independence (23%) is the most expected benefit, showing a strong desire for communities to rely less on external energy sources (Figure 7). It is followed by economic and social benefits: job creation (21%), improvements/development of local infrastructure and services (14%), and increased local business opportunities (14%). Environmental benefits (9%) are seen as secondary compared to direct local benefits. This can be explained by the fact that people strongly link the installation of green ammonia production plants in their areas with local-level advantages rather than only global environmental outcomes.

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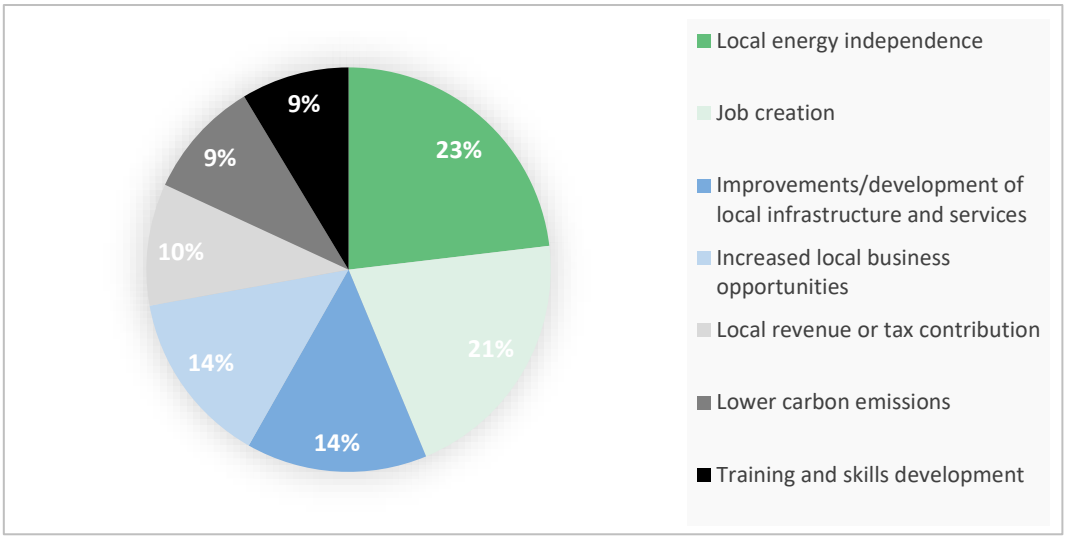

Figure 7. Expected benefits from decentralised green ammonia plants in a local area.

Major concerns about establishing a green ammonia production plant in people's local area:

The main concerns regarding the establishment of a green ammonia production plant in the local area are **safety and toxicity**, which was highlighted by 57 respondents, making it by far the most significant issue. Other notable worries include uncertainty or lack of knowledge (17) and environmental risks (17), along with water/resource concerns (12). A smaller number pointed to noise, smell, or visual impact (8) and technical or management issues (5), while only a few mentioned economic costs (3) or social concerns (1). Interestingly, 7 respondents reported no concerns, showing that while safety dominates, a small group perceives little to worry about.

Despite multiple possible concerns, the data (Figure 8) clearly shows that safety and toxicity are higher than the rest of the issues, suggesting that addressing this aspect could significantly improve public acceptance.

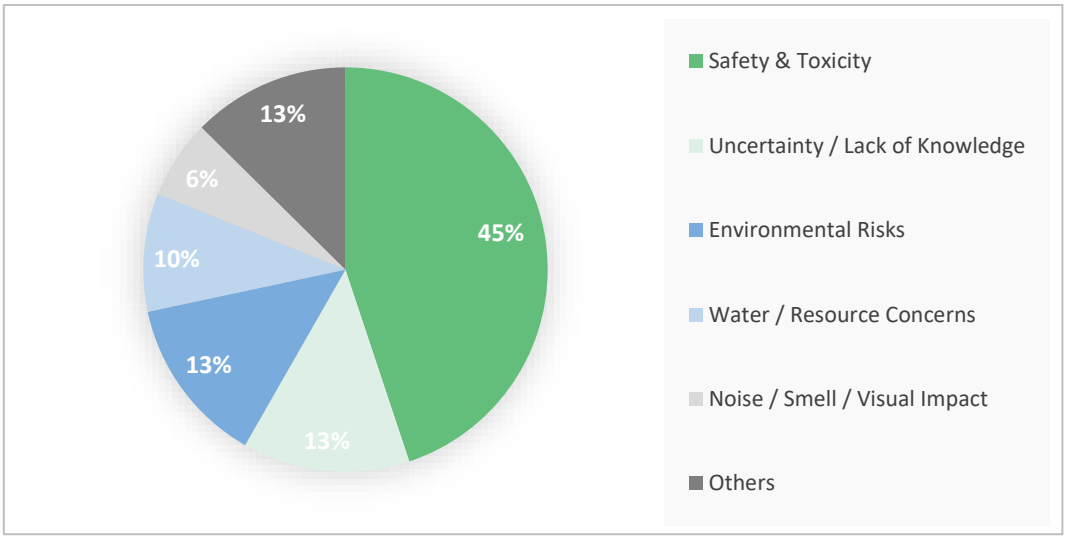

Figure 8. Major concerns if an ammonia production plant was established in a local area.

