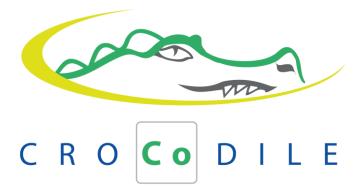
## **Grant Agreement no. 776473**

## **CROCODILE PROJECT**

First of a kind commercial Compact system for the efficient Recovery Of CObalt Designed with novel Integrated LEading technologies



## Deliverable D10.1 List of projects for clustering (vi)

WP n° and title	WP10 Cluster with other projects
Dissemination level	PU
Responsible Author	PNO
Contributor(s)	All Partners
Reviewer	TEC



The CROCODILE project has received funding from the European Union's EU Framework Programme for Research and Innovation Horizon 2020 under Grant Agreement No 776473

https://h2020-crocodile.eu/



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# 3 List of abbreviations and definitions

#### **LIST OF ABBREVIATIONS**

Tecnalia	TEC
Freeport	FRE
Glencore Nikkelverk	GNN
Stena	STE
Ecorecycling	ECO
Larco	LAR
Relight	REL
Lomartov	LOM
Kopacek KG	ISL
Akkuser	AKK
Accurec	ACC
Saubermacher	SAU
Société Nouvelle d'Affinage des Métaux SAS	SNA
Comet Traitements	СОМ
Monolithos	MON
Tecnalia Ventures	TEV
PNO	PNO
Idener	IDE
ENV Aqua	ENV
Katholieke Universiteit Leuven	KUL
Stiftelsen Sintef	SIN
National History Museum	NHM
Bangor University	BAN
Bureau de Recherche Géologique et Minière	BRG
Teknologian tutkimuskeskus VTT Oy	TTM
Asociacion Centro Tecnologico CEIT-IK4	ACT
Fraunhofer Gesellschaft zur Foerderung der Angewandten Forschung E.V.	FRA
C-Tech Innovation Limited	CTE
Osterreichische Gesellschaft fur System Und Automatisierungstechnik Verein	OGS
Fundacion Cidetec	FCI
Luxus Ltd	LUX
Miskolci Egyetem	MIE
Vlaamse Instelling Voor Technologisch Onderzoek N.V.	VITO
The University of Exeter	UEX
Mytilineos Anonimi Etairia - Omilos Epicheiriseon	MYT
Universidad Politecnica de Madrid	UPM
Geologian Tutkimuskeskus	GTU



## D10.1 List of projects for clustering (vi)



Commissariat a L Energie Atomique et aux Energies Alternatives	CEA
Fundacao para A Ciencia e a Tecnologia	FCT
NOVA ID FCT - Associacao para a Inovacao e Desenvolvimento da Fct	AID
Fundacio Privada Institut Catala D'investigacio Quimica	FIC
Technische Universitat Darmstadt	TUD
Fundacion Bcmaterials - Basque Centre for Materials, Applications and	BCM
Nanostructures	BCIVI
Reydesa Recycling, S.L	REY
Recyclage Et Valorisation Technique	RVT
Metso Minerals Oy	MET
Lithref Ab	LIT
Atlantic Copper	ATL
Ghent University	GUN



## 4 Executive Summary

The purpose of this deliverable is to define a list of projects that can be clustered with the CROCODILE project. Clustering projects can help target communication, dissemination and exploitation activities to interested parties. They can be used to foster opportunities for collaboration and synergies, sharing best practices around certain common topics, or identifying common technical and non-technical barriers and potential solutions. Furthermore, it's a way of utilizing other projects networks to "network the networks" and amplify the impact of European funding.

Projects for clustering where located through different sets of databases, mainly (1) PNO's Intelligence database ("Matchpoint") which is linked to the European Commission's Community Research and Development Information Service (Cordis) database, (2) Life's project database, and (3) EIT RawMaterials organization's website. A list of keyword combinations and filters were used in order to identify the most relevant projects with potential for clustering with the CROCODILE project.

The results drawn through the chosen methodology revealed a total of 39 projects: 27 projects funded by H2020 under different sub-programs (i.e. Innovation Actions, Research and Innovation Actions, Coordination and Cooperation, European Training Networks, etc.); 2 projects funded by the LIFE program; and 10 projects funded through the EIT RawMaterials organisation.

