



WASTE2H₂

WASTE TO HYDROGEN

Funding Opportunities Roadmap – Final report

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Abstract

This report describes the strategic plans to elevate future R&D activities within the area of waste-to-hydrogen processes within IPP, and the WASTE2H₂ partner organisations. The work to prepare the report was carried out within the Task 1.3 Funding Opportunities Roadmap in WP1 of the WASTE2H₂ project. The identification of opportunities for R&D fundings was achieved by internal projects meetings, through dialogues and dissemination of information to identify potential cooperation opportunities, development of joint research funding projects at European level, and a thorough analysis of potential sources. KTH, KIT and ENEA have been focusing on identifying and developing joint projects while IPPortalegre has been focusing on finding diversified sources of funding for their Institution as well as possible private funding contracts at Regional, National and Transnational levels. Europe programme, almost certainly, will be the major source for joint projects in the future. Other possibilities are the CETP, Prima or the Interreg programmes. The efforts within the WASTE2H₂ project have successful resulting in a fruitful partnership between the participating organisations. New novel projects ideas have been applied for within the Horizon Europe programme. It is also clear that the partnership is an excellent platform for a further development of R&D capacities to enable the development of novel waste-to-hydrogen technologies. A brief strategy and plan for future collaboration among the WASTE2H₂ partners is presented.

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1. Introduction

Hydrogen is a fuel with immense potential of satisfying the need of an environmentally benign energy source. Waste-derived hydrogen is a promising pathway to divert waste streams away from landfills, other costly treatment, and provide means for a circular economy approach. Significant progress has been made towards a development of waste-to-hydrogen technologies, but several improvements are still needed to enhance process yields and productivities, reducing production costs, and to promote a hydrogen-based society.

This report describes the strategic plans to elevate future R&D activities within the area of waste-to-hydrogen processes within IPP, and the WASTE2H₂ partner organisations. The work to prepare the report was carried out within the Task 1.3 Funding Opportunities Roadmap in WP1 of the WASTE2H₂ project.

2. Opportunities for R&D fundings

The identification of opportunities for R&D fundings was achieved by internal projects meetings in the consortium, through dialogues and dissemination of information to identify potential cooperation opportunities, development of joint research funding projects at European level, and a thorough analysis of potential sources. KTH, KIT and ENEA have been focusing on identifying and developing joint projects (a series of possible collaborations) while IPPortalegre has been focusing on finding diversified sources of funding for their Institution as well as possible private funding contracts (mid- and long-term frameworks) at Regional, National and Transnational levels.

An example of a result of these efforts are the application “CONFLUENCE: CarbOn Neutral liquid Fuel prodUction via innovativE biomass gasificatiON coupled with molten Carbonate Electrolysis”, submitted to the call HORIZON-CL5-2021-D3-03-02 Next generation of renewable energy technologies in February 2022. Unfortunately, the application was not approved, but a new attempt is planned for in January 2024.

2.1. Funding opportunities within Portugal

Portugal 2030 (PT2030) represents a Partnership Agreement between Portugal and the European Commission, outlining strategic objectives for the period of 2021 to 2027, with a total funding of 23 billion euros [1]. The funds are allocated from various sources, including the European Regional Development Fund, European Social Fund, Cohesion Fund, Just Transition Fund, and the European Maritime, Fisheries, and Aquaculture Fund. An additional amount is designated for the Connecting Europe Facility.

Aligned with the European Union's five strategic goals—smarter, greener, more connected, more social, and closer to citizens - PT2030 follows the Portugal 2030 Strategy, structured around four central thematic agendas. These agendas cover the economy, society, and territory development in Portugal by 2030.

The implementation of PT2030 involves twelve programs, addressing themes such as demography, innovation, climate action, and sustainability. These programs span regional and autonomous divisions, as well as technical assistance. The initiative emphasizes principles such as simplification, transparency, partnership, effectiveness, efficiency, and results-orientation.

The PT2030 Partnership Agreement was approved on July 12, 2022, and formally signed on July 14, with all programs receiving approval by December 15, 2022. The initiative aims to mobilize resources in a coordinated and coherent manner to achieve its outlined objectives.

