



WASTE2H₂

WASTE TO HYDROGEN

Joint Strategic Research and Technology Innovation Planning

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Abstract

To achieve a sustainable and fruitful long-term partnership that can improve the scientific and innovation excellence of IPPortalegre, this document presents a joint strategy planning in the scientific areas of WASTE2H2. This deliverable corresponds to a guide for the current and future implementation of research actions and innovation, and it aims at being representative of all the expertise, infrastructures, equipment, on-going research projects of all the consortium partners, and identification of funding opportunities to enhance the relations between all the involved institutions.

Document History

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1. WASTE2H2 concept and scientific domains

The bringing together of IPP, KTH, ENEA and KIT in WASTE2H2 makes the best of each partner's capabilities in the field of waste thermal gasification processes and syngas upgrading with a focus on hydrogen production. Ultimately, WASTE2H2 will contribute to make IPP the flagship of R&I in hydrogen production from waste and biomass resources and techniques, in the region of Alentejo, Portugal. Currently, this research subject is extremely important in the international scene and has considerable interest in all sectors of activity, particularly, general industrial, energy and transport. WASTE2H2 leans heavily on close collaboration of these leading institutions in a multidisciplinary approach that encompasses the existing competences and gaps in this field of research. To move forward in WASTE2H2, the specific contributions of each consortium are grouped in thematic lines (Figure 1), that form the base for all the research activities in the project.

