



EU Raw Materials Week

An insight into successful raw materials projects

EU Horizon Technology
Success Stories
Vol. 3

Foreword



In her 2023 State of the Union speech, the President of the European Commission Ursula von der Leyen, underlined the fundamental role of raw materials for the EU economy. In fact, the European Commission (EC) proposed on 16 March 2023 its [Critical Raw Materials Act](#). The Act puts forward a set of measures to strengthen the raw materials supply chain in the EU, with the goal of securing the EU's future supply of critical raw materials (CRMs) [required for strategic sectors](#) such as renewables, e-mobility or space and defence.

HaDEA, the [European Health and Digital Executive Agency](#), is proud to contribute to this goal by supporting the implementation of Horizon 2020 and Horizon Europe projects in the field of raw materials. These EU-funded projects are competing internationally in a rapidly evolving geopolitical environment, where scientific cooperation delivers innovation in support of EU interests.

The EC has committed close to €500 million for the period 2021-2024 for raw materials R&I under Horizon Europe. This covers primary and secondary raw materials, their supply chain, and policy support. The first 30 projects are already running, worth €260 million funding. They are expected to add significant results to the stock of scientific and technological developments. And this is not all, we are about to sign 18 more projects.

Over the previous programming period (2014-2020) the EC invested around €600 million in raw materials projects. Some of them are now approaching completion and have reached significant results.

The EU Horizon Technology Success Stories session that HaDEA co-organises in the framework of the eighth EU Raw Materials Week is the perfect opportunity to present six Horizon 2020 projects that have brought tangible advancement along the raw materials value chain. The six are just highlights from a rich landscape of EU-funded raw materials R&I.

Some of these projects focus on mineral exploration, offering sustainable and efficient exploration technologies. Others provide novel, environmentally sound mining solutions integrating state-of-the-art digital technologies, such as digital twins or artificial intelligence. Moreover, many target CRMs that are crucial for Europe's green and digital transition: gallium and silicon are used in semiconductors and solar panels; light rare earth elements in wind turbines and electric motors. These technologies play a pivotal role in delivering the [European Green Deal](#) and making Europe the first carbon-neutral continent by 2050.

Self-reliance in mining, processing, and recycling of raw materials is one of the EU's key ambitions. The featured projects are our path makers and I wish them full success in their research and future deployment, and all readers plenty of new insights.

Marina Zanchi
Director of the Health and Digital Executive Agency (HaDEA)

Table of contents

GREENPEG	4
Dig_IT	5
NEXGEN SIMS	6
AlSiCal	7
TARANTULA	8
PHOTORAMA	9
Overview of critical raw materials targeted in featured projects	10

GREENPEG

New Exploration Tools for European
Pegmatite Green-Tech Resources

 Innovation Action (IA)

 1 May 2020 – 31 October 2024

Total budget: €9 250 230

Requested EU contribution

 €8 325 292

90%



cordis.europa.eu/project/id/869274



www.greenpeg.eu

Summary in keywords

Pegmatite exploration technology and Life Cycle Assessment

Granitic pegmatites can be economically enriched in a variety of critical and rare metals, industrial minerals and gemstones, and are thus strategically important exploration targets.

Integrated exploration solutions on the genesis of pegmatite

The project strives to reduce the cost of mineral exploration, as well as its societal and environmental impacts, thanks to optimised exploration strategies.

CRMs addressed

Beryllium (Be), feldspar, lithium (Li), light rare earth elements (LREE), scandium (Sc), silicon metal (Si), tantalum (Ta).

Main results

GREENPEG is delivering an integrated, multi-method, sustainable and low-cost exploration toolset as a complementary suite of multi-scale methodologies that are optimised for the characteristics of small-sized pegmatite deposits. As part of the toolset, three new instrument demonstrators and two new datasets were released:

- the first European Aerospace Safety Agency certified helicopter-compatible nose stinger magnetometer for high-resolution surveys in difficult terrain;
- a piezo-electric seismometer as a low-cost, easy-to-deploy instrument for direct detection of buried pegmatite and quartz commodities;
- a drone-borne hyperspectral imaging system as a low-cost and flexible tool for prospect-scale mineral resources mapping;
- an open-access petrophysical database and a library of spectral reflectance for pegmatite minerals, which will support informed decision-making for optimised geophysical exploration strategies.