In the context of this project and considering IPPortalegre’s position in the current Portuguese R&I landscape, there are several calls of interest within PT2030 that could help IPPortalegre: a) to build on and improve its current infrastructure; b) engage with funded projects directly with companies; c) enhance knowledge transfer academia to industry. Those call are described in Table 1.

Table 1 Identified national calls within PT2030.

ID	CALL	Program	Funding	Opening date	Available funds (€)
17	Circular economy - Business R&D for circularity, Productive investment for circularity and R&D&I for circularity (SI)	ALT2030	ERDF	Q2 - 2024	2 M
19	Scientific Infrastructures included in the National Roadmap of Research Infrastructures of Strategic Interest	ALT2030	ERDF	Q2 - 2024	1 M
449	Infrastructure and technological equipment	ALT2030	ERDF	Q2 -2024	5 M
18	Scientific research and technological development – RDT projects	ALT2030	ERDF	Q2 - 2024	3 M
331	SIID - Business R&D&I (co-promotion)	MULTI PR	ERDF	Q2 - 2024	106 M
24	Collective Actions - Transfer of scientific and technological knowledge	ALT2030	ERDF	Q3 - 2024	2 M

ERDF: European Regional Development Fund

2.2. Calls within Europe

The main identified potential European sources of funding are as follows:

Clean Energy Transition Partnership (CETP): CETP is a multilateral and strategic partnership of national and regional research, development, and innovation (RDI) funding programmes in EU Member States and Associated Countries, co-funded by the European Commission through Horizon Europe (HE) [2]. The programme runs from 2022 to 2027 with the aim to enable a clean energy transition and to contribute to EU’s goal of becoming the first climate-neutral continent by 2050. This will be performed by pooling national and regional RDTI (Research and Development Tax Incentive) funding to support RDI of a broad variety of technologies and system solutions required to make the transition. The CETP includes seven Transition Initiatives (TRIs) for distinct technologies to integrated systems, and several cross-cutting dimensions. The focus is among other technologies for energy conversion and storage, technologies enabling a larger flexibility towards demand, and offering carbon treatment and sinks - all considered as zero emission technologies for the energy system. Detailed description of the seven TRIs can be found in the Strategic Research and Innovation Agenda (SRIA) [3]. The programme is open for project applications once a year.

Interregional cooperation programme (Interreg): Interreg Europe is an interregional cooperation programme, co-funded by the European Union. The programme runs from 2021

to 2027 supporting projects aimed at exchange of good practices and policy learning to reduce disparities in the levels of development, growth, and quality of life in and across Europe's regions in EU27, Norway, and Switzerland. The programme is financed by the Cohesion policy's European Regional Development Fund (ERDF). The programme is open for project applications once a year. [4]

Partnership for Research and Innovation in the Mediterranean Area (PRIMA): PRIMA is partnership research programme with partners from from countries mainly around the Mediterranean Sea. The aim is to perform R&D addressing common challenges related to climate change, population growth and food security, water scarcity and overexploitation of natural resources, sustainable agriculture, and reinforcing Mediterranean lifestyle. The programme is continuous and is open for project applications once a year. [5]

Horizon Europe: The programme is the EU's key funding programme for research and innovation with a budget of €95.5 billion during 2021 – 2027 [6]. The aim of the programme is to tackle climate change, support efforts to achieve UN's Sustainable Development Goals, and enhance EU's competitiveness and growth, by promoting collaboration and strengthening the impact of R&I. The programme is based on the three pillars: Excellent Science, Global Challenge, and Innovative Europe. There are a large number of potential approaches to funding within the Horizon Europe programme depending on areas of interest or level of R&D maturity. Furthermore, the calls are only announced two years at a time, and therefore only some examples of potential calls from the programme Horizon Europe - Work Programme 2023-2024 Climate, Energy and Mobility are listed in Table 2. However,

Table 2 Examples of calls within the Horizon Europe Work Programme 2023-2024. [6]

Topic ID	Topic	Deadline
HORIZON-CL5-2024-D3-01-10	Next generation of renewable energy technologies	16 January 2024
HORIZON-CL5-2024-D3-01-03	Demonstration of improved intermediate renewable energy carrier technologies for transport fuels	16 January 2024
HORIZON-CL5-2024-D3-02-03	Development of smart concepts of integrated energy driven bio-refineries for co-production of advanced biofuels, bio-chemicals and biomaterials	21 January 2025