Selected projects and their networks can amplify the impact of CROCODILE. These projects may be contacted and invited to events creating opportunities for cross-sectoral collaboration, new knowledge combinations and innovation in the field of cobalt valorisation and recovery.





## 5 Background information

Cobalt (Co) is used in many applications that support the shift to a low-carbon economy. Its exceptional properties (e.g. high temperature resistance, corrosion-resistance, and catalyser function) make it a crucial element for electrical power generation turbines, specialty high-strength steel, magnets, bind wear-resistant alloys, chemical industry and oil refineries to name a few. The cobalt largest market share is batteries: about 42% of the overall current cobalt demand worldwide

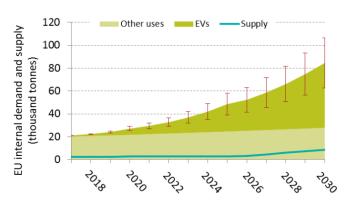


Figure 1. Projected EU internal supply/demand for cobalt

(estimated at 100k ton annually) is related to the production of lithium-ion battery (LIB) cathodes1.

## The coming electric vehicle boom will significantly increase the demand for Co in the EU and globally.

By 2020, the cobalt demand in battery applications alone could be greater than the entire world market for refined cobalt in 2015<sup>2</sup>. In the EU, although the capacity to meet rising demand is projected to increase through mining and recycling activities, there is an increasing gap between endogenous supply and demand. About 65% of its cobalt (approx. 10,000 tons/year) comes from geopolitically unstable countries such as Democratic Republic of the Congo, Zambia or Central African Republic<sup>3</sup>. Only 35% is produced from secondary sources, such as the recycling of spent batteries, super-alloys and hard metals<sup>4</sup>. Acknowledging this challenge, the European Commission considers cobalt as a Critical Raw Material.

#### 5.1 The CROCODILE project in a nutshell

The CROCODILE project will reduce drastically the very high supply risk of cobalt for Europe, provide SMEs with new business opportunities, and decouple the business of large refineries from feedstocks with currently unstable supply of imported primary feedstocks containing Co

In a nutshell, the key outcomes of the project will be:

- Determine innovative metallurgical systems based on advanced pyro-, hydro-, bio-, iono- and electrometallurgy technologies for the recovery of cobalt metal and upstream products;
- Integrate potential systems within existing recovery processes of cobalt from primary and secondary sources at different locations in Europe producing waste streams rich in cobalt;
- and develop a first-of-a-kind mobile system able to produce cobalt metal from black mass containing cobalt from different sources of waste streams such as spent batteries and catalysts.

<sup>&</sup>lt;sup>4</sup> European Innovation Partnership on Raw Materials. Raw materials scoreboard, DG GROW European Commission (2016)



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<sup>&</sup>lt;sup>1</sup>Gandon S., TechCrunch.com, 2017/01/01, URL

<sup>&</sup>lt;sup>2</sup> Alves Dias P., Blagoeva D., Pavel C., Arvanitidis N., (2018). Cobalt: demand-supply balances in the transition to electric mobility, EUR 29381 EN, Publications Office of the European Union, Luxembourg.

<sup>&</sup>lt;sup>3</sup> BIO by Deloitte (2015) Study on Data for a Raw Material System Analysis: Roadmap and Test of the Fully Operational MSA for Raw Materials. Prepared for the European Commission, DG GROW URL



The CROCODILE project factsheet is shown below (Table 1).

Table 1. Quick facts about the EU-funded CROCODILE project



# First of a kind commercial Compact system for the efficient Recovery Of CObalt Designed with novel Integrated LEading technologies

Recovering Cobalt

#### **PROJECT FACTSHEET**

#### **FUNDED IN THE FRAME OF**

Horizon H2020-SC5-2017 - Raw materials Innovation actions

#### **TYPE**

Innovation Action project

#### **DURATION**

June 1<sup>st</sup>, 2018 - May 31<sup>st</sup>, 2022

#### THE PROJECT AIMS TO

Demonstrate on a large scale a mobile metallurgical system for the purpose of recovering Co from various secondary and primary European resources.