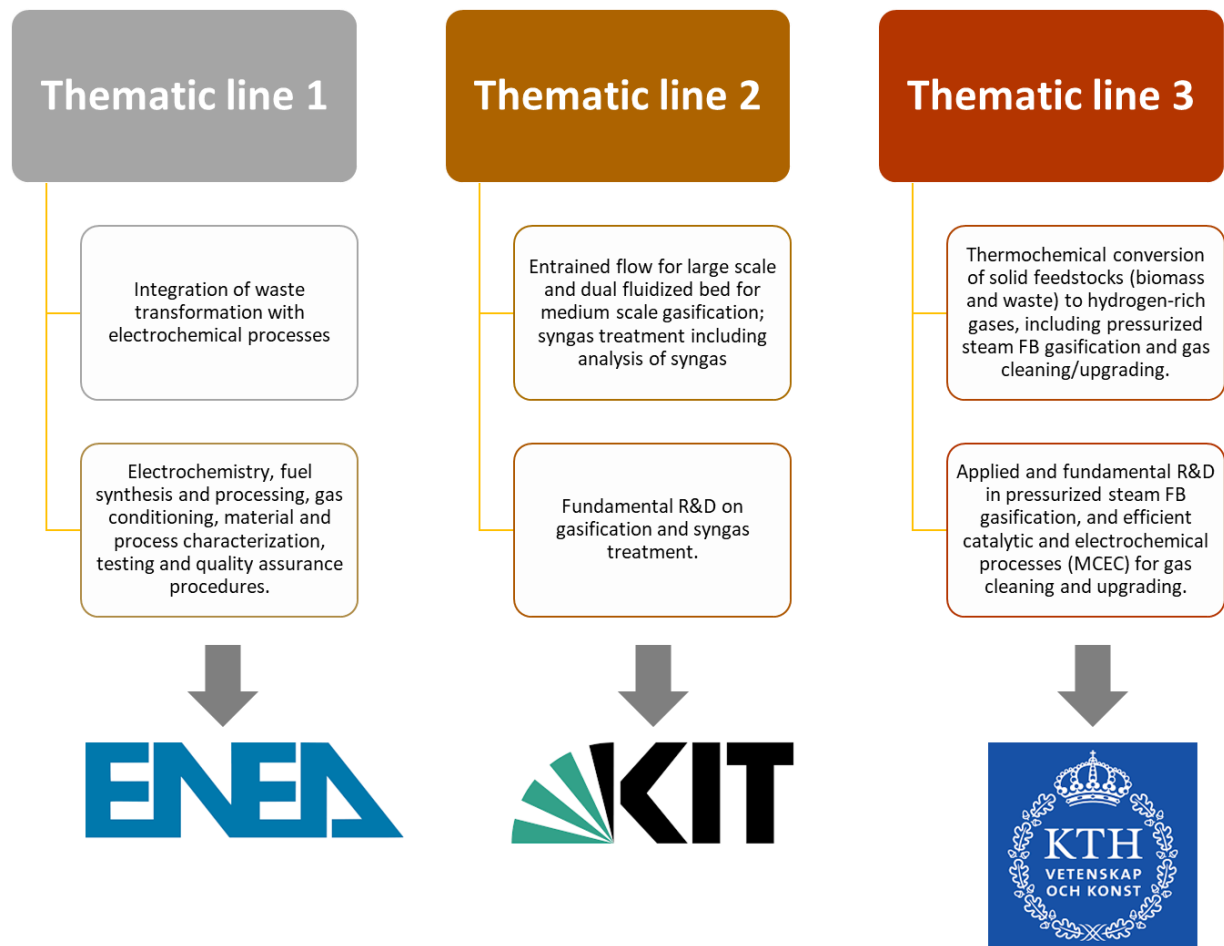


Figure 1. WASTE2H2's thematic lines and corresponding scientific domains and partners.

WASTE2H2 overall research & innovation (R&I) is based on these three thematic lines, with equally strong contributions from each consortium partner. As such, a joint strategic R&I plan

has been drafted, considering all the actions arising from these themes and from the project's expected outcomes.

2. Research and innovation plan

A preliminary approach to the R&I plan was already drafted in WASTE2H₂'s proposal. Entering the last year of the project, the pathway to reach the project's main objectives is now clear and described in Figure 2.