In summary, there are many funding opportunities where Horizon Europe programme, almost certainly, will be the major source for joint projects in the future. Other possibilities are the CETP programme, but in case of KIT, the state Baden-Württemberg, Germany, is not represented. Therefore, this option is not optimal for all partners but can be considered as a potential source for additional support for the other partners. Other possibilities are the Interreg programme and the local PRIMA partnership programme with similar limitations as CETP but for KTH.

3. Strategies for developing collaboration

In the subsequent subsections 3.1 to 3.4, each partners strategy for R&D within waste-hydrogen is presented.

3.1. IPP

IPPortalegre (IPP) strategically focuses on addressing critical issues in waste management, specifically targeting the untapped potential of the "leftover fraction" in landfills and the conversion of wastewater treatment plant (WWTP) sludge through innovative gasification processes. By prioritizing these overlooked waste streams, IPPortalegre aims to harness their potential for hydrogen production using lessons learned from the WASTE2H₂ project.

Furthermore, IPPortalegre is committed to reducing landfilling by actively participating in Portugal 2030 initiatives. The emphasis on infrastructure development, direct engagement with companies, and fostering academia-to-industry knowledge transfer aligns with identified national calls, providing a pathway to enhance IPPortalegre's capabilities. The strategy also responds to the growing awareness of the importance of waste recovery to meet energy needs for self-consumption, positioning IPPortalegre at the forefront of sustainable waste-to-hydrogen technologies and supporting the transition towards a hydrogen-based society.

3.2. KTH

In Sweden, major investments are currently being made in the field of thermochemical conversion of biogenic waste. Examples are Meva Energy AB's forthcoming commissioning of its gasifier technology at the Sofidel paper mill in Kisa, Sweden, and their planned gasification plant for gasifying furniture waste at IKEA in Poland. Other examples are Cortus Energy AB's gasification plant in Höganäs, and the investment planned by Uniper and Sasol ecoFT for a large-scale production of bio-electrofuel in Sollefteå. To meet the needs for R&D and competence development to support the new and forthcoming industrial development, KTH, as the coordinator, jointly with partner academia and R&D institutes and industry is working on establishing a new R&D programme to conduct development-oriented projects and skills development with a concrete industrial connection. The new five-year programme will be based on the previous very successful research collaboration between industries, institutes, and academies within The Swedish Gasification Center (SFC) 2011-2021. The focus is thermochemical processes for conversion of biogenic waste to useful energy carriers, including hydrogen. Important for the programme is collaborating activities and networking with European partners and partners from associated countries. Also, EU projects will be connected to the R&D programme.

3.3. KIT

At present, Germany focuses very much on hydrogen production, but mainly on electrolysis. Here large projects, like H2Mare, where the conversion of offshore wind is investigated, are done. In the area of waste, the strategy is first priority avoiding, second priority recycling and finally conversion to energy. There is much R&D going on in recycling, where chemical recycling is the most interesting topic for KIT. With the former bioliq® plant all the equipment in pilot scale for chemical recycling is available at KIT. Main focus is now closing the carbon loop for waste, especially plastic waste, which is investigated in the new carbon cycle lab at KIT. Funding for all these topics is either by national funding, or by EC funding, where KIT is interested to continue in already existing projects and participating in new consortiums.