#### **GOES BEYOND STATE-OF-THE-ART BY**

Deploying a unique architecture of advanced processes with low cost and minimal environmental impact

#### **PARTNERS INVOLVED**

The CROCODILE consortium is composed of 24 key actors in the domains of materials, processing, components and systems for power electronics

#### Universities

Katholieke Univeriteit Leuven (KUL, BE), Bangor University (BAN, UK)

#### Research centres

Tecnalia (TEC, ES) (coordinator), Sintef (SIN, NO), National History Museum (NHM, UK)

#### Industry

Freeport (FRE, FI), Glencore (GNN, NO), Stena (STE, SW), Larco (LAR, GR), Relight (REL, IT), Akkuser (AKK, FI), Accurec (ACC, DE), Saubermacher (SAU, AT), SNAM (SNA, FR), Comet Traitements (COM, BE)

#### SMEs

Ecorecycling (ECO, IT), Lomartov (LOM, ES), Kopacek KG (ISL, AT), Monolithos (MON, GR), Tecnalia Ventures (TEV, ES), Idener (IDE, ES), ENV Aqua (ENV, UK), PNO (PNO, BE)

#### MORE INFORMATION CAN BE FOUND AT

Project website: <a href="https://h2020-crocodile.eu/">https://h2020-crocodile.eu/</a>

Cordis: https://cordis.europa.eu/project/rcn/214467/en





#### 5.2 Goal and scope of clustering activities

The goal of these clustering activities is to increase the visibility and synergies between CROCODILE and other EU supported actions conducting work in the fields of metallurgy, recycling, Critical Raw Materials, etc. By establishing connections with their respective consortia, the partners of CROCODILE will have the opportunity to promote the project as well as their own expertise, while learning from the challenges and insights gained by other projects' implementation. Favourable conditions for the cooperation with some of these sister projects have already been identified and will be reinforced during the lifespan of the project.

This derivable (D10.1) will present a preliminary list of projects that have been identified as attractive "clustering candidates" for the purposes of:

- disseminating and exploiting the scientific and technical achievements of CROCODILE;
- setting up networks of stakeholders in similar domains and/or promoting relevant concepts;
- and creating spin-off collaborations in the frame of (EU-funded) R&D.

## 6 Overview of projects relevant to CROCODILE

#### 6.1 EU-funded projects identified during CROCODILE's grant application phase

Several partners are involved in different projects related to recycling in general with some being pertinent to cobalt recycling/refining. These projects and their respective consortia are thought to be within the close reach CROCODILE, therefore, their complementarities and stakeholders are well-known to partners. The table below summarizes the projects that have been identified during the grant application phase as <u>proposed by the consortium partners</u>. It should be noted that only those that are currently *active* and funded through EU-funded programmes (namely H2020) are shown.

Table 2. H2020-funded projects identified during the grant application phase

Acronym	Title	Period	Coord.	CROCODILE partners involved
Innovation Act	ions (IA)			
NEMO NEMO	Near-zero-waste recycling of low-grade sulphidic mining waste for critical-metal, mineral and construction raw-material production in a circular economy	May. 2018 - Apr. 2022	TTM	IDE, KUL, BRG
REE4EU REE4EU	Integrated high temperature electrolysis (HTE) and ion liquid extraction (ILE) for a strong and independent european rare earth elements supply chain	Oct. 2015 – Sep. 2019	SIN	STE, IDE, SNA, PNO
Research and I	nnovation Actions (RIA)			
<u>NEOHIRE</u> NEOHIRE	Neodymium-iron-boron base materials, fabrication techniques and recycling solutions to highly reduce the consumption of rare earths in permanent magnets for wind energy application	Feb. 2017 - Jan. 2020	ACT	KUL
PLATIRUS Platirus	Platinum Group Metals recovery using secondary raw materials	Nov. 2016 – Oct. 2020	TEC	PNO, ENV, SIN, MON, KUL





European Training Network (ETN)				
DEMETER NAME OF THE PROPERTY O	European training network for the design and recycling of rare-earth permanent magnet motors and generators in hybrid and full electric vehicles	Sep. 2015 – Aug. 2019	KUL	-
REDMUD	Zero-waste valorisation of bauxite residue (red mud)	Dec. 2014 – Oct. 2019	KUL	-
SOCRATES SOCRATES EU MSCA-ETN	European Training Network for the sustainable, zero-waste valorisation of (critical) metal containing industrial process residues	Sep. 2016 – Aug. 2020	KUL	-

Other - currently closed - projects funded through Seventh Framework Programme FP7 are mentioned in Table 3:

Table 3. Other H2020-funded projects identified during the grant application phase that are currently closed