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The answers to the question *"if the safety of the local ammonia production plant was demonstrated to you, would it help you support it?"* show the extent to which people are willing to support such plant. 79% said "Yes", while a smaller share, 17%, said they were not sure and only 4% responded "No".

Among the respondents who identified safety as their major concern about installing local green ammonia production plants, 80% of them could be convinced with a demonstration.

This suggests that understanding and seeing how a local ammonia production plant operates and how the safety measures operate lower the barriers against it.

Factors that would convince local communities of the safety of a local ammonia production plant:

To the open-ended question of *what would convince people of the safety of the local decentralised ammonia production plant,* multiple answers were given, and they have furtherly been grouped in the following categories:

- Transparency & Communication & Demonstration.
- Proof of Operational Safety.
- Proof of Environmental Benefits (including qualifications).
- Maturity of Technology and Results over Time.

These were grouped into the categories shown in Figure 9:

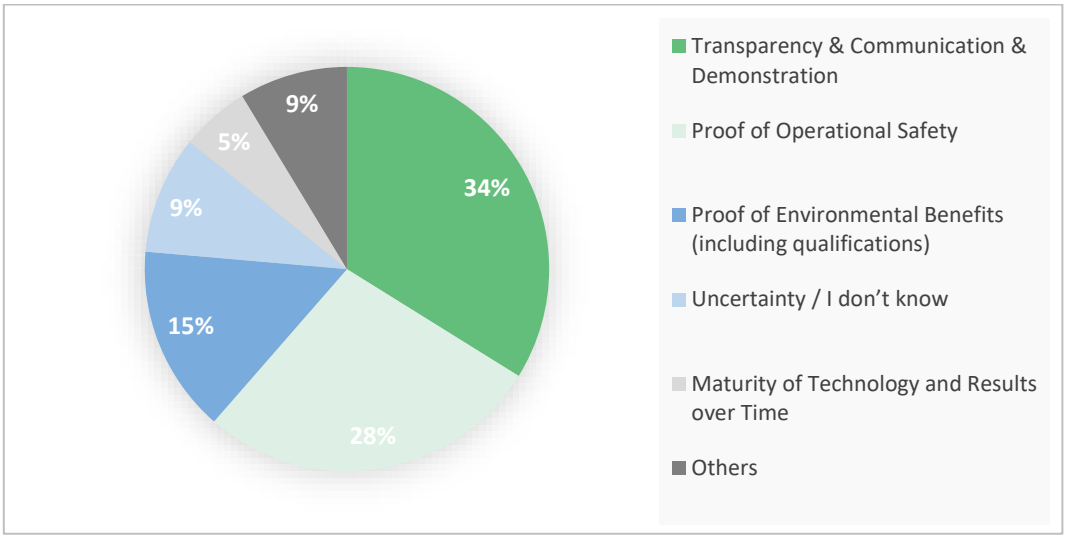

Figure 9. Factors that could convince people of the safety of the local ammonia production plant.

Transparency, communication, and demonstration (34% of responses) are seen as the strongest factors to convince people about the safety of a local ammonia production plant. This is followed by proof of operational safety (28%) and evidence of environmental benefits (15%). Other factors, such as maturity of technology (5%) or operational training, played a smaller role, while very few mentioned cost benefits or local development proof.

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The emphasis on transparency and clear safety demonstrations highlights that building trust through openness could be more important than technical or economic arguments alone.

Factors that would convince local communities to support local ammonia production plants if economic benefits were demonstrated to them:

To the question *"if the economic benefits of a local ammonia production plant was demonstrated to you, would it help you support it?",* the overwhelming majority (99 respondents) said "Yes" and only 4 answered "No" and 24 remaining "unsure". This highlights that clear communication of tangible economic gains—such as job creation, local business opportunities, or tax revenue—could be one of the most effective strategies for building widespread acceptance.

To the question of *"What would convince you of the economic benefits of the local production plant"*, the respondents gave the following factors, which are illustrated in Figure 10:

- Job Creation & Employment.
- Cost Efficiency (Lower Bills, Competitiveness, Prices).
- Proof of Local Development & Community Benefits.
- Availability of Data (Feasibility Study, Business Plan, Case Studies, Real Data, Success Stories).
- Environmental & Sustainability.
- Cost Benefits.
- Transparency & Communication.

