



WASTE2H₂

WASTE TO HYDROGEN

Exploitation Strategy

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Abstract

This deliverable provides WASTE2H2's Exploitation Plan. Exploitation activities seek to generate results that are a direct consequence of the knowledge generated from the project's activities. This is of utmost importance for the consortium members, particularly for IPPortalegre, who is benefitting from the large experience on waste to hydrogen by the twinning institutions (KTH, KIT and ENEA). Exploitation can also mean that new technologies and services can be introduced and developed by the partners in order to achieve tangible exploitation pathways after the project's end. This project refers mostly to gains regarding knowledge that is being shared between the partners, with a clear benefit for students, ESRs, researchers and professor. This document not only addresses the current exploitable results obtained within WASTE2H2, but it also highlights what is to come after the project's end and how the partners will benefit from it.

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1. Introduction

Communication, dissemination, and exploitation are three key concepts for H2020 projects. Exploitation is about making concrete use of research results during and beyond the project’s duration and as such, this deliverable “D5.1 – Exploitation Plan” was developed as a work-in-progress document that weighed and stipulated the gradual development and exploitation of WASTE2H2’s results from the beginning to the conclusion of the project. The document had a preliminary approach in the project’s proposal, that was complemented with revised and new results as the project progressed up to M23 (November 2022).

This document contains a summary of the tangible and intangible exploitable results developed by the project partners and a straightforward strategy for their exploitation post – WASTE2H2. The presented target audiences were sourced from the project’s proposal, whereas the proposed exploitable results were gathered from the project’s activities (mainly dissemination and communication). This document is a public report and will be disseminated through WASTE2H2 media channels and social media platforms.

1.1. WASTE2H2’s preliminary Plan for Exploitation and Dissemination of Results (PEDR)

Waste2H2 project aims to outreach its results by boosting the competitiveness and growth of the European Union economy. A draft Plan for the Exploitation and Dissemination of Results (PEDR) was provided in the project’s proposal (Table 1) to reflect the exploitation and dissemination activities that are being undertaken during WASTE2H2’s implementation:

Table 1: WASTE2H2’s preliminary plan for exploitation and dissemination of results.

Number	Results	Exploitation measures	Dissemination measures	Potential users and uses	Timeline	Target audience
1	International conference proceedings	Research activities	Conferences and workshops	Research, commercial	During the project	Primary users
2	Summer schools Dissemination material	Skills acquired and educational training	Conferences and workshops	Education and training	During the project	Primary users
3	Workshops, dissemination materials	Skills acquired and educational training	Conferences and workshops	Education and training	During the project	Primary users
4	Scientific publications	Research activities and commercial exploitation activities	Journals	Research, commercial, investment and societal	During and after the project	Primary and Secondary users
5	Targeted communication material to promote the value and impact of Waste2H2 activities outputs	Research activities and commercial exploitation activities	Waste2H2 website and social media	Research, commercial, investment and societal	During and after the project	Primary and Secondary users
6	Consolidated strategic research approach	Research activities, and policy making	Waste2H2 website, social media and direct contacts of the consortium	Research and policy making	During the project	Primary and Secondary users

The main objectives of Waste2H2 project are:

- Guarantee that all the actions in WASTE2H2 project are widely known in the targeted communities.
- Share the knowledge and communicate with end-users' groups and audiences with similar interests.
- Exploit different funding possibilities and identify collaborations and consortium-building opportunities.
- Put WASTE2H2 in the context of what is happening in terms of R&I globally.
- Shape a network of “followers” and interested third parties for future communication and collaboration.
- Influence a much wider and pertinent online audience than before.
- Pursue market opportunities arising from the project's results.

Taking these objectives into consideration, a strategy for protection, exploitation and dissemination of results is being ensured by the committed involvement of all partners, not only during project implementation but also during the proposal drafting stage. This commitment was outlined first by all partners by a Letter of Commitment, where the effort for protection, exploitation and dissemination of results is properly envisaged.