Acronym	Title	Period	Coord.	CROCODILE partners involved
CLOSE WEEE	Integrated solutions for pre-processing electronic equipment, closing the loop of post-consumer high-grade plastics, and advanced recovery of critical raw materials antimony and graphite	Dec. 2014 – Nov 2018	FRA	ACC
COLABATS **	Cobalt and lanthanide recovery from batteries	Oct. 2013 - Sep.2016	CTE	ENV
EREAN  EREAN  UFF Multi-Cure Intel® Tailing Reteau	European Rare Earth Magnet Recycling Network	Sep. 2013 – Aug. 2017	KUL	-
hydro	Innovative Hydrometallurgical Processes to recover Metals from WEEE including lamps and batteries	Mar. 2009 – Feb. 2012	OGS	ECO

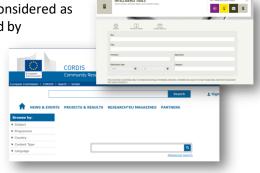
#### 6.2 Other EU-funded projects identified during CROCODILE's implementation phase

#### 6.2.1 Projects funded through the H2020 programme

Other projects have also been recognised which could also be considered as "sister" projects of CROCODILE. The projects have been identified by

performing several queries using PNO's Intelligence database ("Matchpoint") which is linked to the European Commission's Community Research and Development Information Service (Cordis) database<sup>5</sup>.

The results were filtered to include ongoing projects that will end no earlier than <u>April 2019</u> (M12). The keyword (sets) as well as the number of hits that were returned are shown in Table A.1 in the Appendix. Results obtained based on the keywords used are divided into three main groups as follows:



• 1<sup>nd</sup> layer – Projects specifically linked to the cobalt value chain (sourcing/processing/end-use)

<sup>&</sup>lt;sup>5</sup> Cordis database <u>URL</u>



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This category comprises projects with a direct link to the cobalt supply chain, its processing and key market segments of Co-rich products. Projects in this category are likely to encompass similar activities than Crocodile and their respective consortia.

2<sup>nd</sup> layer – Projects showcasing advances in metallurgy/recycling of valuable raw materials

Projects featuring enabling technologies for (metallurgical) (pre)processing and refining of Co and other valuable metals, such as REEs, Li, In, etc. Some of these projects have partners who are developing similar or competing technologies to CROCODILE. They might be approached to set up future research collaborations.

3<sup>rd</sup> layer – Projects linked thematically to Critical Raw Materials

Projects linked to not only Cobalt but other CRM of relevance that can also be of interest to the partners and the technologies considered within CROCODILE to further expand the potential of this project into other applications.

The search in the Cordis database revealed 352 project hints. These were checked to remove duplicates and irrelevant projects and a total of 27 projects remained:

- Six (6) Innovation actions (i.e. NEMO and REE4EU).
- Nine (9) Research and Innovation actions (i.e. PLATIRUS).
- Two (2) Coordination and Cooperation actions.
- Four (4) European Training Networks (i.e. SOCRATES, DEMETER, and RED-MUD)
- Six (6) projects funded through other mechanisms<sup>6</sup>.

Additional to those shown in Table 2, the following projects have been selected as potential clustering partners:

**Table 4.** H2020-funded active projects identified during the project's implementation

Acronym	Title	Period	Coord.	CROCODILE partners involved
Innovation Actions				
ADIR	Next generation urban mining - Automated disassembly, separation and recovery of valuable materials from electronic equipment	Sep. 2015 – Aug. 2019	FRA	,
iModBatt iModBatt	Industrial Modular Battery Pack Concept Addressing High Energy Density, Environmental Friendliness, Flexibility and Cost Efficiency for Automotive Applications	Oct. 2017 – Sep. 2020	FCI	ACC
<u>NIRSort</u>	Development and Market Replication of novel NIR-transparent polymer colourants to replace carbon black, and allow the sorting of black and coloured polymers from mixed waste streams	Jun. 2017 – May 2019	LUX	-
ReWaCEM	Resource recovery from industrial waste water by cutting edge membrane technologies	Oct. 2016 – Sep. 2019	FRA	-

<sup>&</sup>lt;sup>6</sup> Consolidator Grant, ERA-NET Cofund, Advanced Grant, Marie Skcodowska-Curie Research and Innovation Staff Exchange (RISE)



