

EU Horizon program: Horizon-CL4-2021-TWIN Transition

Reducing environmental footprint, improving circularity in extractive and processing value chains (IA)

Refractory Sorting Using Revolutionizing Classification Equipment

Grant Agreement No 101058310

WP11 Dissemination & Exploitation

11.3- Final report on dissemination, communication, and exploitation

ReSoURCE

Project Reference No	101058310
Deliverable	11.3- Final report on dissemination, communication, and exploitation
Workpackage	11
Type	Report
Dissemination level	Public
Date	16. 02.2026
Status	Final
Editor(s)	Sofia Iriarte, Akhilesh K. Srivastava, Hamza Cinar
Contributor(s)	ReSoURCE Consortium
Document Description	This deliverable is connected to all tasks of WP 11. It provides a complete overview of all the dissemination, communication, and exploitation activities carried out during the project duration.

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Executive Summary

This deliverable corresponds to all tasks within Work package 11 and provides a comprehensive overview of the dissemination, communication, and exploitation activities undertaken throughout the ReSoURCE project.

The communication and dissemination strategy has ensured maximum visibility for the project, raising awareness of its objectives, benefits, and results among key stakeholders and the wider public. These efforts have contributed to increasing the reach and impact of ReSoURCE's workflow, outcomes, and innovations.

A particular focus has been placed on highlighting the refractory industry's motivation - not only from economic and ecological perspectives, but also through its commitment to innovation. These drivers have been consistently communicated and reinforced throughout the project's duration.

The exploitation of results has been pursued both at the individual partner level and within an extended network, promoting uptake and further development of project outcomes. This report presents the final implementation and results of the original plan for dissemination, communication, and exploitation, as outlined at the project's outset.

1. Introduction and Objectives

The ReSoURCE project's communication and dissemination strategy has been driven by a fact-based and transparent approach, aiming to make the project relatable and accessible to a wide range of stakeholders - from industry actors and policymakers to researchers and civil society. From the outset, the focus has been on delivering clear and consistent messaging, while creating multiple touchpoints to foster engagement and dialogue.

To support the project's broader objectives and pave the way for the exploitation of its results, tailored activities were designed to inform, build trust, and promote collaboration. A key element of this strategy involved the active participation of consortium partners in stakeholder-oriented events such as conferences, workshops, and exhibitions. These platforms enabled the presentation of project developments, the exchange of knowledge, and the exploration of synergies with potential customers and collaborators.

This deliverable presents a comprehensive account of all communication and dissemination efforts carried out over the course of the project. It demonstrates how these activities have contributed to increasing the visibility of ReSoURCE, promoting its results, and strengthening stakeholder engagement.

The communications strategy - including a detailed content plan for each channel - was developed to:

- Reach targeted audiences with timely and relevant information;
- Align communication outputs with the interests and priorities of stakeholder groups;
- Report effectively to policymakers, funding agencies, scientific peers, and industrial players;
- Raise the public profile of the project and its consortium;
- Differentiate ReSoURCE within a crowded and competitive industrial and research landscape.

A multi-channel approach was adopted, using digital tools such as the project website and social media accounts. These channels played a central role in sharing progress, showcasing results, and building a sense of community around the project.

Finally, this report also provides an overview of all communication, dissemination, and exploitation KPIs that were initially defined in the Grant Agreement. In addition, it highlights key outreach activities, including participation in scientific conferences and the publication of peer-reviewed articles, underscoring the project's commitment to transparency, knowledge exchange, and lasting impact.

2. Communication and Dissemination Strategy

Strategic Framework

The communication and dissemination activities within ReSoURCE were guided by a strategic framework designed to serve multiple interconnected purposes, aligned with the overarching goals of the project. This framework ensured that all outreach efforts were purposeful, targeted, and consistent throughout the project's duration.

At its core, the strategy aimed to communicate the project's progress and milestones in an accessible and engaging manner, keeping stakeholders informed and involved. A key priority was to highlight the contributions of project partners, showcasing their expertise and the collaborative spirit driving ReSoURCE forward.

Beyond visibility, the strategy sought to position ReSoURCE as a thought leader in the field of sustainable refractory solutions. This included delivering fact-based insights into the technical innovations being developed and their potential impact on the industry and beyond.

The framework also emphasized the socioeconomic relevance of the project's outcomes, underlining their role in enabling more sustainable and circular industrial practices. By showcasing transferable advancements, ReSoURCE aimed to encourage cross-sector collaboration and inspire future research and innovation across related industries.

In parallel, the project's communication approach included outreach tailored to academic and educational communities, particularly university students, with the goal of encouraging interest in research careers and technical disciplines relevant to the circular economy.

To implement this framework effectively, ReSoURCE leveraged a variety of communication tools and platforms, with a strong emphasis on LinkedIn as a primary channel for engaging professional and industry audiences. This platform enabled timely updates, partner highlights, and technical insights to reach a relevant and growing network, reinforcing ReSoURCE's presence in the broader innovation ecosystem.

In addition, consortium partners actively contributed to the strategy by representing ReSoURCE at numerous conferences and industry events, where they presented project developments, engaged with peers, and extended the project's visibility across multiple sectors.

2.1 Key Performance Indicators (KPIs) Overview

An overview of the key performance indicators achieved during the project is presented in Table 1.

Table 1: List of Communication, dissemination and Exploitation KPIs

Target audience	Type of D&C activity	Responsible partner	KPI	Results
Research industry	Scientific conferences/ fairs	MUL, ILT, STEFF	At least 1 conference attendance by each technical partner where project results will be presented.	Total of 21
	Scientific journals	MUL, ILT, STEF	At least 1 publication per research partner	Total of 3
General public	Popular science articles	All	1 article per technical partner	Total of 45
All stakeholders	Project website	RHIM	To be launched in M2, regularly updated (monthly), and targeting 100000 visitors during the project.	~17,000 views
	Project videos	RHIM, STEF	6 project videos: <ul style="list-style-type: none"> ▪ 1: Project concept (M4) ▪ 2–5: Current status/presentation of partners ▪ 6: Project outcome and outlook (M42) 	Total of 7
	Brochures, posters	RHIM, STEF	Project brochure presenting key project features (e.g., duration,	1 flyer and 1 roll-up

			budget, partners, objectives, and contact details)	designed has been prepared and it is used by the consortium
	Social media	RHIM, STEF	Over 250 Twitter followers and over 500 LinkedIn members	LinkedIn: 1244 X: 223 followers
	Newsletters	RHIM, STEF	Publish on a 6-monthly basis; provide key updates from the WPs. Will be available on the website and distributed to all subscribed people	0 – in agreement with the PO on switching form Newsletters to Blogs
	Community	CHX	> 25 external organisations engaged in the project when it ends	819 experts and 298 organisations
	Press releases	All	1 per partner	Total of 8
	Media appearances	All	1 per partner	Total of 7
	Joint events with the projects funded in the same call	CHX, STEF	5	Total of 3
	EU/national events, collaboration with national or European networks or initiatives	CHX	Attend 10 EU/national events	Total of 11.

2.2 Communication and Dissemination activities

Website performance and Social media engagement



Figure 1: Highlights of ReSoURCE dissemination, communication and exploitation activities

Throughout the project’s lifetime, the ReSoURCE consortium implemented a comprehensive and strategic approach to communication and dissemination, successfully increasing visibility,

stakeholder engagement, and awareness of project results. Key outcomes included the development and continuous updates on the project website, consistent visual identity, standardised templates, active social media presence, targeted outreach at events, and the production of high-quality dissemination materials, such as blog posts, press releases, fact sheets, videos, and scientific publications. Figure 1 highlights the dissemination, communication, and exploitation activities carried out under the ReSoURCE project.

The **project website** and official social media channels (**LinkedIn, X, and YouTube**) were launched shortly after the project's start and remained active and regularly updated until project end. A detailed description of these platforms was provided in Deliverable D11.1.

The **project website** has served as a central information hub, presenting the project's objectives, technologies, achievements, and partner profiles. It was continuously updated with relevant news, milestones, blog articles, and press releases. In total, **45 scientific blog posts** and **8 press releases** were published on the website during the project, significantly contributing to the visibility of ReSoURCE's technical progress and public-facing results.

While the project did not reach the initially defined KPI of **100,000 website views**, achieving approximately **17,000 views** by the end of the project, this target proved to be **unrealistic and not representative of typical EU-funded project website benchmarks**. The project team therefore placed greater emphasis on **social media channels**, which have become more effective for audience engagement and content dissemination in recent years.

