

Expected results

RareAsh's driving proposed results are related to:

(I) Demand for 21 critical materials as Lanthanides, Scandium, Yttrium, Gallium, Strontium, Rubidium, and Wolfram which is expected to increase since they are needed in the new generation of high-tech materials used by the EU industries;

(II) Recycling large volumes of coal ash waste generated every year cannot be ignored as one of the most promising and potential non-energy secondary unconventional resource of HRM in Europe;

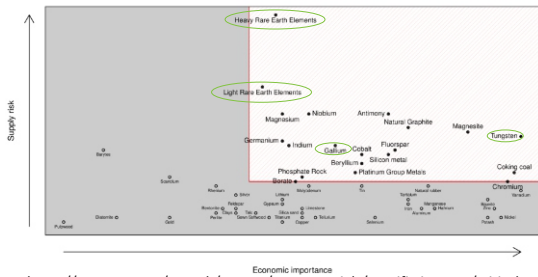
(III) Maximising valuable metal recoveries of the production processes, by choosing of the appropriate methods;

(IV) Environmental goals like combustion waste reduction from landfill sites, reduced mass movement and land use, decreasing CO2 emissions from conventional mining activities;

(V) Contribute to securing a sustainable supply of mineral resources for the EU countries;

(VI) Health and safety aspects;

(VII) Creation of highly skilled jobs and improvement of economic activity.



https://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en

Environmental



Energy recovery unit and landfill of Maia, Portugal

- The utilization and reuse of large volumes of coal ashes generated every year and/or landfilled for HRM extraction purposes, will secure in the future a sustainable supply of critical mineral resources for the EU countries;
- Preserve natural resources, which would otherwise be obtained from natural raw materials by using unconventional secondary resources - fresh and land-filled fly ash and bottom ash - the same way as any other source soft (pulverized) rock for strategic metals production such as Lanthanides, Ga, Sr, Rb, Y and W;
- Waste-less and environmentally safety utilization of various ashes by residue valorization, and recovery of metals with mineral acids instead cyanides;

- Promoting and contributing for sustainable of waste management and waste zero directives application within the EU, facing lowest remaining reserves and same environmental problems.

Technical-economic

- Utilizing coal waste products (CWP) as secondary resources in EU and winning back materials by recycling waste streams, to make EU less dependent on raw materials from elsewhere, and to save EU natural resources;
- Develop metal recovery processes and transform wastes, enriched in metal concentrations similar to those in some mineral ores, as one of the most promising secondary resource into high-grade and valuable metals with various applications, for which previously the technical and/or economical recovery feasibility was not existing;
- Metal recovery from coal ash may be more efficient than the recovery of metals from mineral ores since the physical form is more amenable to processing by several extraction techniques and processes. Thus, time, energy, environment and economic efforts are considerably reduced;
- Obtaining information about composition/metals distribution in these mineral combustion residues and its physical properties (type of 'rock') and about evolution and overall availability of historic dumps;
- Maximizing valuable metal recoveries of the production processes, by appropriate methods/technical solutions for selection and optimization (precipitation, ion exchange, electrolysis, microemulsion) which will valorize the individual characteristics of each waste;
- Obtaining of HRM concentrates with rare earth high content, as a key intermediary in the production process and a by-product of the HRM extraction process;
- Obtaining of high purity reactives, metals and metallic salts, catalysts and adsorbents, metal and oxide nanoparticles, single or deposited on silica, scale controlled and functionalized and solar collectors precursors that will be possible used in high-tech, chemical, environmental and metallurgical purposes;
- Securing a sustainable supply of HRM for the EU countries when the use of rare earths in high-tech is increasing dramatically and the demand for rare earths will continue to grow significantly.
- Promoting "Eco labelling of secondary resources" to inform potential customers and allow for sustainable procurement.

Social

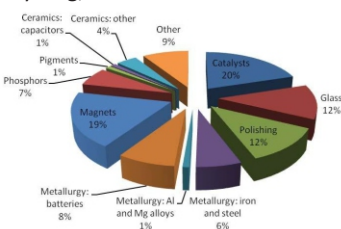
(1) To contribute to new areas of development, economy reinforcement, high qualified jobs, and EU autonomy and security;

(2) To increase the quality of life in urban and rural areas by reducing the health and environmental impact caused by extraction activities, and landfills;

(3) To increase the people's level of awareness and trust in conserving of natural resources by wastes recycling;

(4) To develop reference documentary for people's awareness on long term environmental raw materials securing supply;

(5) To increase the level of people's trust that recycling offers significant investment, innovation and employment opportunities in the EU.



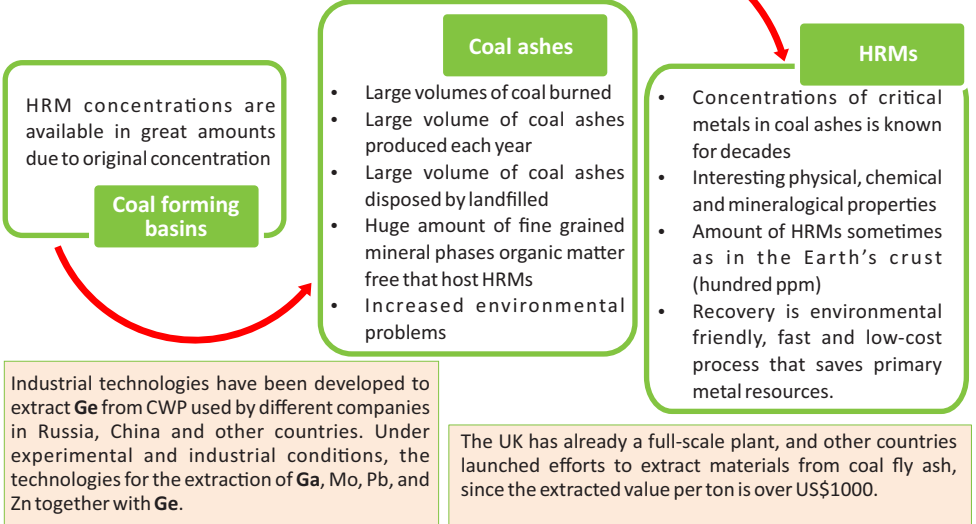
(Source: Google, 2016, Critical raw materials for the EU, Report EU 30 July 2010, USGS, 2015)



HRM in combustion waste products (ashes)



57	La	58	Ce	59	Pr	60	Nd	61	Pm
62	Sm	63	Eu	64	Gd	65	Tb	66	Dy
67	Ho	68	Er	69	Tm	70	Yb	71	Lu



(Source: Goldschmidt, 1935; Mayfield and Lewis, 2013; Seredin and Dai, 2012, Seredin et al 2013).

RareAsh – the proof of circular economy concept

Black to **Green** using **Gray** requires the transition to a "green economy, circular economy" by connection between economic development, biodiversity, ecosystems, climate change, health and peoples welfare in the medium and long term.

By applying the concept of "green economy, circular economy", RareAsh project is aiming:

- New separation solutions in order to prevent excessive use of natural resources for HRMs recovery, with the main objective of reducing environmental risks;
- Long-term alternative to substitute primary raw materials with ash, as secondary raw material, in order to improve quality of life.