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Research and Innovation	n Actions			
CHPM2030 CHPM2030	Combined Heat, Power and Metal extraction from ultra-deep ore bodies	Jan. 2016 – Jun. 2019	MIE	KUL
CHROMIC CHROMIC	effiCient mineral processing and Hydrometallurgical RecOvery of by-product Metals from low-grade metal containing seCondary raw materials	Nov. 2016 – Oct - 2020	VITO	BRG
DEMOBASE DEMOBASE	DEsign and MOdelling for improved BAttery Safety and Efficiency	Oct. 2017 – Sep. 2020	SAFT	ACC
IMP@CT	Integrated Modular Plant and Containerised Tools for Selective, Low-impact Mining of Small High-grade Deposits	Dec. 2016 – May. 2020	UEX	BRG
METGROW PLUS METGrow	Metal Recovery from Low Grade Ores and Wastes Plus	Feb. 2016 – Jan 2020	TTM	IDE, KUL
SCALE  S C a L e  SCANDIUM ALUMINIUM EUROPE	Production of Scandium compounds and Scandium Aluminum alloys from European metallurgical by- products	Dec. 2016 – Nov. 2020	MYT	-
SLIM	Sustainable Low Impact Mining solution for exploitation of small mineral deposits based on advanced rock blasting and environmental technologies	Nov. 2016 – Oct. 2020	UPM	BRG
Coordination & Coopera	tion Actions			
MIREU  MIREU  WINNE AND METALUSEY RECEINS OF EU	Mining and Metallurgy Regions of EU	Dec. 2017 – Nov. 2020	GTU	BRG
SCRREEN	Solutions for CRitical Raw materials - a European Expert Network	Nov. 2016 – Apr. 2019	CEA	BRG, IDE, PNO
European Training Networks				
NEW-MINE NEW-MINE	EU Training Network for Resource Recovery through Enhanced Landfill Mining	Sep. 2016 – Aug. 2020	KUL	-
Other H2020 funded projects				
ERA-MIN 2  ERA-MIN 2  RESEARCH & NOLVATION PROGRAMME ON RAW MATERIALS TO FOSTER CIRCULAR EDONOMY	Implement a European-wide coordination of research and innovation programs on raw materials to strengthen the industry competitiveness and the shift to a circular economy	Dec. 2016 – Nov. 2021	FCT	-





e.THROUGH  e.THROUGH  Tricking rough towards sustainability	Thinking rough towards sustainability	Jan. 2018 – Dec. 2021	AID	-
GREENLIGHT_REDCAT	Towards a Greener Reduction Chemistry by Using Cobalt Coordination Complexes as Catalysts and Light-driven Water Reduction as a Source of Reductive Equivalents	Jul. 2015 – Jun. 2020	FIC	-
<u>IL-E-CAT</u>	Enhancing electrocatalysis in low temperature fuel cells by ionic liquid modification	May. 2016 – Apr. 2021	TUD	-
INDESMOF	International Network on Ionic Liquid Deep Eutectic Solvent Based Metal Organic Frameworks Mixed Matrix Membranes	Mar. 2018 – Feb. 2022	всм	-
SOLCRIMET SOLCRIMET	Solvometallurgy for critical metals	Sep. 2016 – Aug. 2021	KUL	-

#### 6.2.2 Projects funded through the Life programme

The LIFE programme is the EU's funding instrument for the environment and climate action. One key difference with H2020 projects is that it is mainly focused on very-close-to-market initiatives. It should

also be noted that Life funding is eventually used for the (partial) uptake and advancement of past FP7 and H2020 projects. By applying build-in filters (e.g. year range, themes, etc.), Life's project database<sup>7</sup> was screened to identify relevant initiatives funded under the "Environment" sub-programme. Due to the fast evolution of the metallurgical field and the relatively recent breakthrough of Co as CRM, only projects realized after 2014 were retained.

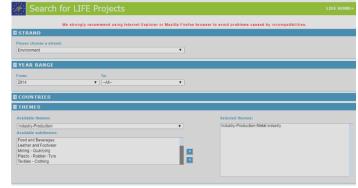


Figure 2. Screenshot of Life project database

Selected themes and sub-themes for the search encompassed:

- Industry production (sub-theme: mining)
- Environmental management (resource efficiency, circular economy and value chains)
- Waste (sub-themes: industrial waste, waste from EEE, waste recycling, waste use, ELVs and tyres)

A total of 85 Life project initiatives was analysed (including closed projects) and the ones deemed most relevant are those two shown below.