Building on the strategy outlined in **D11.2 (Strategic Plan for Exploitation, Dissemination, and Communication)**, the project's communication team focused on targeted engagement with stakeholders across Europe and beyond. Throughout reporting periods 2 and 3, participation in major **conferences and events** was prioritised. In total, the consortium attended **27 events**, including **21 scientific conferences** and **6 international events** (in **Panama, China, and India**). The project also co-organised a joint session at the **Raw Materials Summit**, alongside three other projects funded under the same call. In addition, **three sustainability meetings** were hosted to collect early customer feedback on refractory recycling technologies.

Social media engagement was a central pillar of the dissemination effort. The LinkedIn account featured regular updates, multimedia content, event announcements, and blog promotions. This activity helped grow our online presence substantially. By the end of the project, the LinkedIn account had attracted approximately **1244** followers, while the X account had **223 followers**, reflecting a steady increase in reach and engagement over the project duration.

YouTube was also used to share audiovisual content, including explainer videos and project updates. Across all reporting periods, a total of **7 videos** were produced and uploaded, offering both general overviews and more technical insights into the development of the automated sorting

equipment and other project activities. These videos supported outreach efforts aimed at civil society, industry stakeholders, and policy audiences.

The **visual identity** of the project was consistently applied across all dissemination materials. Flyers and roll-up banners developed at the outset of the project were used throughout, and standardised templates for presentations and reports were maintained across all partners.

All communication and dissemination activities have been catalogued and updated on the project portal, including the full list of scientific publications and conference contributions. This final overview confirms that ReSoURCE successfully reached a broad audience and laid a strong foundation for further exploitation and uptake of its results.

2.2.1 Participation in conferences and events

The most significant conferences and events attended by project members are summarized in Table 2.

Table 2: Overview of the Project Consortium's Participation in Conferences and Events

Event	Location	Date	Activity	Link	Partner Attendance
2022-23					
Long Night of Museums	Austria	1 Oct 2022	Presentation	Link	RHIM
DGAW 12th Science Congress	Hamburg, Germany	9–10 Mar 2023	Presentation/ Publication	Link	MUL
Mineral Recycling Forum 2023	Dubrovnik, Croatia	28-30 Mar, 2023	Presentation	Link	RHIM
UNITECR	Frankfurt, Germany	26-29 Sept 2023	Presentation	Link	RHIM
Sci4Tech Poster Exhibition	Austria, Leoben	2024	Poster	Link	MUL
EAA 2023	Belfast, Northern Ireland	30 Aug – 2 Sept	Presentation	Link	RHIM
PROMISE Scientific Exchange Day	Austria	7 Feb 2023, 13 Feb 2024, 4 Feb 2025	Presentation	Link	MUL
2024					
10th expert conference of Sensor-Based Sorting & Control	Aachen, Germany	13–14 Mar	Presentation and Paper	Link	LSA
EU R&I Days	Brussels, Belgium	28–29 Mar	Participation	Link	RHIM

Pan American Ceramics Congress and Ferroelectrics Meeting of Americas (PACC-FMAs 2024)	Panama, USA	7-11 Apr	Presentation	Link	RHIM
Austrian Waste Management Conf.	Vienna, Austria	22–26 Apr	Presentation, Poster	Link	RHIM, MUL
Mineral Recycling Forum	Dubrovnik, Croatia	22–24 Apr	Presentation	Link	RHIM
Nordic LIBS	Tampere, Finland	5-6 Mar	Invited Presentation	Link	LSA
Berliner Konferenz Mineralische Nebenprodukte und Abfälle 2024 (BKMNA)	Berlin, Germany	12–13 Jun	Invited Presentation	Link	RHIM
CHoPS 2024	Edinburgh, Scotland	2–4 Sep	Presentation and Paper	Link	SINTEF
Int. Colloquium on Refractories	Aachen, Germany	17–18 Sep	Presentation	Link	RHIM
9th Int. Symposium on Refractories	Chengdu, China	15–18 Oct	Presentation	Link	RHIM
CIRCON2024	Jamshedpur, India	3–4 Oct	Presentation	Link	RHIM
ASPIRE Conference	Brussels, Belgium	23–24 Oct	Participation	Link	SINTEF
Aufbereitung & Recycling 2024	Freiberg, Germany	7–8 Nov	Presentation	Link	MUL
RecyDepoTech 2024	Leoben, Austria	13–15 Nov	Presentation/ Publication	Link	MUL
2025					
Spektaris Photonik 2025	Altenberge, Germany	6 Mar	Presentation	Link	Fraunhofer ILT
Berlin Metal Cycles Conf.	Berlin, Germany	2 Apr	Presentation	Link	Fraunhofer ILT
Mineral Recycling Forum 2025	Cannes, France	9–11 Apr	Presentation	Link	RHIM, MUL
Thursday's Talk @ TU Graz	Graz, Austria	10 Apr	Presentation	Link	MUL
Youth Entrepreneurship Week	Austria	12–16 May	Presentation	Link	RHIM
ICSWDG 2025	Dongguang, China	9–12 Jun	Presentation	Link	MUL
School Climate Camp (Ecoality)	Austria	15 Jun	Workshop/ Presentation	Link	MUL

MC17 Materials Chemistry	Edinburgh, Scotland	7–10 Jul	Poster	Link	CPI
AI, Data and Robotics Forum (ADRF25),	Norway	23-24 Sep	Workshop, Presentation	Link	SINTEF
Net Zero Supply Chain Conference & Exhibition	Durham, UK	02 Oct	Participation	Link	CPI
20th International Symposium on Waste Management, Resource Recovery and Sustainable Landfilling	Cagliari, Italy	13 –17 Oct	Presentation	Link	MUL

Figure 2 presents pictures from conferences and events attended by project members.



Figure 2: Pictures from events and conferences

2.2.2 Press releases and media appearances

The main highlight that brought together all recent media coverage was ReSoURCE winning the **Phönix Award** (Figure 3 and Figure 4). This achievement attracted considerable media attention, with features in three outlets:

- *Börse Express*: “Abfallwirtschaftspreis ‘Phönix’ 2024 geht an RHI Magnesita GmbH”
- *Umwelt Journal – Fachmagazin für Klima, Umwelttechnik, Energie- und Abfallwirtschaft*: “Abfallwirtschaftspreis ‘Phönix’ 2024 geht an RHI Magnesita GmbH”
- *Wirtschaftszeit*: “RHI Magnesita wird mit Abfallwirtschaftspreis ‘Phönix’ ausgezeichnet”

In addition, the project and its potential impact were featured in the Montanuniversität Leoben's university newspaper. In total, **8 press releases** were published by various project partners, further amplifying the project's visibility.

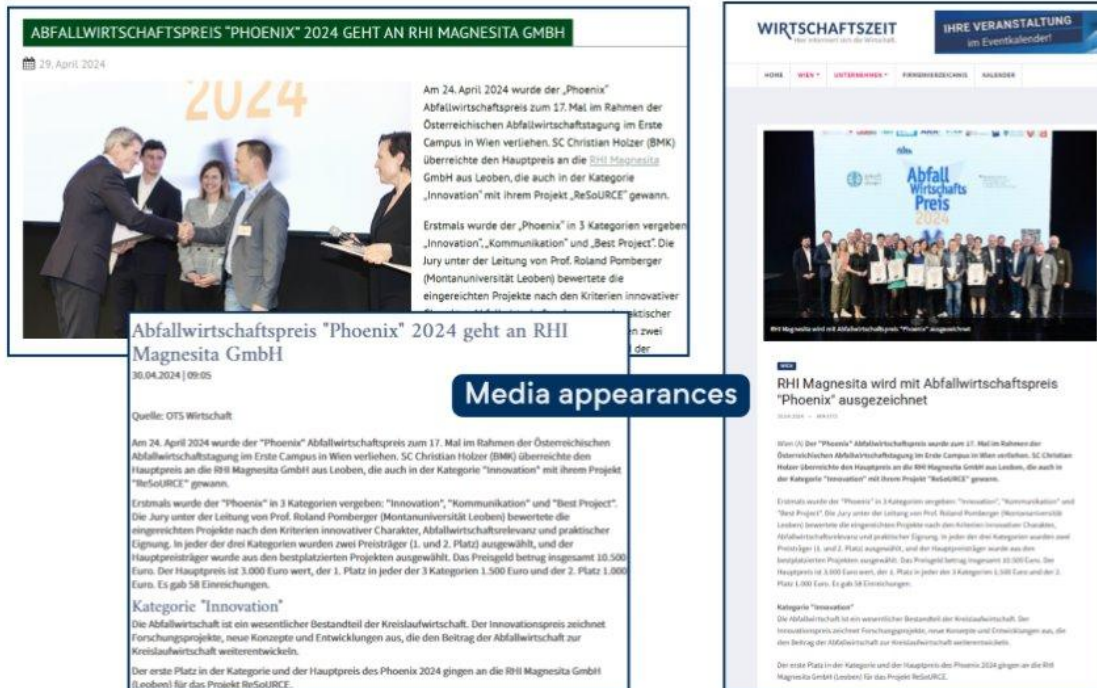


Figure 3: Pictures of the media appearances



Figure 4: Pictures of the Phönix Award in Vienna, April 2024.