Follow-up

The GREENPEG toolset and innovations will be upscaled into marketable technological and knowledge-based consultancy services. The piezo-electric seismometer development will be followed up in a new project.

SME project partners promote and provide the nose stinger magnetometer and the GREENPEG toolset as consultancy service to industrial stakeholders. Various stakeholders from lithium exploration and Enhanced Geothermal System (EGS) have approached GREENPEG partners to learn about the benefits of its developments.

An application for a Marie Skłodowska Curie Action (MSCA) doctoral network on pegmatites is under preparation for submission in November 2024.

Benefit for the EU

The toolset will be easily deployable by small- and medium-sized enterprises and accessible to exploration and mining companies. Thus, making European pegmatite exploration competitive, strengthening the European CRM supply chain and contributing to leading edge exploration “Made in Europe”.

New targeted tools like the petrophysical database, the nose stinger magnetometer and the piezoelectric seismometer allow a more efficient and sustainable exploration with a significantly decreased environmental impact and larger societal acceptance. This is supported by a methodology for ESG best practice.

Dig_IT

A Human-centred Internet of Things
Platform for the Sustainable Digital Mine of
the Future

 Research and Innovation Action (RIA)

 1 May 2020 – 30 April 2024

Total budget: €6 997 416

Requested EU contribution

 €6 997 416

100%



cordis.europa.eu/project/id/869529



digit-h2020.eu

Summary in keywords

Mining

The project seeks to increase mining efficiency by utilising optimised scheduling, increased uptime using predictive operation and maintenance and advanced geological interpretation during the exploration mining phase to identify new opportunities.

Internet of Things (IoT)

Dig_IT aims to develop a human-centred Industrial IoT (IIoT) platform connecting the mining ecosystem of assets, environment and humans.

Main results

The main innovations of the Dig_IT project are:

- Smart Garment development for mining personnel assessing occupational health, safety and environmental (OHSE) parameters, physical and chemical agents;
- Environmental Health Safety and Sustainability Monitoring through IIoT;
- Fluid Dynamics digital twins design and development for air/water quality predictive analysis;
- geotechnical digital twin development process IIoT/Edge interfaces integrated;
- Big Data optimisation for early prediction of slope failure of open pit mine;
- safety culture rule-based methodology for the assessment of the mining workers' training needs;
- Sustainable Blockchain platform for mine data traceability and transparency;
- Decision Support System web-based intelligent platform for mining.

Follow-up

The resulting IoT platform will remain at the demo sites after project completion. Therefore, the end-users within the project consortium will build on the results immediately. In the short to medium term, other mining sites could take up the project results in follow-up R&D projects aiming at increasing the Technology Readiness Level (TRL) of Dig_IT developments, thus paving the way for commercial rollout.

Benefit for the EU

The project has a human-centred approach at its core, as also evidenced in the project title. Therefore, the main contribution of Dig_IT is its implementation of sensors and models that predict risks. This will improve the safety of miners during mineral extraction and the environmental sustainability of mining operations.

The technologies will also increase the efficiency and economic viability of mining operations; for example through tools for optimising planning/operations or predictive maintenance of machinery.

NEXGEN SIMS

Next Generation Carbon Neutral Pilots for Smart Intelligent Mining Systems

 Innovation Action (IA)

 1 May 2021 – 30 April 2024

Total budget: €16 247 347

Requested EU contribution

 €12 986 248

81%



cordis.europa.eu/project/id/101003591



www.nexgensims.eu

Summary in keywords

Sustainable extraction of minerals

Efficient, safe and sustainable mining as an enabler for a global green transition, with minimised environmental impact, operation efficiency, safety and job creation.

Sustainable underground mining

Efficient, safe and autonomous material handling by using battery powered mining machines, supported by AI powered fleet optimisation, 5G communication network and autonomous robotised inspection.

Main results

The project has three major pilots to demonstrate and develop technologies within the following areas:

- Robotised inspection before and after blasting: fully autonomous drone inspection of high safety risk areas in underground mines, to remove humans from unsafe zones and allow early access to the blasted area.
- Autonomous material handling: utilising battery-powered machines for early access to the muck pile after blast, and increasing the utilisation of the machines.
- Autonomous vehicles in mixed traffic: focus on investigating how to make two vehicles meet and pass each other in a safe way underground. This work will give the opportunity to optimise the flow in a mine, which increases both safety and productivity, and can contribute to the establishment of laws and regulations in this area.