 Table 5. Life-funded active projects identified during the project's implementation

Acronym	Title	Period	Coord.
Integrated projects			
BiotaWee	Bioleaching of WEEE wastes for the recovery of valuable metals	Jul. 2018 – Dec. 2020	REY
<u>life-libat</u> Lį̇́Bat	Recycling of primary Lithium BATtery by mechanical and hydrometallurgical operations	Jul. 2017 – Dec. 2020	ECO

<sup>&</sup>lt;sup>7</sup> LIFE's project database <u>URL</u>



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#### 6.2.3 Projects funded through the EiT

Within the European Institute of Innovation and Technology (EIT), EIT RawMaterials is a body of the European Union that supports innovation projects addressing European challenges linked to the sourcing and management of raw materials.



Figure 3. EiT RawMaterials Project Timeline

EIT RawMaterial innovation projects are divided in the following six areas:

- i. Exploration and raw materials resource assessment.
- ii. Mining in challenging environments.
- iii. Increased resource efficiency in mineral and metallurgical processes.
- iv. Substitution of critical and toxic materials in products and substitutions for optimised performance.
- v. Recycling and materials chain optimisation of end-of-life products.
- vi. Design of products and services for the circular economy.

A concise summary of all the EiT RawMaterials projects (closed/active) is provided in the organisation's website<sup>8</sup>. The search for EiT projects relevant to CROCODILE included funded-initiatives under all the themes mentioned above except for "ii". Due to the focus of CROCODILE on technologies and products which of industrial/commercial potential, only up-scaling projects were retained. These, according to EiT are "innovation projects based on validated technologies that need additional step(s) for up-scaling, demonstration or implementation. The objective is to bring the technology to market, as a product, service or process. The technology must be at Technology Readiness Level (TRL) of at least five at the beginning of the project and corresponding to a technology validated in relevant environment". The search revealed 73 projects. Those which are completed of irrelevant for CROCODILE were not considered and the rest which are deemed most relevant are shown below:

Table 6. EIT RawMaterials active projects identified during the project's implementation

Acronym	Title	Period	Coord.	CROCODILE partners involved
Integrated projects				
AutoBatRec2020	Automotive Battery Recycling 2020	Jan. 2018 - Mar. 2021	FRA	-
<u>CarSiFer</u>	Innovative Recycling Solution for waste containing Carbon, Silicon and Iron	Jan. 2019 - Jun. 2020	RVT	-
FLAME	FLy Ash to valuable MinErals	Apr. 2017 - Mar. 2020	VITO	-
GREENY	GRinding Energy EfficiencY	Jan. 2019 - Jun. 2021	MET	-

<sup>&</sup>lt;sup>8</sup> EiT RawMaterials organisation's website <u>URL</u>



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## D10.1 List of projects for clustering (vi)



<u>LiRef</u>	Multi-feed Lithium Technology	Jan. 2019 - Jun. 2021	LIT	-
Morecovery	Modular recovery process services for hydrometallurgy and water treatment	Jan. 2019 - Dec. 2021	GTU	-
RECOVER RECOVER	Innovation in Motion: Red mud and Copper slag Valorisation in Engineered Products	Apr. 2017 - Mar. 2020	KUL	-
RED SCOPE	Recovery of Effluent Discharge for Sustainable Copper Processing in Europe	Apr. 2017 - Dec. 2019	ATL	-
RESIELP	Recovery of Silicon and other materials from End-of-Life Photovoltaic Panels	Apr. 2017 - Mar. 2020	CEA	REL
SUPRIM SUPRIM	Sustainable Management of Primary Raw Materials through a better approach in Life Cycle Sustainability Assessment	Apr. 2017 - Dec. 2019	GUN	-

# 6.3 Summary of clustering projects

Based on the research developed regarding clustering projects of CROCODILE, the following image shows the progress timelines of those projects that can be compared to CROCODILE.

## D10.1 List of projects for clustering (vi)





Figure 4. Gantt Chart of identified clustering projects





## 7 Performed clustering activities during the first year

Over the first 6 months of the project's implementation, three clustering activities were carried out:

Table 7. Overview of clustering activities in CROCODILE (M1-M6)

Innovation Forum in Athens, 4<sup>th</sup> October, 2018- Presentation by PNO, (Attended by CROCODILE Partners: PNO, TEC, LAR, MON, LOM, REL, VITO, SIN



**Description:** H2020 Innovation Forum is an on-going clustering initiative, bringing together H2020 projects with policy makers, end-users, industry representatives, investors, start-ups and SMEs.