More pictures about the events and conferences can be found in this link: [Pictures](#).

2.2.3 Showcasing Impact through Webinars and Seminar

As part of ReSoURCE’s final phase of communication and exploitation activities, a series of three thematic webinars were organised between December 2024 and July 2025. These sessions provided key opportunities to present project outcomes to industrial stakeholders, foster dialogue, and explore future collaborations for the uptake of recycled refractory materials and enabling technologies.

On December 4, 2024, ReSoURCE hosted its first public webinar titled “*Unlocking New Opportunities with Recycled Refractory Materials.*” The session focused on showcasing the materials produced through the milling of spent refractory linings originating from the cement and steel industries. With a strong emphasis on practical application, the webinar aimed to engage downstream industries that could benefit from these secondary raw materials by presenting their technical specifications and opening the door for collaboration opportunities. The event attracted 60 registrants and was attended by 35 participants, including 25 external stakeholders - a clear sign of market interest. To ensure targeted outreach, the webinar was promoted across relevant LinkedIn stakeholder groups such as *Lamination Film (Thermal + WET)*, *The Concrete Society – Discussion Forum*, *TPE from Recycled Raw Materials*, and *Circular & Regenerative Economy*. The session was delivered with the support of project partners CPI, RHI Magnesita, and Crowdhelix.

The second webinar in the ReSoURCE series, titled “*Unlocking Circular Potential: Refractory Fillers in Advanced Composites,*” took place on June 26, 2025. This session focused on the potential use of recycled refractory fillers - obtained from milled refractory linings from the cement and steel industries - in advanced composite applications. Specifically, the webinar targeted sectors such as thermoset-based roofing systems and thermoplastic-based automotive components, highlighting the performance characteristics of the materials and opportunities for industrial uptake. Out of 43 registered participants, 17 joined the session, including 6 external stakeholders. While the topic addressed a more niche audience, the webinar contributed to the project’s broader goal of fostering market uptake for secondary raw materials. As with the previous session, participants received follow-up materials including the full slide deck and detailed technical data sheets. The webinar was organised with the support of project partners CPI, RHI Magnesita, and Crowdhelix.

Next webinar in the ReSoURCE series, “*Exploring LIBS for Industry-Wide Recycling and Material Characterisation – A Construction Waste Case Study,*” was held on July 15, 2025, and proved to be the most successful in the series (Figure 5). Focused on enabling circularity through real-time elemental analysis using Laser-Induced Breakdown Spectroscopy (LIBS), the session explored how this technology can support the accurate characterization of recycled concrete and construction waste - a key enabler for secondary material valorisation in the cement sector. The webinar attracted 56 registrants and was attended by 48 participants, 34 of whom were external stakeholders,

demonstrating both strong interest and high engagement. A particularly lively Q&A session followed the presentations, reflecting the relevance of the topic to current industrial needs. The event featured contributions from project partners LSA, CPI, RHI Magnesita, and Fraunhofer, alongside external experts from the UK's Materials Processing Institute, who shared their insights into sustainable cement and concrete practices. Targeted promotion across LinkedIn groups - including *Global Metallurgist*, *Building Green*, *Waste Management & Recycling Professionals*, and *Critical Raw Materials* - helped reach a wide and relevant audience.

All three webinars were promoted through the ReSoURCE website, the Crowdhelix platform and newsletters, and social media. In addition, all project partners actively contributed to the outreach effort by reposting and sharing webinar information within their professional networks and by inviting targeted stakeholders of interest to ensure relevant participation and maximise impact. To extend their reach beyond the live events, the recordings of the first two webinars were uploaded to the ReSoURCE YouTube channel, making the content accessible to a wider audience and enabling continued engagement with the project's findings. Furthermore, participants received presentations including contact details from the presenters.

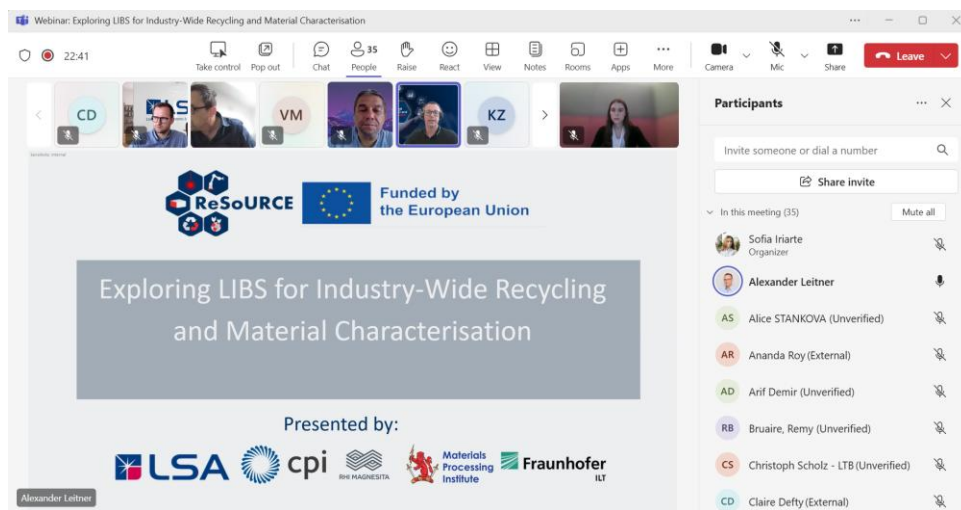


Figure 5: Screenshot of the LIBS webinar, July 2025.

An additional webinar was organised by FIRE (Federation for International Refractory Research and Education) on **November 26th, 2025**, titled “*Sorting the Future: ReSoURCE and the Making of a Circular Economy – Featuring insights from a PhD at the frontlines of innovation.*” The event showcased ReSoURCE’s technological and scientific advances in circular materials management and provided an engaging platform for knowledge exchange between research and industry. Alexander Leitner (Pioneer Research, RHI Magnesita, Austria) and Florian Feucht (Chair of Waste Processing Technology and Waste Management, Technical University of Leoben) presented their

perspectives on the challenges and opportunities in advancing material sorting and recycling technologies within a circular economy framework.

SINTEF will participate in the upcoming Technical Seminar Series to be held at Herøya Forskningspark in Porsgrunn, Norway, on 28 November 2025. During the event, Akhilesh Srivastava and Kristin Søiland (SINTEF, Norway) will present “*Smart Recycling in Action – RAPTOR & PHOENICS: Transforming Powder Technology with AI and Sensor Innovation.*” The seminar is organised by Herøya Industrial Park, SINTEF, the University of South-Eastern Norway, Telemark County Council, and Powered by Telemark, and will bring together industry and research stakeholders to discuss innovations in sustainable and digitalised industrial technologies.

2.2.4 Key Exploitable Results Fact sheets

To support the dissemination and exploitation of the project’s most valuable outcomes, we developed a series of fact sheets highlighting each Key Exploitable Result (KER). These concise, accessible documents provide essential information on the innovations, potential applications, and impact of each result, making them useful for stakeholders across industry, research, and policy. To further extend their reach, the fact sheets were also promoted through a dedicated campaign on LinkedIn, engaging a wider professional audience and driving traffic to the project website.

All fact sheets are publicly available in the “[Knowledge Vault](#)” section of our website. More details on KERs are available in Section 3 of this report.

2.2.5 Crowdhelix platform – Circular Helix

Helix strategy for 2-5 years (access to membership, cooperation, active results...)

The Circular Industry Helix (Figure 6), hosted on the Crowdhelix platform, has developed into a vital cooperation and distribution tool that links stakeholders working within the topics of circular economy, recycling technologies, materials, and sustainable manufacturing. The Helix which was initially developed as a digital community to foster cooperation on partnerships and knowledge sharing will continue to develop further into a self-sustaining open innovation network that promotes collaboration between research organizations, academic institutions, SMEs, big businesses, and policy actors involved in Horizon Europe and related projects.