1.2. Relation to the other WASTE2H2 work packages (WPs)

This exploitation plan uses the results from most of the WPs in various forms. Although not each WP directly implemented exploitation actions or activities during the project, each WP is producing outputs that are internally exploited for the development and implementation of other outputs and actions. Considering that in Coordination and Support Actions (CSA), the approach to innovation should be tailored to the specific technical, market and organisational issues to be addressed in relation to the project objectives, it can be considered that each WASTE2H2 supports the implementation of exploitation actions in WP5 “Sustainability Beyond WASTE2H2 and Exploitation”. The various outputs of each WP are:

- Knowledge-based deliverables (e.g., D1.1 Current Research Status Report, D1.2 Joint Strategic Research and Technology Innovation Planning, D4.1 Factsheets on IP management, D5.2 Sustainability Roadmap, D5.3 White paper on ‘Waste to Hydrogen’).
- Methods and tools as concrete and tangible outcomes that can be applied in hands-on exercises (e.g., D4.2 Stakeholders database, D4.3 Report on collaboration agreements with industry).
- Activities that were implemented to gather and share relevant information from IPPortalegre staff and stakeholders (e.g., D3.1 ESRs activities report (including Short Term Staff Exchanges, Immersive Summer Schools, and Research Management & Career Development Training), D2.1 Report on Thematic Workshops, D2.2 – Report on Exploratory Visits).

2. Target audiences

The dissemination and exploitation of WASTE2H2 actions and results are addressed to the following target communities:

Primary target audiences – the direct beneficiaries: Will benefit from the knowledge and results created and disseminated within the project due to their own work. These primary targets include both individuals, namely IPPortalegre staff and ESRs, but also small and medium sized organizations from the engineering and science sectors. There are additional target groups, that can also benefit from WASTE2H2's activities for their own work, as follows:

- End-users: The consortium will value the right for individual end-users to participate in and have access to the results, through consultation, active deliberation, and participation.
- International hydrogen and biomass technologies scientific community.
- Educational community.
- Industrial community: This is the segment that may use the results of the project to improve their market offer and better serve demand. As such, this sector can clearly and directly benefit from the results of the project.
- Research & Innovation sector: WASTE2H2 intends to maximize opportunities for ESRs and Senior Researchers.

Secondary target audiences – the dissemination partners: Secondary target audiences are all intermediaries who can help in the promotion and dissemination of the results to the direct beneficiaries listed above and to final users. Their interest in the results of the project is based research results and innovation in general and in the hydrogen and biomass sectors. With that end, WASTE2H2 provides them with information and “content” which they can use in the services they provide to clients:

- Knowledge transfer agencies and regional innovation networks.
- Researchers from universities and institutes, as well as private research organizations, non-profit research organizations and research branches of associations. For them, the project is not only a source of information, but also a platform to interact with and to promote their own research.
- Industry associations and federations, their representatives who deal with equipment and manufacturing (framework conditions, technological developments, standards).

Exploitation will be addressed based on the results of the joint research activities to improve mobility within the consortium's infrastructure services, enhanced information access provision, and sharing of the common standards, protocols etc. resulting from networking activities. Specific measures for building on the preliminary PDER will allow effective transfer knowledge and innovation management of WASTE2H2 results.

3. Exploitation plan

3.1. Overview of WASTE2H2's exploitation plan and exploitable results

WASTE2H2 has a duration of 36 months, and this deliverable is due on M23, which means that there are significant exploitable results to be detailed so far.

This section provides a detailed overview of the main project results that are expected to be exploitable and have been identified as of interest for the target groups and possible beneficiaries of WASTE2H2's results. Figure 1 summarizes WASTE2H2's exploitable results:

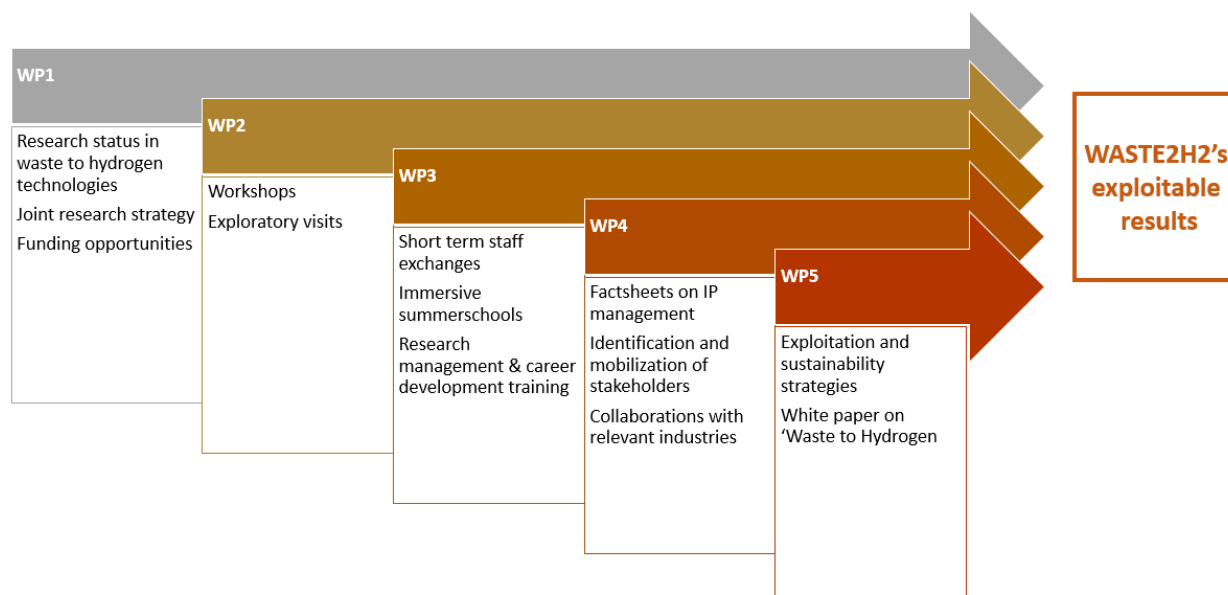


Figure 1: WASTE2H2's major exploitable results.

WASTE2H2 consortium partners are exploiting the project's results in ways that are helping expand their knowledge-base and enabling them, particularly IPPortalegre, to get to the forefront of waste to hydrogen research using thermal and electrochemical processes. Partner's exploitation can be described as follows:

- Enhancing the teaching scope and quality by introducing new research approaches and technologies into the institutions or the participants curricula. Therefore, WASTE2H2 participants, mainly IPPortalegre's staff will apply their newfound knowledge and experience into their classes and projects.
- Offering professional training on the studied waste to hydrogen solutions, including research management and career development training focused on ESRs to further their research skills.
- Present project results to end-users, industry partners, students, university staff and the overall research community by means of the above-mentioned workshops and summerschools.
- WASTE2H2 events also increased awareness and adoption of the project's findings and results not only on an educational level, but also engaging society into waste to hydrogen technologies.
- Identifying future joint research opportunities between the project's partners, based on project results and lessons learned.
- And, particularly for IPPortalegre, improved positioning for future and enhanced opportunities for cooperation with the industrial sector.

3.2. Target audiences' feedback

To better assess WASTE2H2's impact on the target audiences, the participants from the project's events answered a brief questionnaire on their experience within WASTE2H2. The questionnaire consisted of three quick answer questions (see Figures 2, 3 and 4), and two questions that required their opinions.

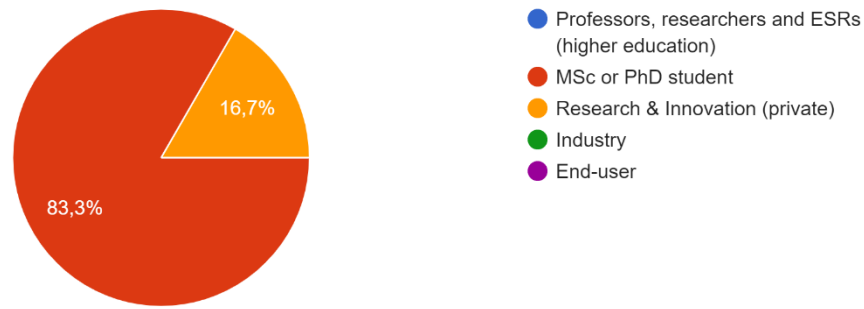


Figure 2: Question 1 - "To which WASTE2H2 target audience do you belong?"

As seen in Figure 2, most of the people that attended WASTE2H2 activities so far were MSc and PhD students. This result is aligned with some of the project's main goals, which correspond to training and further the target audience's knowledge on the core subjects of the project. There is also a small percentage of attendance from R&I private institutions which is meaningful regarding dissemination of the project.