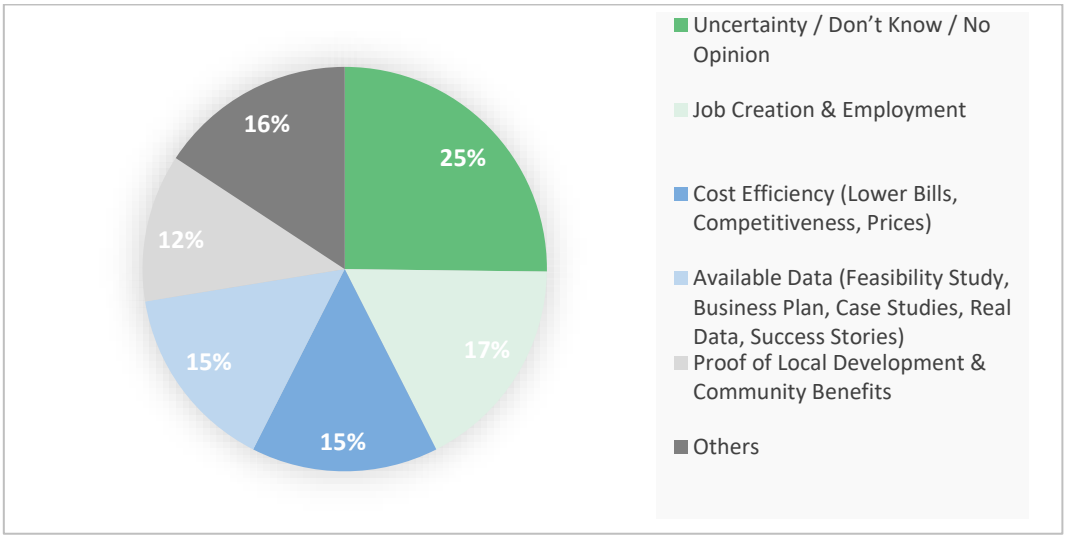

Figure 10. What would convince respondents of the economic benefits of a local ammonia production plant.

Job creation and employment (17%) and cost efficiency (15%) are the most convincing factors for respondents when considering the economic benefits of a green ammonia production plant. Equally, real data and feasibility studies (15%) play a key role, highlighting the demand for concrete evidence. Meanwhile, uncertainty and lack of opinion (25%) show that a significant number of people remain unconvinced or lack enough information to decide. Other factors such as local development benefits (12%) also contribute, though less strongly.

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The fact that hard evidence (data, feasibility studies) and solid outcomes (jobs, lower costs) are prioritised suggests that people want both trustworthy proof and visible, practical benefits before fully supporting such projects.

What is an aesthetically acceptable local production plant?

To the question *"If it were demonstrated to you that the local plant would be aesthetically acceptable, would it help you support it?",* support is lower compared to previous factors such as safety or economic benefits. Still, a "Yes" answer remains the largest share, accounting for about half of the results (54%), while the other remaining half is divided between "No", (25%); and "Maybe/Not sure", (23%).

Regarding what is an aesthetically acceptable local production plant, Figure 11 shows that the most preferred options are green integration (42%), with respondents preferring designs that blend with nature through trees, landscaping, and natural elements. A large share also expressed no preference or indifference (32%), suggesting that for many, aesthetics is not a key concern. This highlights a divide between those who value environmental design and those who see appearance as less relevant.