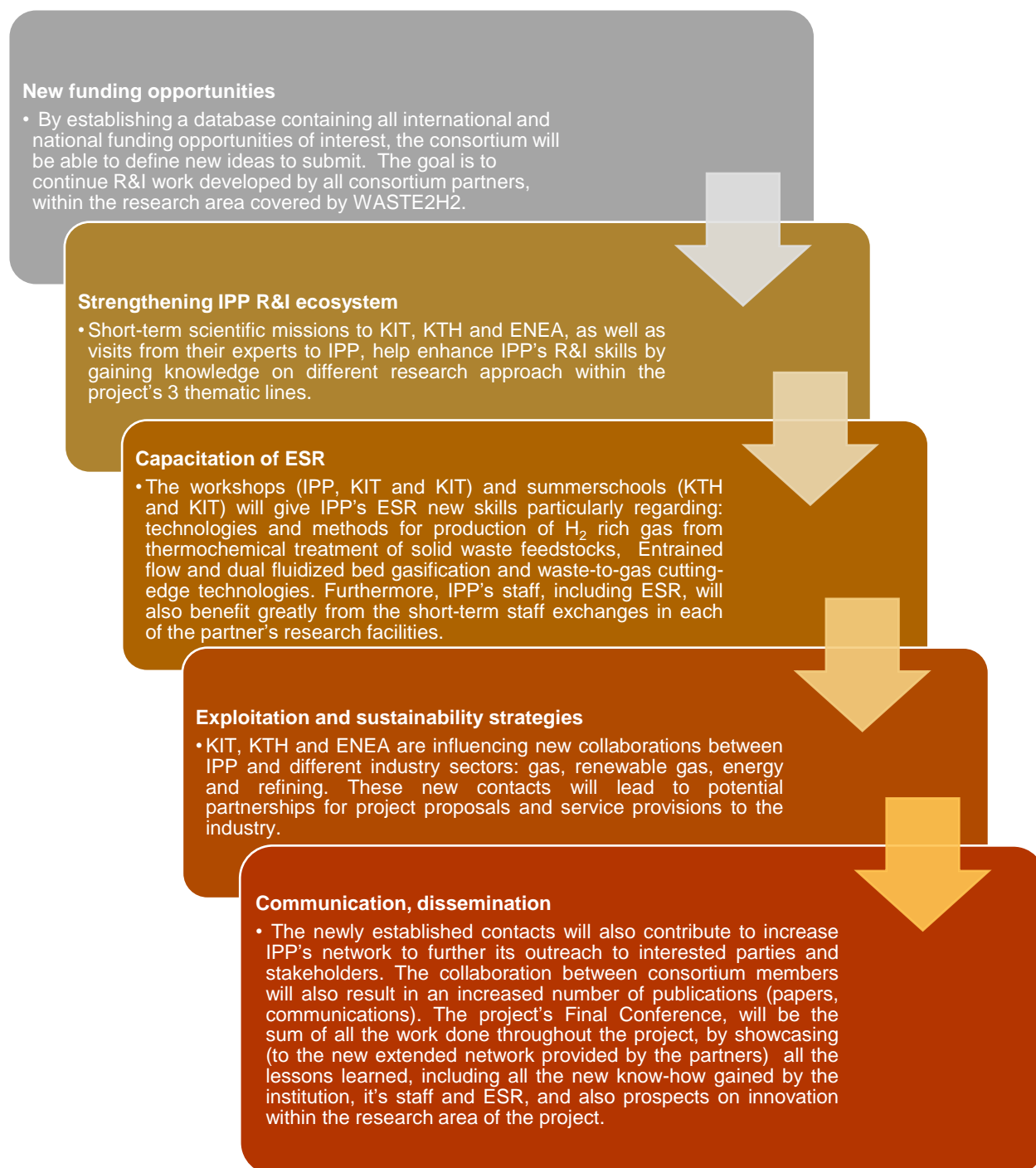


Figure 2. WASTE2H₂ R&I plan.

Following the established R&I plan entails a system to measure its success. As such, several Key Performance Indicators (KPI), were defined for the duration of the project. Status of these KPI and the target values by the end of the project are represented in Table 1.

Table 1. Performance in research, innovation, and competitiveness, by the end of 2022, and what is expected by the end of the project (2024).

KPI	Value at submission	Current project values	Target 2024
Nº of international funding applications	0	+4	5
Nº of approved international projects	13	+4	19
Nº of coordinated international projects	0	0	3
Nº of national funding applications	16	+4	22
Nº of companies involved with IPPortalegre	21	+5	30
Nº of peer reviewed articles published in international journals	60	+5	70
% Of ISI WoS or Scopus journal publications	93%	+1%	96%
Nº of national and international patents	0	0	2
Nº of ESR	19	24	30
Nº of researchers (exclude. ESR)	26	+3	34
Nº of attended conferences (includ. Workshops)	28	+5	39
Nº of organized conferences (includ. Workshops)	3	+3	5
Nº of visits from experts from internationally recognized institutions	4	+3	10
Nº of internal seminars, workshops, and training actions	8	+10	16
Nº of service provision to the industry or other academic institutions	4	+1	8

3. Following the R&I plan: Short-term and medium-term activities

3.1. Project proposals

The search for funding opportunities has been carried out throughout the duration of the project. With the information on open calls (national and international), the whole consortium can choose proper calls to apply considering the thematic lines of WASTE2H2. Table 2 shows the open calls for Cluster 5 of the Horizon Europe Funding Program (calls that cover the research areas of this project):

Table 2. Funding opportunities for the thematic lines for WASTE2H2 (Horizon Europe).

Call	Type of Action	Opening date	Closing date	Budget per project (M€)	Total indicative budget (€)	Final TRL
HORIZON-CL5-2023-D3-02-01	RIA	04-05-2023	05-09-2023	4	8	5
HORIZON-CL5-2023-D3-02-07	RIA	04-05-2023	05-09-2023	4	12	4-5
HORIZON-CL5-2023-D3-01-06	IA	13-12-2022,	30-03-2023	9	18	6-7
HORIZON-CL5-2023-D3-01-07	IA	13-12-2022,	30-03-2023	9	18	6-7
HORIZON-CL6-2024-ZEROPOLLUTION-02-2-two-stage	RIA	17/10/2023	21/02/2024 and 14/09/2024	4	8	4-5