1. Membership and Access

Verified members involved in the circular economy and materials innovation sectors will continue to have access to the Helix. The onboarding process for new members will involve:

- Direct invitations from Crowdhelix network moderators and ReSoURCE partners.
- Outreach through partnerships on EU-funded projects and events for dissemination.
- Involvement in brokerage and matching events like the Material Helix Event and the Circular Economy and Materials matching Event.

With an emphasis on involving SMEs, start-ups, and industrial clusters that can expedite technology transfer and utilization of research discoveries, the Helix hopes to increase its membership base by 2026.

2. Collaboration and Inter-Project Involvement

The Helix will serve as an active clustering environment for cooperation among projects tackling the EU's twin transition priorities. Particular areas of emphasis will consist of:

- Collaborative distribution efforts with Horizon Europe initiatives (such as RAWMINA, Hephaestus, ROTATE, DICIM, and REFORM).
- Cooperative gatherings and webinars to exchange research findings, best practices, and exploitable outcomes.
- Assistance in developing proposals, assisting members in locating funding opportunities and consortiums in line with upcoming Horizon Europe requests;

The Crowdhelix digital platform facilitates the spread of knowledge through shared publications, newsletters, and thematic events.

3. Active Utilization and Observable Outcomes

The Helix will concentrate on producing measurable, active outcomes in order to sustain long-term involvement, such as:

- Creation of new project proposals and consortia under Horizon Europe (five to ten are anticipated annually including Helix members).
- Cross-sector partnerships in the field of circular materials between academia and businesses

4. Sustainability

The Crowdhelix platform has the a capacity to self-sustain, which combines ongoing moderation, member support, and platform-driven distribution, will guarantee the Helix's sustainability beyond the ReSoURCE initiative. The network will continue to be reachable via crowdhelix.com, preserving all shared documents, events, and content pertinent to the project. The Circular Industry Helix will do the following to increase its long-term value:

- Maintain your role as a conduit for circular economy research dissemination
- Encourage the use of research findings in industry.
- Expand its reach beyond Horizon Europe to encompass collaborations in EIT RawMaterials, the LIFE Program, and other frameworks focused on sustainability by facilitating the integration of new European and global initiatives.

Circular Industry
Circularity in heavy industry, foundries, works: analysing, processing and re-valourising refractory and specialist materials

Background
A key priority area for the European area is to increase security and sustainability in the access and use of primary and secondary raw materials, with a focus on those Critical Raw Materials which have been defined as vital for EU industrial value chains and strategic sectors.

Applying technological solutions to transform industrial waste management processes in extractive and energy-intensive industries has the potential to yield rapid and significant results. The potential for impact is clear: extractive industries alone are responsible for 50% of the world's carbon emissions and more than 80% of biodiversity loss. For energy intensive industries, in most cases the primary raw material production has the highest impact on a product's carbon footprint. Safe and efficient circular process strategies are needed.

Open data and modelling, standardisation, demonstration, industrial symbiosis and cross-sectoral cooperation are required to de-risk and spread the benefits of research and innovation advances.

Key Project: ReSoURCE
Refractory products are indispensable for all high-temperature processes above 1200°C, such as steel, cement, glass, and nonferrous metal production. Since the refractory lining of a furnace or vessel is designed for a specific material and application, multiple refractory product types, with different chemistries, are combined to achieve the required performance. This poses major challenges for reuse, as the chemical composition of the recycled material is critical if it is to be used again in a refractory.

The ReSoURCE project goal is a comprehensive, advanced sensor-based system for refractory waste sorting and powder handling. Key technologies include LIBS and hyperspectral imaging. If the project is successful, it will enable the robust engineering of an automated sorting equipment that will increase the recycling of refractory breakout material from the current estimate of 7–30% (plus 10% of downcycling) to up to 90%. With approximately 28 million tons of used refractory bricks generated annually, the ecological and societal benefits will be considerable.

Seeking collaborators for Circular Industry projects?
Post a new Opportunity in this Helix

819 Experts
298 Organisations
47 Countries

Marco Lopes
Helix Manager

Alexander Leitner
Helix Leader

"RHI Magnesita are proud to lead this community on circularity in energy-intensive industries including refractories. Industrial-scale waste streams represent significant opportunity to recover value by application of novel technologies and processes."

Figure 6: Helix Platform.

In summary, the Circular Industry Helix, which brings together more than 819 specialists from 298 organizations in 47 countries, is one of the most vibrant and influential communities on the Crowdhelix platform. Its ongoing expansion shows a strong dedication to promoting innovation and cross-sector cooperation in circularity, sustainable manufacturing, and materials science. In the future, the Helix will strengthen long-term collaboration between academia, business, and policymakers by building on the momentum created by the ReSoURCE project. The Helix will continue to be a key hub assisting Europe's shift to a more resilient, circular, and resource-efficient economy by encouraging active involvement, information sharing, and access to new research possibilities.

2.2.6 Scientific publications

The project has published the following scientific articles during the project.

- (1) Heid, S., Leitner, A., Sedlazeck, S., Kek, F., & Stahl, P. (2025). [Unlocking the Recycling Potential of Fine Refractory Breakout Materials](#). RHI Magnesita Bulletin, 99-104.

- (2) Feucht, F., Moderegger, R., Neuhold, S., & Sedlazeck, K. (2025). Analysing material flows and final fate distribution of spent refractories from steel casting ladles and cement rotary kilns in Europe. Resources, Conservation and Recycling, 215, 108158.
- (3) Feucht, F., Neuhold, S., Leitner, A., Fricke-Begemann, C., Hernandez, J., Mörkens, V., & Sedlazeck, K. (2025). Materialcharakterisierung gebrauchter Feuerfeststeine als Schlüssel für das effektive Training von Sensoren. Berg Huettenmaenn Monatsh, 170, 259–265.
- (4) Feucht, F., Neuhold, S., Leitner, A., Fricke-Begemann, C., & Hernandez, J. (2024). The heat is on! – From the material characterisation of spent refractory bricks to sensor training (practical examples from Project ReSoURCE). Conference proceedings of the 17th Recy & DepoTech conference (p. 517).
- (5) Leitner, A., Neuhold, S., Heid, S., Gavagnin, D., Meschik, P., Stastny, R., Zocratto, B. Moraes, M. (2024). Enhancing Refractory Recycling: The Role of Automated Sensor-Based Sorting Systems. RHI Magnesita Bulletin, pp. 41-46.
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2.2.7 Cooperation with research and educational programs

The project has facilitated postdoctoral research as well as doctoral, master’s, and bachelor’s theses at MUL, SINTEF, and Fraunhofer ILT (Table 3). These activities are described in detail in Deliverable D11.4 (Report on Cooperation with Research and Education Programs). In addition, some partners have contributed to short-term training activities for students and employees.

Table 3: Cooperation with research and educational programs

	MUL – Chair of Waste Processing Technology and Waste Management	MUL – Chair of Mineral Processing	SINTEF	Fraunhofer ILT
Postdoc		1		
Doctoral Theses	1			
Master Theses	1	2	1	1
Bachelor Theses	1	1		

2.2.8 Networking and joint activities

Together with the projects funded under the same call, ReSoURCE participated in workshop called “Accelerating the adoption of circular strategies in the Raw Materials and steel industries”. The workshop was divided into two sessions and a roundtable discussion. The first session addressed “*Why we need to improve the extractive, refractories and steel industries.*” The aim of this session was to provide a high-level view of the global context of the extractive, refractory and steel industries. The second session provided an overview of Hephaestus, Rotate, RawMina and ReSoURCE projects and their technologies. The aim was to provide an insight into the projects, technologies and expected impacts. The workshop concluded with roundtable discussions and provided takeaways at the societal, environmental and innovation levels to engage the audience and create new connections for the future exploitation of the projects’ outcomes.

In scope of the networking and joint activities, two major events were organized by the project partner Crowdhelix in cooperation with initiatives who work in the similar research area as the ReSoURCE project consortium. The details of the two events which were delivered in 2023 and 2025 are as follows:

1st Helix Event: Material Helix Event (Trinity College Dublin, November 22–23, 2023)

Crowdhelix and AMBER (Advanced Materials and Bioengineering Research Center) collaborated to sponsor the Material Helix Event, which was held on November 22–23, 2023, at Paccar Studios, Naughton Institute, Trinity College Dublin (Figure 7, Figure 8, Figure 9 and Figure 10). In order to address particular Horizon Europe calls in the areas of advanced materials, circularity, and

sustainable innovation, this two-day event aimed to promote cooperation among research organizations, academic institutions, and industry players.