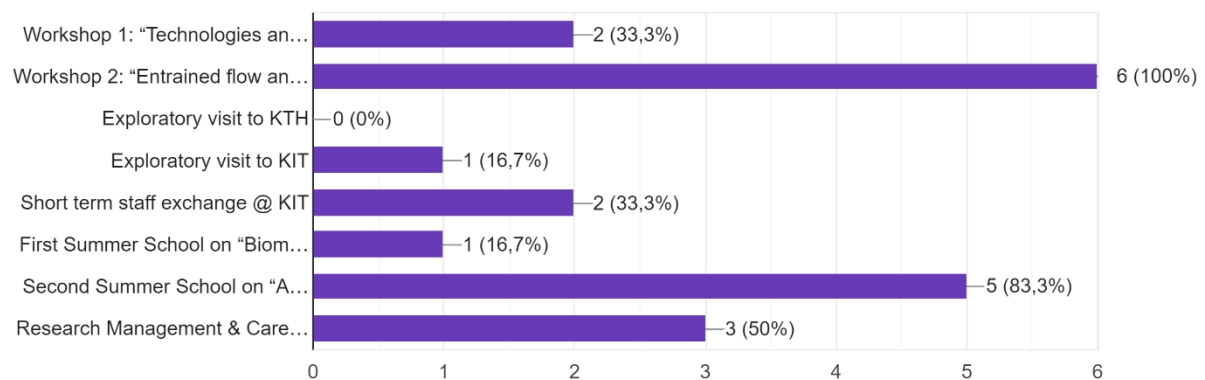


Figure 3: Question 2 - "Which WASTE2H2 events did you attend?"

Figure 3 shows that the 2nd workshop held at KIT, was the event with higher attendance rate. This workshop detailed technical issues regarding entrained flow and fluidized bed gasification and had several presentations by the academia and industry related with the topic. The 2nd summerschool also held at KIT presented 83.3% of attendance. These results show that this project's target audiences, besides the overall interest in hydrogen production using wastes, have a particular interest in gasification technologies.

So far, there were two STSE, with two researchers from IPP going to KIT. This corroborates the interest in innovative gasification technologies and syngas applications not only for hydrogen production but for chemical synthesis (which is a very strong research area in KIT).

The research management and career development training showed 50% of attendance from everyone who answered the questionnaire. The attendance of this activity was mainly from IPPortalegre staff, and it was a success from the audience's engagement point of view.

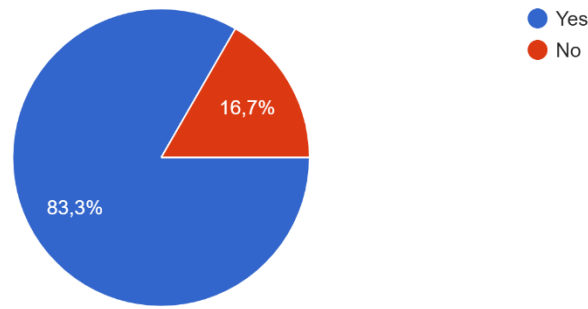


Figure 4: Question 3 – “Would you attend Workshop 3 “Overview of waste-to-gas cutting-edge technologies”, to be held at IPPortalegre (February 2023)?”

Given the previous WASTE2H2 activities, target audiences were asked if they would participate in the project’s last workshop (Figure 4). The answers were overwhelmingly positive (83.3%), which is a very strong indicator of the interest that this project is gathering in MSc and PhD students, mostly.

The questionnaire had two last questions that required developed answers:

- Question 4 – “How will you use your newly acquired knowledge and skills to improve R&I on waste gasification for hydrogen production at IPPortalegre or your place of work?”
- Question 5 – “As an ESR, has WASTE2H2 been useful to your work? If yes, how?”

Summarizing the answers to Question 4, most people answered as follows:

1. Use the acquired management techniques to apply in their current workplace.
2. Use the newly acquired knowledge on syngas analysis to further their work/thesis.
3. Prepare and develop collaborative projects aiming to use gasification technologies for waste conversion.
4. Apply the gained knowledge on gasification campaign organization as performed at KIT to the research infrastructure at IPPortalegre.
5. Use KTH and KIT knowledge on gasification and their reactors to modify current IPPortalegre’s equipment.
6. Start engaging stakeholders and extend IPPortalegre abilities for service provision.
7. Use the more technical knowledge for better analytical results, better performance in the gasification tests and cleaning of the syngas according to its subsequent uses (SOFC and Fischer-Tropsch).