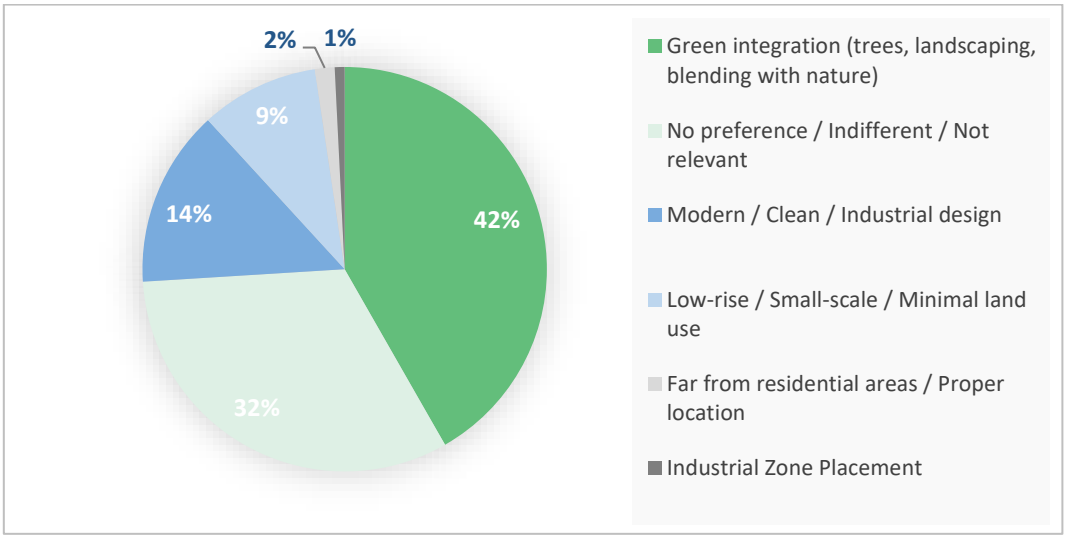

Figure 11. Factors describing how the participants perceive an aesthetically acceptable plant.

Who would people trust to own and operate a green ammonia production plant in a local area?

The survey results (Figure 12) show that most respondents place their trust in a public-private partnership (31%) to operate a local green ammonia production plant, followed by trust in a private company but with local benefits (22%) and local community (16%), indicating a preference for models that keep benefits close to residents.

Meanwhile, municipal and national government received less support, and very few respondents trusted a consortium of chemical industry operators. Interestingly, 17% participants expressed no preference, suggesting that for some, the ownership model is less important than the plant's outcomes.

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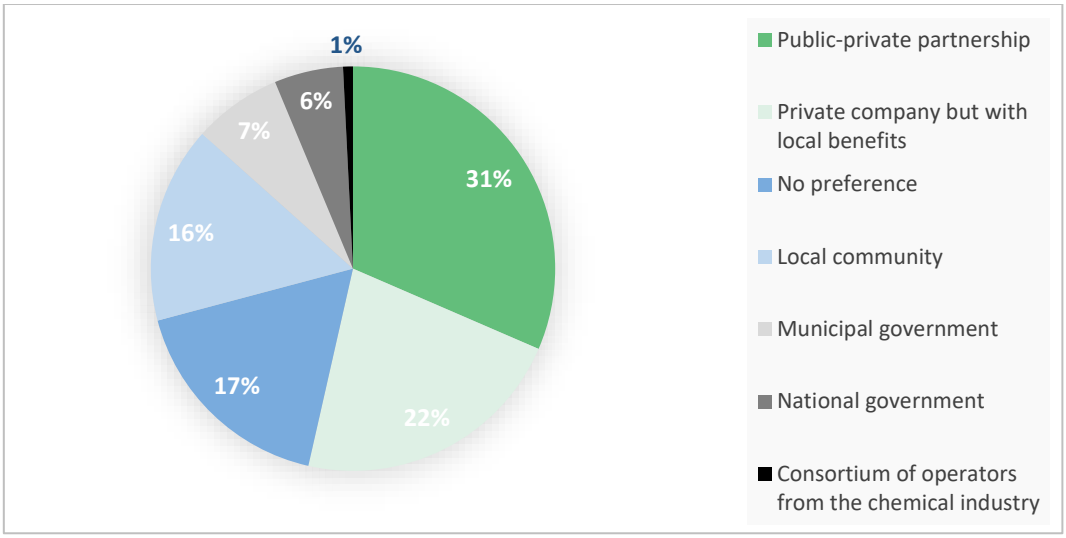

Figure 12. Preferences for who should own and operate a local ammonia production plant.

It is interesting to observe that people lean more towards collaborative or community-benefiting structures than purely governmental or industrial ones.

However, these results have to be taken carefully as the majority of answers come from Spain, and a comparative analysis between countries will not be reliable.

Reasons for choice of owner and operator of the local ammonia production plant:

To the question ´´*What is the main reason for your choice*´´ of who should own and operate a green ammonia production plant, participants gave the following reasons (Table 7):

Table 7. Reason for choice of owner and operator of green ammonia production plant.

Reason of answer regarding trust in a specific owner & operator of a local production plant	No. of answers
Economic reasons	8
Expertise/ Management	28
Local benefits	25
Corruption concerns	17
Safety concerns	6
Transparency and regulation	23
No preference; don't know	18
Overall negativity/ I don't trust no one	2

The most frequent factor is expertise and experience in management (28 answers), followed by local benefits (25) and transparency and regulation (23), showing that people want operators who are both capable and aligned with community interests. At the same time, corruption concerns (17) highlight a very high degree of scepticism, while safety reason (6) was mentioned less often in this case. Interestingly, a notable share of respondents expressed uncertainty or no preference (18), and a small minority (2) reported overall mistrust in any stakeholder.