Figure 7: Helix Event flyer

The event offered a special forum for coordinators including the ReSoURCE project (represented by Chandana Ratnayake – SINTEF) and partners who plan to continue taking part in Horizon Europe proposals and who are motivated to discuss how to work together, especially in the following areas:

- HORIZON-CL4-2024-TWIN-TRANSITION-01-01: Bio-intelligent manufacturing industries (Made in Europe) (RIA)
- HORIZON-CL4-2024-TWIN-TRANSITION-01-05: Technologies/solutions to support circularity for manufacturing (Made in Europe) (RIA)
- HORIZON-CL4-2024-DIGITAL-EMERGING-01-31: Pilot line(s) for 2D materials-based devices (RIA)
- HORIZON-HLTH-2024-TOOL-05-02: Bio-printing of living cells for regenerative medicine
- HORIZON-CL6-2024-CircBio-02-3-two-stage: Increasing circularity in electronics value chains
- HORIZON-CL6-2024-CircBio-02-1-two-stage: Circular solutions for textile value chains through innovative sorting, recycling, and design for recycling
- HORIZON-CL4-2024-RESILIENCE-01-36: Advanced biomaterials for health care (IA)
- HORIZON-CL4-2024-RESILIENCE-01-35: Biodegradable polymers for sustainable packaging materials (IA)

The event was attended by 49 researchers from different research institutions across Europe and diverse stakeholders such as "Consejo Superior de Investigaciones Científicas- CSIC Spanish National Research Council" and "Intel Ireland".

Day 1: Cooperation and Acceleration of Impact

Prof. Sinéad Ryan, Dean of Research at Trinity College Dublin, gave a welcome speech on the first day, and Dr. Lorraine Byrne, Executive Director of AMBER, gave an overview of AMBER and the Materials Helix.



Figure 8: Helix Event Picture

In her presentation on the CrowdHelix Platform and Material Helix for Impact Acceleration and Future Collaboration, Dr. Karen Galvin, Head of Network Engagement at CrowdHelix, highlighted prospects for cross-sector collaborations.

Irish National Contact Points Dr. Sergio Fernandez-Ceballos and Mark Sweeney presented sessions that offered information on funding opportunities for industrial and environmental innovation as well as Horizon Europe Clusters 4-6. Experts from Trinity College Dublin, including Dr. Sibú

Chullanayil Padmanabhan, Parvaneh Mokarian, and Mark Mitchison, spoke about their experiences and difficulties with project coordination in "Demystifying Coordination."



Figure 9: Helix Event Picture

Later, Dr. Vincent Jamier of the Leitit Technological Center hosted the EU Projects Panel Discussion: "Materials Innovation for Circular Economy," which featured a number of Horizon Europe projects, such as:

- Dr. Chandana Ratnayake (SINTEF Industry) is the representative for the ReSoURCE project.
- Colin Keogh's Convert2Green project (Inlecom Commercial Pathways)
- Rocco Lupoi's ThermoDust project (Trinity College Dublin)
- Dr. Brennan Fournet's BioICEP project (Technological University of the Shannon)



Figure 10: Helix Event Picture

The focus of the workshop was on cooperative innovation in the manufacturing, circular economy, and materials industries. Project coordinators' pitch presentations, a poster session, and networking receptions marked the end of the day.

Day 2: Horizon Europe Calls and Advanced Materials

An exclusive guided tour of the Advanced Microscopy Laboratory and Additive Research Laboratory kicked off the second day, giving guests a firsthand look at Ireland's state-of-the-art research facilities. Later sessions comprised:

- Dr. Emma Siddall's Impact Acceleration (Trinity College Dublin)
- Lars Montelius, a professor at Lund University, presents the Advanced Materials Initiative.

Working in parallel to create cooperative proposals for future Horizon Europe Calls: Opportunities for long-term collaborations and knowledge sharing within the European academic community were reinforced as the program concluded with presentations and feedback from breakout sessions and closing statements.

2nd Helix Event: Circular Economy and Materials Matchmaking Event (DFactory Barcelona, Leitat Technological Center, April 29-30, 2025)

Circular Economy and Materials Matchmaking Event was held in Barcelona, Spain, between April 29–30, 2025 (Figure 11 and Figure 12). The event was organized by Crowdhelix and hosted by LEITAT Technological Center. Researchers, innovators, and industry stakeholders drafting applications for Horizon Europe calls pertaining to materials innovation, the circular economy, and sustainable manufacturing were encouraged to collaborate and network during the event.



Figure 11: Helix Event flyer

Building on the success of earlier Crowdhelix "Helix" events, this matchmaking event functioned as a specialized brokerage and partner-building platform, assisting attendees in creating new consortia for the forthcoming Horizon Europe Pillar II Cluster 4 and Cluster 6 calls. Professionals from research and technology organizations (RTOs), academic institutions, small and medium-sized enterprises (SMEs), and industry partners looking to work together on circularity-driven innovation in materials science, resource efficiency, and advanced production were the event's target audience.

84 participants from all around Europe attended the event, representing academic institutions, research centers, businesses, and sectoral groups working to promote material innovation and circularity. The occasion provided Horizon Europe projects and prospective future consortia with a vibrant forum for networking, cooperation, and information sharing.

The event's international and interdisciplinary nature was demonstrated by the diverse variety of institutions and nations represented among the attendees. Among the participating organizations were:

Imperial College London, Masaryk University, Riga Technical University, University of Leeds, Manchester Metropolitan University, Brunel University London, NOVA University Lisbon,

Autonomous University of Barcelona, Technological University Dublin, and Vilnius Gediminas Technical University are a few examples of universities.



Figure 12: Matchmaking Event in Barcelona, 2025

LEITAT Technological Center, SINTEF AS, IRIS Technology, Polymer Institute of the Slovak Academy of Sciences, AlmaScience, CETIM, Institute of Physics Belgrade, RISC Software GmbH, and Center for Process Innovation (CPI) are some of the research and technology centers.

Y.S. Cypriot Catalysts Ltd., LOMARTOV, Global Factor International Consulting, ENIDE, TheGreenTech, Dimea Oy, and Construction Cluster Ireland are examples of industry and consulting firms.

NGOs and associations: Packaging Cluster, Zero Waste Montenegro.

In addition to sharing insights from its clustering work with sibling projects Hephaestus, ROTATE, and RAWMINA, the ReSoURCE project participated in the panel discussion on circularity in materials. Within the perspective of the EU's twin transition, the seminar sparked discussion about potential future collaboration prospects and sustainability initiatives.

Day-1: Keynote addresses, project presentations, and conversations about EU-funded projects were in center of discussions on the first day.

- Keynote addresses: LEITAT Technological Center and the Spanish National Contact Point (NCP)

- Participants present novel concepts and research avenues during elevator pitch sessions.
- Representatives from a number of EU-funded initiatives, such as ReSoURCE, DICIM, REFORM, CREDIT, Exploit4InnoMat, and IS2H4C, participated in a panel discussion.
- Fostering partnerships and chances for informal collaboration through networking reception took place.

Day 2: Included interactive seminars and site visits:

- A guided tour of DFactory Barcelona that showcases cutting-edge circular manufacturing technology
- Key Horizon Europe calls and cross-sector opportunities are discussed in parallel topic sessions.
- Group presentations outlining results and suggested actions

In addition, Crowdhelix's open innovation concept, an international digital platform that links corporations, universities, and research organizations to work together on EU-funded research and innovation, was presented during the event. The Circular Economy Helix, a digital community within the Crowdhelix platform that promotes cooperation and knowledge sharing on circular economy-related topics, was presented to the audience. The Helix facilitates matchmaking for Horizon Europe proposals and speeds up impact across connected value chains by bringing together hundreds of specialists working on sustainability-driven projects.

For a detailed account of networking efforts and joint activities with external stakeholders, please refer to Deliverable D9.4 – Second Report on Networking and Joint Activities. This current report focuses on the external communication and dissemination dimensions of those interactions.

Final Event of the ReSoURCE Project

The ReSoURCE Final Event – *“Driving Digital Innovation for a Circular and Competitive European Industry”* was held on 17 November 2025 at the ‘AT60’ House of Austria in Brussels, strategically scheduled to coincide with the European Commission’s Raw Materials Week. The event was open to the public and promoted widely through LinkedIn, targeted email invitations, and partner networks to reach the most relevant stakeholders across industry, research, and policy. In total, the event gathered around 35 participants, including representatives from EU institutions, industry associations, academia, and project partners (

Figure 13 and Figure 14).