WASTE2H₂ KPI for project submission (4 by 2024) is almost met, but IPP still must coordinate three projects by 2024. As such, and because receiving research funds also enhances other important aspects of R&I, the consortium will be adapting and re-submitting its first joint project proposal (CONFLUENCE) and another project proposal (Waste2Mobility) during the 1st semester of 2023, as follows:

- **CONFLUENCE** (new acronym to be defined): The European Union (EU) aims to achieve climate neutrality by 2050. Usage of biomass-waste and renewable electricity for production of renewable fuels in Power-to-X processes will accelerate the process of achieving the net-zero emission targets and facilitate a flexible storage of intermittently produced renewable electricity in chemical form. The recent update of European Commission “Fit for 55” package (2021) focuses on elements related to the promotion of alternative fuels. Especially, the ReFuel EU Aviation proposal introducing targets for sustainable aviation fuel (SAF) and synthetic aviation fuels, and a proposal Fuel EU regulation to introduce GHG intensity reduction requirements in maritime transports for 2025 to 2050. To prepare the ground for new process technologies meeting these targets, CONFLUENCE will: (a) Develop a novel Power-to-X process concept for production of renewable fuels (TRL 3-4) with a low carbon footprint and better resource efficiency from biomass-waste and renewable electricity and (b) Identify the plausibility of upscaling the technologies at real conditions considering technological, environmental, economic, social and policy compatibility.
- **Waste2Mobility** (new acronym to be defined): Waste2Mobility tackles the problems of unvalorized wastes and EU external dependence on NG/fossil fuels, while simultaneously contributing to establish and optimize sustainable advanced biomass to bioenergy supply chains across Europe, enhancing a specific circular economy philosophy, contributing to the EC European Green Deal and several UN Sustainable Development Goals. The main objective of this project is to develop a technological demonstration process to produce methane-rich syngas (final content 95 vol.% from sewage sludge (SS) and solid wastes (SW) from different sources (e.g., agriculture, forest, and refuse-derived fuel), considering the use of gasification followed by methanation as the base technology. The produced biomethane is intended for use as a fuel in different mobility applications based on dual fuel engines (DFE), namely: heavy-duty vehicles (trucks, special machinery, etc.); auxiliary systems in marine ships (merchant, cruises, etc.); supply the grid of Synthetic Natural Gas that complies with the specifications NP. EN 016723-1 for industrial and domestic use. There is an intention to redesign, optimize and validate a multi-stage waste transformation and valorization process, built upon extensive knowledge and know-how. The project will be substantiated into two small scale pilot units (TRL5) which will allow for parametric

modelling, analysis, and validation of this innovative process towards the production of compliant syngas for mobility and power generation with DFE engines. The environmental, social, and economical sustainability at larger scales (industrial level throughout Europe) will also be assessed and accounted as a main pillar of the Waste2Mobility project.

3.2. Workshops, STSE and exploratory visits

To follow the R&I plan regarding “Strengthening IPP R&I ecosystem” and “Capacitation of ESR”, the following activities are planned for the 1st semester of 2023:

- WASTE2H₂ will have its final workshop in February 2023, at IPPortalegre’s facilities.
- Two people from IPP will have a STSE at KTH’s facilities in April
- The last exploratory visit from the project will take place in May 2023 to ENEA’s facilities
- And one person from IPP will have an STSE to ENEA in May/June 2023.

3.3. Final conference and white paper on “Waste to Hydrogen Technologies”

By the 2nd semester of 2023, “Exploitation and sustainability strategies” and “Communication, dissemination” will be the most pressing points on the R&I plan. To achieve project’s goals, the consortium will:

- Jointly write a white paper on “Waste to Hydrogen Technologies”, throughout 2023, with publication to be finalized by the end of the year (November).
- Organize the project’s Final Conference (December), with all consortium partners, involved staff and ESR, and all the new established contacts from industry that were gained during the project’s duration.