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How would local communities like to be involved in the decisions-making process if a green ammonia production plant is to be implemented:

The answers were grouped in the following categories:

- No interest in participating in decision making
- Having real-time data / informed from the beginning
- Receive public information (surveys, newspapers, newsletters, etc.)
- Site visit and active participation
- Voting
- Negativity towards decentralised green ammonia
- Through training for risk prevention

The results are presented in Figure 13:

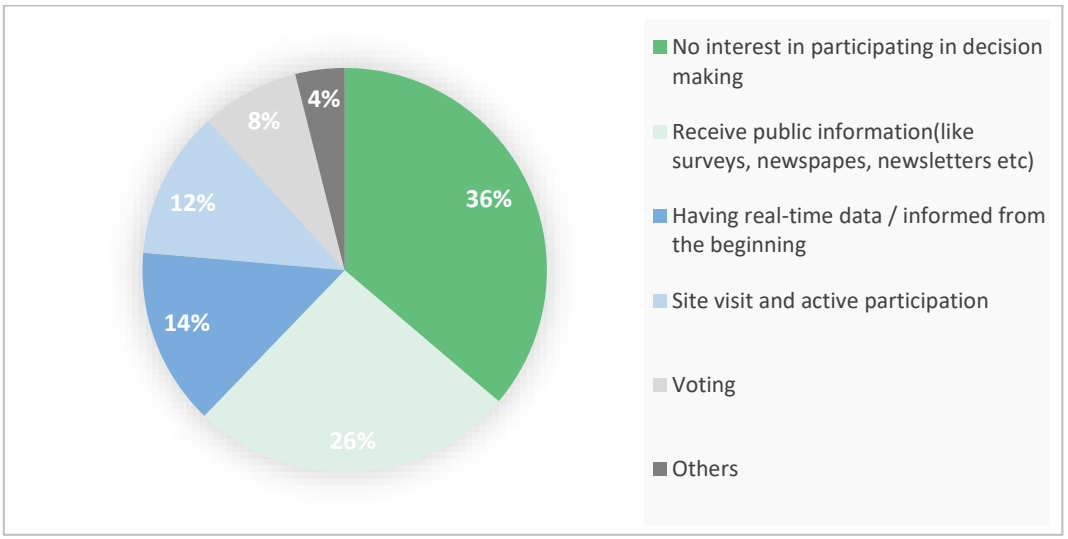

Figure 13. Preferences for involvement in the decision-making process of establishing a green ammonia production plant in a local area.

The results show that the majority of respondents (36%) expressed no interest in participating in the decision-making process regarding the implementation of a green ammonia production plant. However, a significant number still valued being kept informed, with 26% preferring public information through surveys or newsletters and 14% asking for real-time updates from the beginning. Smaller groups highlighted active involvement, such as site visits or voting. Only a few respondents mentioned training for risk prevention or expressed outright negativity towards decentralised green ammonia.

The fact that most respondents expressed no interest in participating in the decision-making process is not encouraging, as it may suggest a lack of confidence in their own knowledge or ability to contribute meaningfully. This may reflect the perception that they do not have the necessary background or information to engage with such a technical topic.

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What would make people more comfortable about having a green ammonia plant in their locality:

The answers to this open-ended question in Figure 14 show that what would make people more comfortable with having a green ammonia production plant in their locality is mainly safety and security (20%), followed by transparency and information (18%), highlighting the importance of building trust and providing clear communication. Environmental protection (8%) and economic & local benefits (10%) also play a role, though to a lesser degree.

Interestingly, the largest share of responses (24%) falls under *"other/unique answers"* suggesting that many participants have specific or context-dependent concerns that do not fit into the other categories. This underlines the need for tailored approaches when engaging with local communities.