The event showcased the main results and impacts of the ReSoURCE project, focusing on how AI-driven and sensor-based technologies can enable circular management of refractory materials. The programme combined high-level discussions with practical examples, demonstrating how the project's digital innovation supports the EU's goals for a greener, more competitive, and resilient industrial base.

The workshop featured three sessions. The first presented the Key Exploitable Results (KERs) developed within the project, highlighting advances in LIBS, AI-based multi-sensor systems, and industrial demonstrators. The second session focused on case studies and success stories, showing how project innovations are being implemented in real industry contexts. The final panel discussion brought together European, industrial, and policy perspectives to reflect on future directions for circular raw material management, digitalisation, and skills development in Europe.

The event concluded with a short wrap-up and networking aperitivo, offering participants the opportunity to exchange ideas and explore future collaboration opportunities. Overall, the ReSoURCE Final Event successfully showcased the project's achievements, stimulated dialogue among key stakeholders, and reinforced the project's contribution to advancing Europe's circular and digital transformation.



Figure 13: Group picture at final event, Brussels November 17th, 2025.



Figure 14: Compilation of pictures at final event, Brussels November 17th, 2025.

Communication after project end

As the ReSoURCE project concludes, strategic steps have been taken to ensure that its communication and dissemination efforts continue to deliver value beyond the project’s lifetime.

The consortium is committed to continue sharing RESoURCE results via scientific publications or events. The first events happening shortly after ReSoURCE official project closure were

- RHI Magnesita 2025 bulletin - [Bulletin 2025 - The Journal of Refractory Innovations | RHI Magnesita](#)
 - News item - [Successful Completion of ReSoURCE—RHI Magnesita’s First Coordinated Horizon Europe Project | RHI Magnesita](#)
 - Research article - [Unlocking the Recycling Potential of Fine Refractory Breakout Materials | RHI Magnesita](#)
- 9th International Conference on Refractories, Jamshedpur (21 Jan 2026) — Sustainable Refractory Solutions Powered by Advanced Technologies, Alexander Leitner, RHI Magnesita
- 13th Edition of the Euro-Mediterranean Symposium on Laser-induced Breakdown Spectroscopy, EMSLIBS 2025. January 2026, France. Oral Presentation by Yanick Conin, Fraunhofer ILT: “Real-time Predictive LIBS Target Selection for Heterogeneous Materials via HSI-3D Sensor Fusion”
- K1-MET Simulation Conference – April 2026, Linz – Austria

Moreover, the project website will remain online and accessible for a minimum of two years following the end of the project. It will continue to serve as a central repository for public deliverables, publications, event materials, and key results - providing ongoing visibility to stakeholders, researchers, and industry actors.

The ReSoURCE LinkedIn page will also remain active during this post-project period, with occasional updates or resharing of partner activities that are relevant to the project's legacy and further exploitation of its results. This channel will help maintain visibility among the professional community and encourage continued engagement. Furthermore, the project e-mail box project-resource@rhimaginesita.com, will remain active for 5 years.

In addition, materials developed during the project - including webinar recordings, scientific publications, and press releases - will remain publicly available and can be used by consortium members in future presentations, research, education, or collaborative initiatives. Partners are encouraged to reference ReSoURCE in future proposals and cross-sectoral projects where relevant.

By maintaining these communication channels and promoting continued use of the project's outputs, ReSoURCE aims to extend its impact, foster cross-industry dialogue, and support the long-term exploitation of its results across the European innovation landscape.

3. Key Exploitable Results (KERs)

This section presents the Key Exploitable Results (KERs) generated during the ReSoURCE project. A total of nine KERs have been identified, each representing significant outcomes with potential for exploitation.

Within the scope of the ReSoURCE project, the KERs are classified into two distinct groups:

- **KERs 1-4:** These are independently exploitable results, each representing an innovation with direct application potential in the context of project ReSoURCE.
- **KERs 5-9:** These are supporting or enabling results, designed to be integrated within KERs 1–4 to enable or enhance their functionality, performance, or market readiness.

Additionally, these KERs also present opportunities for exploitation in industrial sectors beyond the scope of this project.

Each Key Exploitable Result (KER) is presented with its main features, intended target groups, and proposed mode of exploitation. For KERs 1 to 4, additional information is provided on business plan and the expected technological, environmental and economic impact.

Table 4 provides an overview of all KERs, including their IDs, titles, ownership and exploitation type.

Table 4: Overview of all KERs generated in the project ReSoURCE.

ID	Title/Name of KER	Owner(s)	Exploitation type
KER 1	RAPTOR	RHIM	Independent
KER 2	PHOENICS	RHIM, LSA, SINTEF	Independent
KER 3	Boosting Recycling Rates in Low-Carbon Refractory Products	RHIM, SINTEF	Independent
KER 4	Materials Passport (RefCem and RefFerro)	CPI, RHIM	Independent
KER 5	Dual Integrated LIBS Systems for Real-Time, High-Precision Material Classification	LSA, Fraunhofer ILT, INN	Integrated into KER 1,2,6
KER 6	AI-based Multi Sensor System	Fraunhofer ILT, LSA, NEO	Integrated into KER 1

KER 7	Multi Chamber Fluidized-bed Particle Separator	SINTEF	Integrated into KER 2
KER 8	Real-Time Hyperspectral Material Classification Platform for Industrial Sorting	NEO/ Fraunhofer ILT/RHIM	Integrated into KER1,6
KER 9	LCA and TEA study	CPI	Integrated into KER 1,2,3,4

KER 1: RAPTOR

Owner(s): RHIM

Description

The project ReSoURCE strives to innovate the full process chain of refractory recycling with an AI-supported multi-sensor sorting equipment as its core technology. If successful, the outcome will reduce Europe's CO₂ emissions by 800 k tons per year.

The RAPTOR (acronym for Refractory Automated Precision Technology for Optimized Recovery, Demo A) is a mobile, sensor-based sorting system developed to transform the recycling of used refractories. It is a key demonstrator in the EU-funded ReSoURCE project, targeting particles (> 5 mm) from spent refractory material streams. Refractories are critical for industries like steel and cement but have a high CO₂ footprint. Manual sorting is limited to coarse material (> 70 mm) and to optical features only. The RAPTOR enables high precision, automated recycling - boosting recovery, reducing emissions, and advancing the circular economy. The RAPTOR processes pre-crushed and sieved breakout materials on a conveyor. Each particle is analyzed by a 3D camera, hyperspectral imaging (HSI), and a LIBS (Laser-Induced Breakdown Spectroscopy) sensor. Particles are sorted using robotic pickers or air ejection into bins. The LIBS system removes surface contamination and detects chemical elements like magnesium or aluminum. The HSI helps define regions of interest (ROIs), reducing LIBS usage. The system is fully automated and enables high-resolution sorting for enhanced recycling accuracy.

Target Users

Refractory producers and recyclers, Other solid waste recyclers

Mode of Exploitation

- Internal deployment of replicated RAPTOR within various production/recycling plants of RHIM
- Replicated and adapted units for other industrial sectors

Business Plan and Sales Forecast

Market Entry Strategy: Production of replicated units, pilot and full-scale installation projects

The revenue model for KER RAPTOR is presented in Table 5.

Table 5: Revenue Model for KER RAPTOR

Year	Total No of Equipment	Equipment sold	Expected Revenue	Cost Savings
Y1	1	0	0 M€	0.5 M€
Y2	2	1	2 M€	1 M€
Y3	3	1	2 M€	2 M€
Y4	4	1	2 M€	3 M€
Y5	6	2	4 M€	5 M€
Y6-10	11	5	10 M€	12 M€

Expected Impact

Economic Impact: As presented in the revenue model in previous section, upskilling workforce for automated sorting processes.

Environmental Impact: Each RAPTOR unit is expected to deliver annual reductions of approximately 15,000 tonnes of CO₂ emissions, save 15 GWh of energy, and reduce landfill waste by 5,000 cubic meters.

Scientific/Technological Impact: RAPTOR demonstrates for the first time a fully automated, mobile sorting solution for coarse refractory fractions, integrating singulation, 3D object detection, LIBS+HSI-based classification and robotic/air-pressure ejection into one transportable unit (TRL 7-8). The system enables high-resolution, material-specific sorting directly at recycling sites, significantly increasing the availability and quality of circular refractory raw materials.

The demonstrator provides a robust dataset covering sensor performance, classification behaviour and system throughput under industrial conditions. These results form the scientific basis for further optimization of online LIBS analytics, adaptive machine-learning models, and digital-twin approaches.