Follow-up

After successful demonstrations of the described pilots, several project partners will continue their exploitation work with technologies, services, and products. The consortium is looking into new opportunities for projects for further collaboration and development that build on the project's results.

Benefit for the EU

NEXGEN SIMS contributes to:

- increased operational efficiency and market share for EU mining companies and technology providers;
- systemic approach targeting carbon-neutral mining;
- high potential for expansion in the fast growing €18 billion mining market;
- future and even deeper mining enabled in the EU;
- improvements in safety and job creation;
- trust to build public awareness for European sustainable mining by communicating project achievements, results and their possible impacts as well as communicating the modern sustainable mine as an enabler for the green transition.

AlSiCal

Towards sustainable mineral and metal industry: ZERO Bauxite Residue and ZERO CO₂ from co-production of Alumina, Silica and precipitated Calcium carbonate.

Research and Innovation Action (RIA)

1 September 2019 – 29 February 2024

Total budget: €5 888 235

Requested EU contribution

€5 888 235

100%



cordis.europa.eu/project/id/820911



www.alsical.eu

Summary in keywords

Sustainable raw materials

A new technology with CO₂ utilisation and zero-waste, avoiding bauxite residue generation.

Resource efficiency

Complete transformation of one single mineral into three valuable raw materials.

CRMs addressed

Bauxite / aluminium (Al).

Main results

The AlSiCal project has conceived, developed, and benchmarked several process alternatives to transform anorthosite into alumina, silica, and precipitated calcium carbonate, with integrated CO₂ utilisation and zero-waste generation. Alsical's technology has proven its technical and economic viability at high sustainability standards.

The technology has been validated at TRL 4, and one of the three core-steps at TRL 5. Other results include a new public data base of anorthosite deposits in the world, reactors, and process models, and innovative views and tools regarding the social dimension of mining and mineral processing initiatives.

Follow-up

AlSiCal's technology is strongly positioned for further development. The most competitive process for anorthosite has been developed in full by the Institute for Energy Technology (IFE) in Norway. IFE is conducting efforts to upscale AlSiCal technology for future industrialisation.

Potential expanded application areas to other minerals are envisioned. An alternative route based on a former patent by IFE and Nordic Mining AS has been proposed by AVLabs as a potential alternative to the AlSiCal technology. AVLabs may pursue future R&D on the alternative route to confirm its feasibility.

Benefit for the EU

AlSiCal technology unlocks currently unexploited mineral resources in Europe (anorthosite) thus securing self-supply of critical raw materials. This technology enables a European complete value chain in the aluminium industry from mine to market, without generating bauxite residue.

It efficiently transforms CO₂ into another valuable raw material (precipitated calcium carbonate) and achieves high resource efficiency by co-producing valuable raw materials with zero waste generation. It is expected that upscaling and industrial deployment of Alsical's technology stages will lead to new jobs in Europe.

TARANTULA

Recovery of Tungsten, Niobium and Tantalum occurring as by-products in mining and processing waste streams

 1 June 2019 – 30 November 2023

Total budget: €6 946 607

Requested EU contribution

 €6 946 607

100%



cordis.europa.eu/project/id/821159



h2020-tarantula.eu

Summary in keywords

Refractory metals recovery

Developing a toolkit of novel, efficient and flexible metallurgical technologies with high selectivity and recovery rates for tungsten (W), niobium (Nb) and tantalum (Ta).

Prototype validation

After selection, based on life cycle assessment and life cycle costing of the most suitable flowsheets investigated at lab scale.

CRMs addressed

Niobium (Nb), tantalum (Ta), tungsten (W).

Main results

Among the several technologies researched during the project, a process based on a combination of iono- and electro-metallurgical technologies delivered the best results from a technical, economic and environmental point of view.

The selected technologies were up-scaled and integrated in a prototype, where the final flowsheet was validated for the production of metal oxides at a kilogram-per-day capacity, the products met the commercial specifications of their broadest market segment. In addition, W, Nb and Ta containing mining waste were identified and the regulatory framework for future exploration of mining residues was investigated.

Project data was collected in compliance with the technical guidelines for compatibility with the JRC's Raw Materials Information System (RMIS) and subsequently fed into the [RMIS database](#).