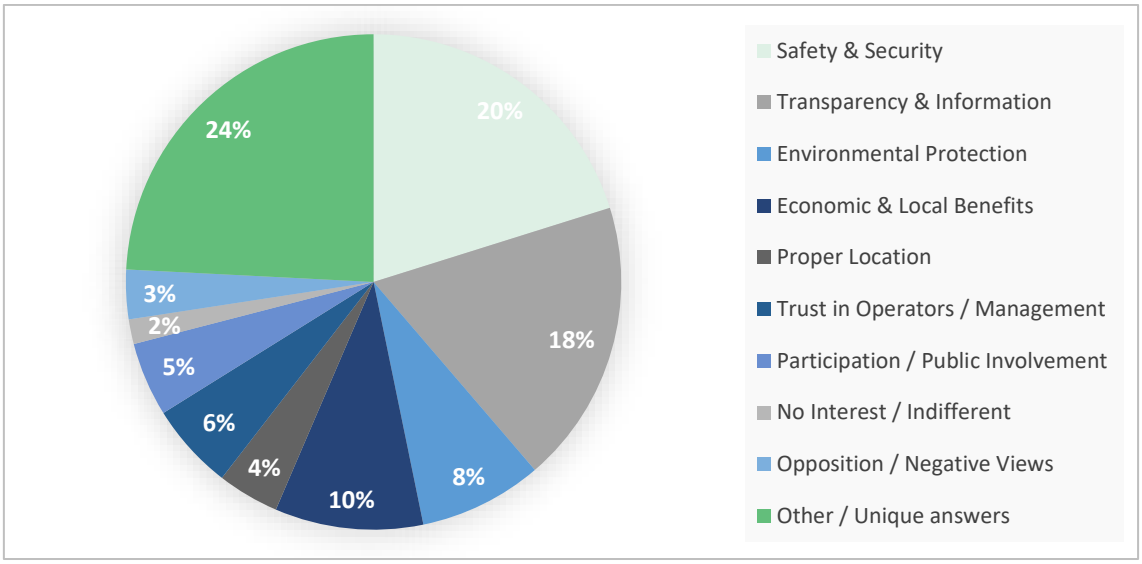

Figure 14. What would make people more comfortable with having a green ammonia production plant in their locality

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4. KEY COMMUNICATION GUIDELINES & RECOMMENDATIONS

Communication towards R&I projects on green ammonia technologies that are suitable for decentralised use:

Through the work conducted on the Social Readiness Level of DARE2X, the consortium has identified the following **key arguments** to use for building a communication strategy in favour not only of its own technology, but any technology that is meant for the decentralised production of green ammonia:

- Reduction of environmental impacts.
- Responsible use water in the production process.
- An environmental option for storing energy.
- An environmental option for fertilisers, which presently are based on fossil fuels and thus providing significant reductions in CO_2 emissions.
- Why local production of green ammonia is desirable, what are the advantages and disadvantages of the 2 systems of producing ammonia and why is DARE2X approach desirable.

Communication towards decision-makers, developers, industry and academia:

The literature review conducted in this task informed us about **key issues** that need to be known to decision-makers, developers, industry and academia and around which communication need to be built to ensure acceptance of decentralise green ammonia production by local communities and as a product:

Local communities:

- Perceived risks.
- Proximity to sites.
- Framing of green ammonia in public discourse and misconceptions.
- Trust in who implements the projects.
- Water scarcity.
- Opposition to Renewable Energy expansion.

Maritime shipping:

- Lack of regulatory clarity.
- Lack of dedicated infrastructure in terminals and onboard.
- High costs of transitioning to alternative fuels combined with slow rate of fleet renewal.
- Current maritime regulations prohibit the use of toxic gases as fuel. Ammonia is toxic.
- Engine designs become increasingly modular making it technically possible for ammonia-fueled ships to be commercially viable .

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- Need of collaboration of regulatory actors, engine manufacturers and industry stakeholders to overcome regulatory and infrastructure challenges.
- Need of investment support from the part of governments.

Agriculture:

- Production costs are high & there is a need for government support to reduce them if we were to promote green ammonia as fertiliser.
- Decentralised production could reduce dependence on imported ammonia and hence contribute to stabilising costs.
- Little information on farmers' willingness to adopt green ammonia is available and more research should be done.

Communication regarding the social feasibility of decentralised green ammonia production:

The survey conducted in this task informed us about the factors that condition willingness of people to support the establishment of small-scale green ammonia plants in their local areas. The main points that need to be communicated for establishing such plants are:

- People are generally open to the idea of having small-scale green ammonia production plants in their local areas, but this willingness is tied to the factors exposed hereafter:
- People may express general positive feelings after receiving clear and detailed information about the concept of decentralised green ammonia production and the potential benefits are clearly presented to them.
- People need reassurance before fully supporting such projects: safety is one of the strongest conditions for acceptance of local green ammonia production plants - the need for guarantees on operational safety, transparency in communication, and demonstrations of how risks, particularly the toxic character of ammonia as a chemical are managed is repeatedly emphasized. Without this trust, concerns about accidents, environmental risks, or health effects become significant barriers.
- Another key factor is economic benefit. People are more likely to support projects if there is proof of lower energy costs, possible job creation, and visible local development. People want clear and accessible data, feasibility studies, and real-world examples that demonstrate competitiveness and added value for their communities.
- Reduction of CO_2 emissions is important for the citizens as it is ensuring that the projects genuinely contribute to decarbonisation.
- From an aesthetic point of view, integration of the plants into the natural environment also plays a role. Respondents prefer plants that integrate into the landscape through green design.
- Trust in who owns and operates the green ammonia production plant is crucial. Greater trust in public-private partnerships and private companies with local benefits is shown, while local communities are also seen as credible operators by some people. However, this can vary depending on the economic, political, and social context of each country.
- Participation in decision-making process is low, with many respondents expressing little interest in being actively involved. This may reflect a lack of confidence in their own expertise or a sense of detachment from technical issues. However, with the right

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training and awareness-building initiatives, people could become more willing to engage in shaping these projects.