KER 2: PHOENICS

Owner(s): RHIM, LSA, SINTEF

Description

A quality control and sorting device equipped with multiple sensors (e.g., Laser-induced breakdown spectroscopy), direct sorting units (e.g. multi-chamber separator) and powder handling technologies (e.g., pneumatic transport, cyclones). PHOENICS (acronym for Powder Handling Optimization ENabling Improved CharacteriSation, DemoB) is designed to characterize fine spent refractory materials (< 5mm) ensuring continuous quality control and to separate the material based on size fractions, physical properties and/or chemistry. Powder handling technologies ensure the safe operation of dust streams. This sorting device is being designed as a mobile prototype unit for fine particles (< 5mm).

Target Users

Refractory producers and recyclers, Other solid waste recyclers

Mode of Exploitation

- Internal deployment of replicated PHOENICS within various production/recycling plants of RHIM
- Replicated and adapted units for other industrial sectors

Business Plan and Sales Forecast

Market Entry Strategy: Pilot and full-scale installation projects, sensor upgrades for further business case exploitation, production of replicated units

Revenue Model: The automated sorting units RAPTOR and PHOENICS will enable the recycling plants to process more material, increasing revenue through increased throughput but also by decreasing input material costs (higher grain size variations). New markets (upcycling routes) and virgin raw material savings are the basis for the revenue model that will be developed during full validation of PHOENICS.

Due to the multiple individual components of PHOENICS and its flexibility, it will provide various economic and ecological benefits. One business case builds on the effective separation of carbon from the refractory matrix (KER3); with that a cost intensive virgin raw material (graphite) can be replaced, yielding not only significant price reductions but also strengthening the supply chain resilience and carbon footprint; a second business case builds on the usage of fine material in alternative applications (KER 4). With improved quality control, feedstock stability for alternative markets can be guaranteed, and upcycling routes are established. The LCA and TEA impact of one of the use cases is reflected in KER 9, highlighting significant economic and ecological benefits for both industries.

Expected Impact

Economic Impact: As presented in the revenue model in previous section, upskilling workforce for automated sorting processes.

Environmental Impact: Each PHOENICS prototype unit is expected to deliver annual reductions of approximately 5,000 tonnes of CO₂ emissions, save 5 GWh of energy, and reduce landfill waste by 1000 cubic meters.

Scientific/Technological Impact: PHOENICS represents a first PoC for continuous automated quality control and sorting of fine fractions, combining individual separation techniques on lab scale into a demonstrator (TRL 5-6) installed at a recycling plant, the demonstrator yields a significant increase in data relevant for an optimized usage of spent refractories, a patent application has been filed.

KER 3: Boosting Recycling Rates in Low-Carbon Refractory Products

Owner(s): RHIM, SINTEF

Description

The recycling rate in low carbon refractory products is increased to 40% (from 25%) by using recycling material below 1 mm which is pre-processed by an innovative comminution technique and the multichamber separator. The depletion of the carbon content in the coarser fraction and the enrichment of carbon in the finer fraction enables the production of well performing low carbon recycling products for the steel industry. Conventional comminution and manual sorting technologies generate agglomerates within circular raw materials for recycling, accompanied by high carbon content in the coarse fractions, which limits the reuse in low carbon recycling bricks.

The improved liberation of carbon matrix by optimized pre-processing technologies in combination with a multi-chamber separator enables the generation of tailored circular raw materials, separating carbon-enriched from carbon-depleted fractions. This results in improved brick properties, e.g., density, and porosity, while increasing the share of recycled content.

Target Users

RHIM, other refractory producers

Mode of Exploitation

Launching new range of products in the market with improved sustainability profile

Business Plan and Sales Forecast

Market Entry Strategy: New range of refractory products with improved sustainability profile

Revenue Model: Sales of new products, savings in virgin raw material usage/price reduction. Starting from successful laboratory trials, year 1 will focus on validation of lab trials in production route including validation of PHOENICS (KER 2), implementation of recipe changes within quality management routine, infrastructural requirements for plant production, establishment of business model.

Expected Impact

Economic Impact: First lab trials focused on magnesia carbon bricks with low carbon content (3 % of total magnesia carbon production in Europe), however established routes with combinations of innovative comminution and separation aggregates incl. PHOENICS and RAPTOR will broaden the usage to other magnesia carbon and carbon bonded brands.

Societal/Environmental Impact: 40% recycling rate, 100% graphite substitution in low carbon bricks

Scientific/Technological Impact: Deployment of the separation technology within PHOENICS (KER 2). Transfer to additional carbon bonded refractory materials. Current TRL is 4. TRL 6 is expected in Year 1 through brick prototype produced by pilot trials in the plant.

KER 4: Materials Passport (RefCem and RefFerro)

Owner(s): CPI, RHIM

Description

The development of a materials passport within the ReSoURCE project serves as a critical enabler for the reuse and upcycling of industrial refractory waste into non-refractory applications. The passport provides a comprehensive “fingerprint” of the materials capturing detailed physicochemical, structural, and functional properties to guide their processing and integration into new value chains. In this initiative, two refractory waste streams SCL_1 and CRK_1 sourced from steel and cement industries respectively, were subjected to advanced characterisation. Techniques such as X-ray diffraction (XRD), Raman and FTIR spectroscopy, SEM-EDX, inverse gas chromatography (IGC), and thermal/electrical property testing were employed. These analyses identified the presence of key phases like MgO, graphite, spinel, and calcium silicates, along with physical parameters such as particle size distribution, bulk/skeletal densities, thermal conductivity, dielectric constants, and electrical resistivity. By capturing these datasets systematically, a reusable, application-driven profile termed the materials passport was established. This enabled clear differentiation of the two streams based on critical properties: SCL_1 exhibited conductive characteristics due to high graphite content, while CRK_1 displayed dielectric behaviour with broader compositional complexity. Such insights informed decisions on processing, functionalisation (e.g. silane treatment), and end-use suitability.

The passport not only facilitates quality assurance and traceability of recycled fillers but also supports AI-driven modelling and design of polymer composites, coatings, and advanced formulations. Ultimately, the materials passport enhances circularity by bridging waste origin with performance-based reusability in new sectors, thereby transforming industrial by-products into high-performance, specification led materials.

Target Users

Refractory recyclers, Polymer and Composite manufacturers, coating formulators, construction material developers, and sustainability-focused industries seeking alternative fillers. It also involves researchers, recyclers, and circular economy innovators.

Mode of Exploitation

The materials passport enables commercial reuse of refractory waste in polymer composites, coatings, and insulation, offering cost-effective, sustainable alternatives to virgin fillers and supporting industrial decarbonisation and circular economy strategies.

Business Plan and Sales Forecast

Market Entry Strategy: Facilitating the supply of recycled materials through RHIM by providing product passports, enabling various industries to utilize recycled spent refractories as sustainable raw materials in their production processes.

Revenue Model: Revenue is expected from selling recycled materials to other industries utilizing recycled spent refractories as raw materials in their production processes. Indicative revenue models for mRef Cem and mRef Ferro, based on limited customer feedback and corresponding estimations, are presented in Table 6 and Table 7, respectively.

Table 6: Revenue model for mRef Cem

Year	Primary Market	Projected number of Clients	Expected Revenue
Y1	Pilot: UK Composites, building and infrastructure, specialty inks and coatings, Building tiles and cement additives etc.	7	£35,000
Y2	EU Expansion + Construction Tier 1s	30	£300,000
Y3	Global Scale-up (Asia, NA)	70	£700,000

Table 7: Revenue model for mRef Ferro

Year	Primary Market	Projected number of Clients	Expected Revenue
Y1	Pilot: UK Composites, building and infrastructure, specialty inks and coatings, Building tiles and cement additives etc.	7	£15,000
Y2	EU Expansion + Construction Tier 1s	30	£100,000
Y3	Global Scale-up (Asia, NA)	70	£300,000

Expected Impact

Economic Impact: Presented in Business Plan and Sales Forecast in previous section. In addition, 25-50 direct to indirect jobs in the areas of Data analysts, platform support, and recycling logistics.

Environmental Impact: Reducing ~5,000 tonnes CO₂ emission by 2028 via improved recyclability and reduced landfill. 10-15% reduction in virgin raw materials per production line for better design and end-of-life recovery.

Scientific/Technological Impact: A robust and reliable technical data sheet for recycled materials, tailored to meet the quality and performance requirements of industries utilizing these materials as raw inputs. 2000-5000+ materials passport issues to industries producing composite parts, coatings, precast units etc.