3.4. ENEA

In Italy hydrogen and hydrogen related technologies are experiencing a great increase of interest, due to the large amount of public funds coming from institutions. Particularly the recovery and resilience plan (PNRR 2021 - 2026) will finance 3.4 bn€ of investments, covering the entire value chain of hydrogen, from the production to the storage, transportation and final uses. In this framework ENEA will lead the activities on R&D, coordinating the Italian research operative plan on hydrogen. Within this plan several activities on the production of hydrogen from biological residues and the production of renewable fuels will be carried out, aiming to improve the efficiencies of consolidated technologies and explore new concepts and pathways to bridge the gap between research and industrial deployment. Within the scope of the hydrogen operative plan there is the will to increase the international collaborations on the topics of interest promoting the networking among European research institutions sharing results and best practices. Together with the PNRR Italy has been awarded with almost 2 bn€ in the framework of IPCEI program (Important Projects of Common European Interest) on hydrogen in order to build infrastructures and facilities for the future deployment of hydrogen in Europe. Particularly one of the projects will build a bio-refinery based on the gasification of plastics and disposable waste, able to produce 1500 ton/year of green hydrogen treating up to 20000 ton/year of waste. Also, in the case of IPCEI projects the international collaboration among EU countries is strongly recommended to amplify the spill over effects of each project.

4. Reflections on funding opportunities

The efforts within the WASTE2H₂ project have resulted in a successful partnership between the participating organisations, resulting in the formulation of new novel projects ideas and EU project applications. The partnership is an excellent platform to use for further development of R&D capacities to enable the development of novel waste-to-hydrogen technologies. All partners perceive the benefits of continuing the collaboration, and the strategy are briefly summarized as follows:

- A core working group, initially with a representative from all partners, will be formed after the end of the project. New members will be included to expand the group whenever needed but the core will be the original partners. The group will be managed by IPP.
- The core working group will have regular yearly meetings to identify potential fundings and to plan for the preparation of the application. The group will also discuss strategies and plans for developing:
 - infrastructure for demonstrating waste-to-hydrogen technology,
 - a strong partnership with industry,
 - competence needed,
 - and networks of industrial and research partners.
- Infrastructure for R&D and demonstrating new waste-to-hydrogen technology will be built. The idea is that IPP will be the partner where the main part of the infrastructure will be located.
- Arrange information exchange seminars to reach out to industry and society.

Figure 1 schematically illustrates the elements in the strategy. A brief roadmap for the following 5 years is shown in Figure 2.

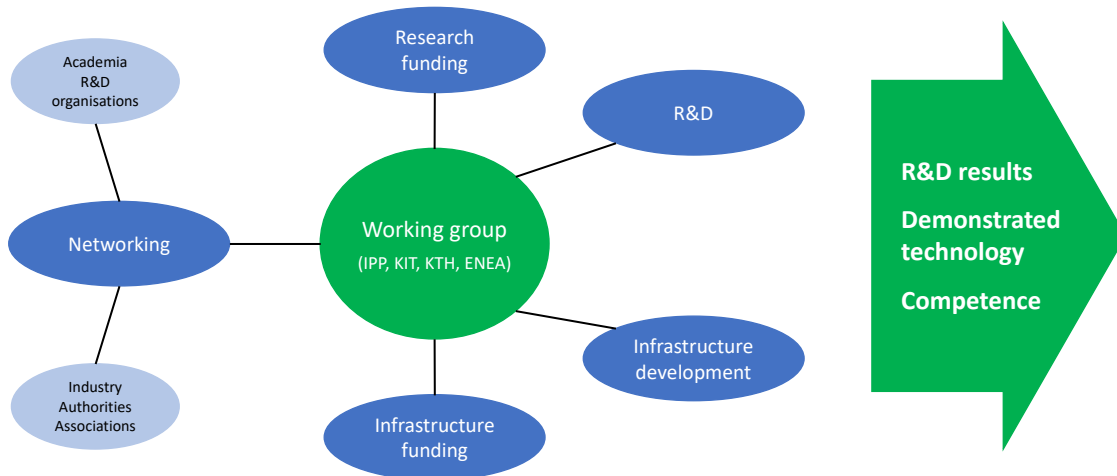


Figure 1 A schematic of the elements included in the strategy.

Description	2024				2025				2026				2027				2028			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Formation of Work Group	■																			
Horizon Europe																				
2023-2024	■	■	■	■																
2024-2025					■	■	■	■	■	■	■	■								
CETP			■	■			■	■			■	■			■	■				
Other	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Seminar (information exchange)					■	■			■	■			■	■			■	■		
Work group meetings		■				■				■				■				■		

Figure 2 A Roadmap of activities for the following 5 year

5. References

1. <https://portugal2030.pt>
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4. Interreg Europe, <https://www.interregeurope.eu>
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