As seen from the above answers, WASTE2H2 activities proved to have stirred the willingness of IPPortalegre’s researchers and students to implement novel ways of working and apply their recently gained knowledge directly into their workplace.

Regarding Question 5, ESRs that attended WASTE2H2 answered that, overall, the workshops and summerschools have helped them consider different utilizations to valorize the feedstocks from their current experiments. Moreover, the ESRs also pointed out that these activities helped them learn new analytical methods, new methods of operating gasifiers, knowing new reactors and their possible operational complications.

3.3. Exploitation by the end of WASTE2H2

In WASTE2H2, it is considered that all the partners are committed to the exploitation of the project results beyond its closing date to ensure the sustainability of the results. The overall goals of further activities are:

- To guarantee the overall continuity and sustainability of the exploitable results by ensuring target audiences receive and understand the concepts and application of the results.
- To promote the dissemination of new results that are completed after the project duration to guarantee their outreach is as wide and strong as of the exploitable results that are already completed.
- To continue collaboration with partners and other initiatives that already existed or started during the project in order to increase the educational and research impact of WASTE2H2.
- To serve as basis for the development of working networks for ESRs on waste-to-hydrogen technologies.

Overall, there are three major future exploitation lines that this project aims to develop: training, new research lines and entrepreneurship.

3.3.1. Training

Some of WASTE2H2 results can be used to develop education and training programs for professionals and/or the general public. Considering the know-how from the involved partners, they can provide skills and knowledge, and bring about societal transformation, via waste valorization for hydrogen production. For example, projects dealing with syngas cleaning can develop training for students, researchers, or company owners (overall interested parties) on identifying and troubleshooting issues with cleaning systems, catalysis, syngas quality and syngas final applications. IPPortalegre has already started to apply acquired knowledge into training courses, namely in introductory courses on hydrogen technologies, mostly given to the Portuguese industry sector with high interest in the energy transition.

3.3.2. New research lines

For IPPortalegre this will be one of the major future exploitation pathways. The twinning with KTH, KIT and ENEA has given the institution tools to start building on its current research and divert to complementary research lines. For a small interior institution this is of high relevance since new research lines can address specific research problems within the settings of specific context, location and/or culture. Accordingly, IPPortalegre is working on proposing future studies that can fit its current gasification studies by defining concrete cleaning systems for the produced syngas (produced with local waste streams) and by applying the syngas for the benefit of the community.

Moreover, scientific outputs or more commercial ideas, such as models, methods, prototypes, and any data produced or knowledge gained during WASTE2H2, can be utilized by the scientific community for future research.

3.3.3. Entrepreneurship

Future application of WASTE2H2 results can also be directed to “Exploration”. Exploration corresponds to a type of innovation that will require IPPortalegre to leave its comfort zone and examine new markets, products, and business models unfamiliar to them (since it is an educational institution). All outputs from this project, particularly the generation of knowledge and new ideas, can be channeled to create, expand, or influence waste valorization pathways towards hydrogen

production. New technologies or methods that are conceived or developed as part of the project can serve as the first step towards creating a new start-up and entering the market. IPPortalegre can foster creativity by given space to ideas within the project's topic and help young entrepreneurs to navigate the technical and bureaucratic issues of developing and implementing their business ideas. KTH has give significant inputs on how to overcome the barriers of implementing new business ideas, and what kind of support IPPortalegre can give to boost the creation of new companies rising from the knowledge gained in WASTE2H₂. IPPortalegre will implement the suggestions by KTH (D4.1) to have this "entrepreneurial hub" and assist its staff on advancing with their projects from a commercial point of view.

3.3.4. Scientific and Technological Strategies on Gasification and Hydrogen Technologies

In terms of scientific approaches gathered during WASTE2H₂, IPPortalegre will apply this newfound knowledge, and:

- Development of waste gasification technologies to increase the hydrogen content, specifically gasification with oxygen and water vapor.
- Development of catalytic materials for fluidized bed gasifiers to increase the conversion of polycyclic compounds.
- Development of waste valorization processes by small-scale thermal gasification that enable the production of energy and hydrogen-rich fuels for self-consumption, both in terms of electricity, heat, and fuels for internal combustion engines.
- Development of applications of hydrogen-rich syngas in cogeneration systems, e.g., high temperature fuel cells, and dual fuel internal combustion engines.
- Development of hydrogen separation processes by carbonaceous membrane systems.