In summary, people are willing to accept green ammonia production plants, but only under specific conditions. Safety must be convincingly demonstrated, economic benefits need to be clearly proven, and trusted stakeholders must take responsibility for the projects. Building trust, ensuring transparency, and involving communities in the benefits are the main drivers that can make such initiatives acceptable and supported at the local level.

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5. CONCLUSIONS

A successful impact positioning of DARE2X technology, which is suitable for small-scale decentralised green ammonia production using renewable energy, depends on several key factors.

In this deliverable we first introduced the work that was done in order to collect the necessary information regarding all the key issues to take into consideration for ensuring public support of green ammonia and its decentralised production.

Responsible Research and Innovation work with the DARE2X members allowed us to extract which priority concerns exist and what the DARE2X project needs to do about them to align its technology with these concerns and extract communication messages.

For R&I projects on green ammonia, the message is to align their research practice, objectives and outcomes to societal needs, by understanding who their stakeholders are, what are their needs and concerns and what would make them engage with the projects. In the particular case of small-scale decentralised green ammonia production, the stakeholder number one is local communities. Our stakeholder analysis showed that this is not a homogeneous group and we need to cater to the various interests and needs.

A rapid literature review allowed us to understand what are the key issues that hinder green ammonia acceptance, either in local communities or as a fuel in maritime shipping and as fertiliser in agriculture. For researchers, policy makers and industry, the message is to collaborate closely to address all what is keeping decentralised green ammonia production form rolling-out, despite its huge potential for decarbonising large sections of the industry. Government support is needed, both at national and local levels.

An in-depth stakeholder analysis allowed us to identify who are the main stakeholders who can affect or be affected by technologies such as DARE2X and analyse their interests and motivations.

Finally, a survey on the social feasibility of decentralised green ammonia production allowed us to understand what benefits people generally expect from the installation of local green ammonia plants, what would convince them of their safety, the economic benefits they can bring and how can they be aesthetically acceptable. It also informed us on who, in people's opinion, should own and run a local green ammonia plant and why, and how people want to be involved in the decision-making process.

Little is known about green ammonia and its benefits, and this is true across all levels of education. The message is people are generally open to the idea of having small-scale green ammonia production plants in their localities, but this willingness is tied to the demonstration of the safety of the plants, the economic and social benefits they can bring, trust in who owns and operates the plant and, to a lesser degree the aesthetics of the local plant.

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7. ANNEXES

7.1 ANNEX 1: Survey schedule

Hereby, the survey as shared to the participants is presented:

New technologies are being developed to produce **green ammonia**, which is ammonia that does not emit CO2, because it uses renewable electricity coming from solar or wind farms.

We are conducting this online survey to understand public perception of installing small-scale plants to produce green ammonia locally. You do not need to have any specific knowledge to complete it. You need to have 18 years old +

This survey is entirely anonymous and takes up to 15 minutes to complete it.

If you consent to participate in this survey, please proceed by pressing the 'continue' button.

SECTION 1: About You

These questions help us understand the background of the people participating in this survey.

1. **What is your gender?** ***(select only one answer)***
    - Male
    - Female
    - Non-binary / Other
    - Prefer not to say
2. **What is your age?** ***(select only one answer)***
    - 18–24
    - 25–34
    - 35–44
    - 45–54
    - 55–64
    - 65+
3. **What is your highest level of education?** ***(select only one answer)***
    - Less than Secondary
    - Secondary
    - Vocational/Professional training
    - University degree

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- Postgraduate degree
- Other

4. **In which country do you currently live?** ***(Dropdown menu: All EU member states)***
5. **In which region do you currently live? Please write the name of your region:** ***(Open-ended)***
6. **In which of the following areas do you currently live?** ***(select only one answer):***
   - Urban
   - Suburban
   - Rural
   - Near a port
   - In an agricultural area
   - Other -> specify ***(open-ended)***
7. **Are you currently employed in one of the following sectors?** ***(select only one answer):***
   - Agriculture
   - Low or Zero Carbon Fertilizers
   - Chemicals
   - Port & Maritime shipping
   - Renewable Energy
   - Energy - Low or Zero Carbon Fuels (hydrogen/ammonia)
   - Energy
   - None
8. **What level of income do you consider you have?** ***(select only one answer)***
   - Low income
   - Middle income
   - High income

SECTION 2: Energy and the Environment

9. **How important for you is reducing CO2 emissions?** ***(select only one answer)***
   - Not at all important
   - Not very important
   - Important
   - Very important

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- Extremely important
- Don't know

10. Are there any wind or solar energy farms in your local area? ***(select only one answer)***

- Yes
- No

10.1. How do you feel about having wind or solar farms in your local area? ***(select only one answer)***

- Very positive
- Somewhat positive
- Neutral. Neither positive, nor negative
- Somewhat negative
- Very negative

10.2. What is the main reason for your feeling about having wind or solar farms in your local area? ***(Open – ended)***

11. Would you support the expansion of wind and/or solar farms in your region? ***(Select only one answer)***

- Yes
- No
- Not sure

SECTION 3: Your knowledge of green ammonia and its decentralised production.