KER 5: Dual Integrated LIBS Systems for Real-Time, High-Precision

Material Classification

Owner(s): LSA, Fraunhofer ILT, INN

Description

Two integrated LIBS systems deliver high-precision, spectroscopic real-time analysis and classification of a broad range of materials. By performing multiple measurements at different surface locations, the systems maximise reliability and reproducibility. In addition, a powerful cleaning pulse can be applied to remove oxide layers or contaminants, ensuring consistently accurate, reliable, and truly representative analytical results under even the most demanding industrial conditions. Fully automated classification of materials for sorting, adaptable to varying grain sizes, weights, and surface conditions. The system offers flexible throughput rates depending on the applied separation methodology, ensuring optimal performance, efficiency, and precision across a wide range of industrial sorting applications.

For RAPTOR, a broadband spectrometer system was successfully integrated into a sorting machine, enabling real-time analysis of LIBS spectra. The classification results are transferred directly to the robot and pressurized valve ejection control system, with full connection to the automation control. A 40 W laser system with a multi-pulse option was implemented, providing enhanced flexibility and performance for different material types and sorting conditions. Full synchronization between the laser, spectrometer, and sorting control system was achieved, ensuring efficient operation and high reliability.

For PHOENICS, a laser system with reduced optical power was developed for the analysis of fine fractions in continuous flow. This setup includes optical beam guidance and a spectrometer system to enable continuous PHOENICS measurements at the very short distances required in this configuration.

Target Users

Refractory recyclers, other solid waste recyclers (for example, demolition waste recyclers), general recycling or sorting applications in industries and R&D

Mode of Exploitation

Integration in replicated RAPTOR and PHOENICS through AI-based multisensor. New R&D projects in other industrial sectors than refractories.

KER 6: AI-based Multi Sensor System

Owner(s): Fraunhofer ILT, LSA, NEO

Description

For sorting used refractory bricks, a system of three different optical sensors is used to classify each brick. AI-based algorithms firstly control the operation of one sensor depending on the data of others and secondly combine the data of all sensors to determine the right material class for each piece of refractory.

High-purity refractory sorting faces a limitation: no single sensor can capture all necessary material properties. The process demands simultaneous analysis of shape, contaminations, mineralogy, and chemistry – requiring multiple specialized sensors and complex data fusion. Coordinating targeted elemental analysis with broader area mapping creates bottlenecks in processing speed and decision accuracy.

Combining the data prior to the material classification step generates a complex data set from which AI-based evaluation methods achieve improved results compared to individual evaluation, identifying patterns and correlations in changing material streams. The high variability of feedstock material is a challenge for sensor training, which is largely facilitated and accelerated using machine learning.

Target Users

Sorting applications for spent refractories and other solid waste materials such as plastics, glass, demolition, batteries, metals, construction materials.

Mode of Exploitation

Integration in replicated RAPTOR and PHOENICS through AI-based multisensor. New R&D projects in other types of materials including primary raw minerals and complex waste streams which are challenging for characterisation and sorting today.

KER 7: Multi Chamber Fluidized-bed Particle Separator

Owner(s): SINTEF

Description

The multi-chamber fluidised-bed separator is designed to separate particles based on differences in size and density. Within the ReSoURCE project, the unit has been tested for removing impurities from spent refractory fines (<1 mm). The resulting fractions can then undergo different recycling processes, enhancing overall recyclability. Removing specific impurities from refractory materials is essential to enable their reuse in new refractory products. The presence of certain compounds can make the material unsuitable for such applications. Presence of dust can pose a risk of human and environmental exposure when handling fine powders. The separation unit can also be used to remove the airborne dust fraction to make the powder easier and safer to handle. The system is flexible and can handle various material types, by varying the air velocities for each chamber. It can be equipped with sensors to further optimize the separation process. The same principle can be applied across a wide range of industrial powder applications, for recycling, dedusting or as a pre-process step.

Target Users

The multi-chamber fluidized bed technology can be tailored for any solid material requiring sorting based on parameters such as size, shape, and density, particularly for fine powders. This makes it highly relevant for industries involved in the processing or recycling of metals, minerals, and ceramic materials.

Mode of Exploitation

Integration into replicated PHOENICS units, new R&D initiatives focused on alternative primary raw materials for the metal, mineral, and ceramic industries, as well as on spent materials such as demolition waste and black mass from end-of-life batteries.

KER 8: Real-Time Hyperspectral Material Classification Platform for Industrial Sorting

Owner(s): NEO/ Fraunhofer ILT/RHIM

Description

Real-time hyperspectral imaging system and multivariate analysis platform enabling rapid material identification and sorting in industrial processes, enhancing recycling efficiency, quality control, and process automation.

Developed and validated a real-time hyperspectral imaging platform for automated classification of refractory materials on a conveyor belt. The system successfully identified and sorted used refractories into recycling categories based on spectral and multivariate analysis, demonstrating reliable inline performance and seamless integration with other sensing and sorting technologies in the industrial workflow. Efficient recycling of used refractories is hindered by their heterogeneous composition and contamination. Manual sorting is slow and inaccurate, limiting material recovery and quality. Automated, reliable identification of material types in real time is essential to enable high-throughput, sustainable recycling processes. The solution combines high-speed hyperspectral imaging with robust multivariate modeling to enable precise, real-time classification of materials on conveyor belts. Its high spectral and spatial resolution ensures accurate identification under varying conditions, while adaptable models allow optimization and inclusion of new materials. Non-contact, continuous operation enhances sorting accuracy, throughput, and recycling yield, delivering significant efficiency and sustainability benefits for industrial material recovery processes. The solution includes 2 high resolution hyperspectral cameras working in the VIS-NIR-SWIR spectral region, custom broadband illumination sources and an industrial computer for control and data analysis. Can be mounted on top of most industrial conveying systems.

Target Users

Raw materials (mining); recycling industries (refractories, plastics, glass, demolition, batteries, metals, construction materials).

Mode of Exploitation

Integrated into replicated RAPTOR units. Also, as a standalone hyperspectral classification module, part of integrated sensor systems, or a customizable service, enabling licensing, OEM integration, and tailored deployments across recycling, mining, and process monitoring industries.

KER 9: LCA and TEA study

Owner(s): CPI

Description

Three key studies were conducted for Project ReSoURCE. A technoeconomic assessment (TEA) and life cycle assessment (LCA) were conducted to quantify the economic and environmental improvements from implementing ReSoURCE's automated sorting process compared to the established manual sorting process. Additionally, a conceptual design study was completed where a commercial-scale refractory automated recycling facility was developed, incorporating an increased throughput. Refractory bricks are commonly sorted manually across the industry. However, this has many limitations as well as having low sorting accuracy. The TEA and LCA analysed the economic and environmental impacts of moving to ReSoURCE's automated sorting system. The concept study on the other hand, evaluated the throughput capabilities and optimisation opportunities to assess the feasibility of a commercial-scale ReSoURCE process. The TEA showed that the automated sorting process could increase the value added per tonne of material as well as significantly increase the total facility revenue generated by unlocking capacity and increasing recovery and valorisation. The LCA showed that the automated system reduces environmental impacts and identified environmental “hotspots” within the process for future improvement. The concept design study enabled the identification of potential process bottlenecks, defined optimisation strategies, and assessed the benefits and challenges of onsite and offsite sorting.

Target Users

Initially, these studies will be utilized by RHIM. However, they will be of further interest to the Refractory industry.

Mode of Exploitation

LCA/TEA modules will be integrated into KERS 1,2,3 and 4. It can also be adapted as LCA/TEA modules in other solid waste recycling R&D and commercial projects.

4. Conclusions

The project ReSoURCE has carried out extensive dissemination and communication activities through regular projects update blogs on website, social media engagement, targeted press releases, project meeting and networking activities, achieving all defined KPIs. Scientific impact was ensured by several peer-reviewed publications and active participation in leading conferences, outreach events, and education activities such as Bachelor, Master, and Doctoral theses. Exploitation activities resulted in 9 Key Exploitable Results (KERs), offering significant technological, environmental and economic benefits. Furthermore, networking efforts through Circular Helix and other collaborative events have facilitated strong partnerships and knowledge exchange.

5. Annexes

Link to project website: [ReSoURCE Website](#)

Link to pictures on website: [Pictures](#)

Links to publications and results of the project: [KnowledgeVault](#)

Links to media appearances: [Former Press Releases](#) / Press articles under the 'Press' section in the [KnowledgeVault](#)