Follow-up

A post-project impact follow-up committee has been created, including the partners with the main exploitable results. Its main objectives are:

- to keep Dissemination, Exploitation and Communication momentum beyond the end of the project to maximise project impact;
- to investigate new, emerging opportunities for the exploitation of the project's results.

Benefit for the EU

The EU's primary production of tungsten ore – mainly in mines located in Austria, Portugal and Spain – covers only a limited part of EU domestic demand. Similarly, although it has some niobium deposits, the EU does not produce any niobium or tantalum ores and is entirely reliant on imports. Finding alternative, secondary sources of tungsten, tantalum and niobium is paramount.

The technology developed in TARANTULA has been tailored for the recovery of tungsten and niobium/tantalum from domestic resources: industrial scrap and mining waste (tailings and slags from primary mineral extraction), thus contributing to secure the EU's W, Ta and Nb supply and sovereignty.

PHOTORAMA

PHOtovoltaic waste management – advanced Technologies for recOvery & recycling of secondary RAw MAterials from end-of-life modules

 Innovation Action (IA)

 1 May 2021 – 31 October 2024

Total budget: €10 365 764

Requested EU contribution



cordis.europa.eu/project/id/958223



www.photorama-project.eu

Summary in keywords

Photovoltaic waste management

Developing trailblazing technologies to implement a strong and reliable photovoltaic (PV) panel recycling scheme.

Photovoltaic circular model

Demonstrating full circularity by re-injecting the secondary raw materials in interdisciplinary value chains.

CRMs addressed

Copper (Cu), gallium (Ga), silicon metal (Si).

Main results

More than six technologies that strongly depend on each other are being brought to TRL 6-7 and implemented in a pilot line. From mechanical disassembling to delamination (mechanical, optical) and metal recovery (leaching, electrodeposition), the pilot line is a comprehensive “state-of-the-art” solution working in the field.

The output fractions of the line are directly reusable secondary raw materials such as aluminium, glass, copper, silicon, silver, indium, and gallium recovered at a high degree of purity. Two impactful results for both the business case and resource preserving are the recovery of high-purity glass and solar cells' metals; nowadays mainly re-directed to low-value application. The project concept of complementary technologies demonstrates efficient waste management and opens the perspectives of PV recycling to move forward to up-cycling.

Follow-up

The final scale-up and process optimisation of the pilot units are currently under progress to reach the objectives. The partners are working together to set up the pilot line by adapting the units to each other with the aim of running the full demo on industrial site for six months in 2024.

Further scale-up is envisioned to supply market-ready equipment to reply to external end-users/recyclers that already requested quotation. PHOTORAMA's commercial exploitation is designed to generate equipment as an isolated unit or combined/full-line, involving collective business ownership and operations from the consortium.

Benefit for EU

PHOTORAMA delivers technological solutions that allow Europe to manage the million tons of PV waste coming in the next decades. It also demonstrates the strong potential to develop a new market for secondary raw materials in Europe, covering with 1-year production more than 1% of annual cumulative European imports of Ag/Si/In/Ga.

Beyond just technical performance, PHOTORAMA showcases the feasibility of a circular model in the field, for solar industry to become an exemplary model for other fields and sectors. PHOTORAMA clearly contributes and supports the EU's leading positions (EU Circular Economy Action Plan, REPowerEU).

Overview of CRM targeted in featured projects

<u>CRM</u>	Project(s) targeting CRM
S Arsenic	
Antimony	
Baryte	
Bauxite / Aluminium	AlSiCal
Beryllium	GREENPEG
Bismuth	
Boron/Borate	
Cobalt	
Coking Coal	
S Copper	PHOTORAMA
S Feldspar	GREENPEG
Fluorspar	
Gallium	PHOTORAMA
Germanium	
Hafnium	
Helium	
Heavy Rare Earth Elements	

<u>CRM</u>	Project(s) targeting CRM
S Lithium	GREENPEG
Light Rare Earth Elements	GREENPEG
Magnesium	
S Manganese	
Natural Graphite	
S Nickel	
Niobium	TARANTULA
Phosphate Rock	
Phosphorus	
Platinum Group Metals	
Scandium	
Silicon Metal	GREENPEG, PHOTORAMA
Strontium	
Tantalum	GREENPEG, TARANTULA
Titanium Metal	
Tungsten	TARANTULA
Vanadium	

S = Strategic

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