12. Have you heard of green ammonia before?

- Yes
- No

13. (If you answered yes) How confident are you in your understanding of green ammonia? ***(Select only one answer)***

- Not at all confident
- Slightly confident
- Moderately confident
- Very confident
- Extremely confident

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14. **Have you heard of the concept of <u>decentralized green ammonia production</u>? *(Select only one answer)***
    - Not at all familiar
    - Somewhat familiar
    - Moderately Familiar
    - Very familiar
    - Extremely familiar

15. **(If you answered yes) How confident are you in your understanding of <u>decentralised green ammonia production</u>? *(Select only one answer)***
    - Not at all confident
    - Slightly confident
    - Moderately confident
    - Very confident
    - Extremely confident

SECTION 4: About green ammonia production in your local area

Please read carefully the following information about decentralised green ammonia production: (Presented in Figure 3).

16. **After reading this information, how do you feel about having a small-scale (container size) green ammonia production plant in your local area? *(Select only one answer)***
    - Very positive
    - Somewhat positive
    - Neutral. Neither positive, nor negative
    - Somewhat negative
    - Very negative

17. **What is the main reason for your feeling about having a green ammonia production plant in your local area? *(Open – ended)***

18. **What benefits would you expect from the establishment of a green ammonia production plant in your local area? (*Select all that apply*)**
    - Job creation

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- Increased local business opportunities
- Improvements/development of local infrastructure and services
- Local energy independence
- Lower carbon emissions
- Local revenue or tax contribution
- Training and skills development
- Other (please specify) ***(Open – ended)***

19. **If a green ammonia production plant is established in your local area, what is the major concern you would have?** ***(Open – ended)***

20. **If the safety of the local ammonia production plant were demonstrated to you, would it help you support it?**
    - Yes
    - No
    - Not sure

21. **What would convince you of the safety of the local ammonia production plant?** ***(Open – ended)***

22. **If the economic benefits of the local ammonia production plant were demonstrated to you, would it help you support it?**
    - Yes
    - No
    - Not sure

23. **What would convince you of the economic benefits of the local production plant?** ***(open-ended)***

24. **If it were demonstrated to you that the local plant would be aesthetically acceptable, would it help you support it?** ***(select only one answer)***
    - Yes

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- No
- Not sure

25. **What is an aesthetically acceptable local production plant for you?** ***(open-ended)***

26. **Who would you trust to own and operate such a green ammonia production plant in your local area?** ***(select only one answer)***
    - Local community
    - Municipal government
    - National government
    - Private company but with local benefits
    - Public-private partnership
    - No preference
    - Other

27. **What is the main reason for your choice above?** ***(Open – ended)***

28. **What would you want to know most to support the implementation of a green ammonia production plant in your area? And how would you prefer to be informed?** ***(Open-ended)***

29. **If a green ammonia production plant were going to be implemented in your area, how would you like to be involved in the decision-making process?** ***(Open-ended)***

30. **In general, what would make you more comfortable with having a green ammonia plant in your local area?** ***(Open-ended)***

31. **Do you have any other thoughts or comments about the establishment of a green ammonia production plant in your local area?** ***(Open-ended)***

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7.2 ANNEX 2: Demographic and Socioeconomic Profile of Survey Respondents

Table 8. Demographic information about the participants of the survey.

VARIABLE	RESPONSE	PERCENTAGE
Gender	Male	44%
	Female	54%
	Prefer not to say	23%
Age	18–24	5%
	25–34	35%
	35–44	21%
	45–54	20%
	55–64	17%
	65+	2%
Level of education	Less than Secondary	1%
	Secondary	1%
	Vocational/Professional training	8%
	University degree	31%
	Postgraduate degree	58%
	Other	1%
Level of income	Low income	13%
	Middle income	79%
	High income	8%
Sector of employment	Agriculture	2%
	Low or Zero Carbon Fertilisers	0%
	Chemicals	19%
	Port & Maritime shipping	10%
	Renewable Energy	9%
	Energy - Low or Zero Carbon Fuels (hydrogen/ammonia)	11%
	Energy	1%
	None	48%
Type of living area	Urban	76%
	Suburban	10%
	Rural	7%
	Near a port	4%
	In an agricultural area	1%
	Other	2%

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