Link

#### Other projects:

- ENSUREAL
- SCALE
- REMOVAL
- PLATIRUS
- HYDROWEE
- CHROMIC
- .....
- NEMO
- REMAGHIC
- METGROW+CROCODILE
- Locomatech
- Pvadapt
- SABINA
- MIREU

#### projects: Discussion topics:

- Clustering Interactive tool which highlights
- contact points
- between projects in the areas of
- processes,
- materials, project
- objectives, KPIs and exploitable
- results
- LCA
- methodology
- RTD to Business
- Business applications

SCRREEN Clustering meeting-CRM Week in Brussels, 12th November, 2018- Presentation by PNO, (Attended by CROCODILE Partners: PNO, KUL, TEC, LAR, MON, LOM, REL, VITO, SIN)



Description: Event organised by the SCRREEN CSA project in collaboration with the European Commission addressing the latest news on raw materials in the EU. Discussion themes include relevant issues: policy, technology, international cooperation, framework conditions, etc.

Link

#### Other projects:

- SCRREEN
- NEMO
- REE4EU
- DEMETER
- COLLECTOR
- ECOCOMBAT
- INTMET
- SLIM,
- SLIIVI,
- GLOREIA,EXTREME.
- EXINE
- SCALESusCritMat

#### **Discussion topics:**

Presentation and Interactive panel

between CROCODILE,

SCRREEN, NEMO,

REE4EU, DEMETER and the audience (250

stakeholders)

CARE INNOVATION 2018 in Vienna, November 26-29, 2018 Presentation by PNO, (Attended by CROCODILE Partners: PNO, TEC, SAU, ECO, ISL, REL)



Description: This Symposium is the only platform for presenting the upto-date progress on sustainable development and the development of eco-efficient electr(on)ic & automotive products. More than 70% of the attendees come from the industry.

Link

acadile eu/

#### Other projects:

LIFE-LIBATFENIXLCDVAL

#### **Discussion topics:**

Business concept of the mobile

system, circularity in the EEE sector, Advanced recycling

recycling technologies





#### 8 Conclusions

Deliverable 10.1 of CROCODILE has as main goal to determine a preliminary list of projects that are suitable as "clustering candidates" for CROCODILE. The interest on a further connection with those projects relates to (1) an increase in the dissemination and exploitation of the the scientific and technical achievements of CROCODILE; (2) setting up networks of stakeholders in similar domains and/or promoting relevant concepts; and (3) creating spin-off collaborations in the frame of (EU-funded) R&D.

Based on an extensive research in diverse sets of databases (i.e. Cordis, Life database, and EIT database), and after filtrating the results to the most attractive candidates, a total of 39 clustering projects have been identified and described in this report. The results drawn through the chosen methodology indicate a total of 39 projects, selected out of a list of 510 pre-identified ones (i.e. 352 H2020 funded projects, 85 LIFE funded projects and 73 EIT funded projects).

Throughout the body of the report, a brief description of these projects is provided and Crocodile partners that are also involved on those projects have been identified. Extended information regarding these projects and a link to their website for more information can be found in the Annex section.



#### 9 References

Alves Dias P., Blagoeva D., Pavel C., Arvanitidis N., (2018). Cobalt: demand-supply balances in the transition to electric mobility, EUR 29381 EN, Publications Office of the European Union, Luxembourg.

BIO by Deloitte (2015) Study on Data for a Raw Material System Analysis: Roadmap and Test of the Fully Operational MSA for Raw Materials. Prepared for the European Commission, DG GROW <u>URL</u>

Consolidator Grant, ERA-NET Cofund, Advanced Grant, Marie Skcodowska-Curie Research and Innovation Staff Exchange (RISE)

Cordis database URL

EiT RawMaterials organisation's website URL

European Innovation Partnership on Raw Materials. Raw materials scoreboard, DG GROW European Commission (2016)

Gandon S., TechCrunch.com, 2017/01/01, URL

LIFE's project database URL



# 10 Appendix

# 10.1 Section 6.1 Identification of sister H2020 project for the purpose of clustering activities

**Table A1.** List of keywords used to identify relevant to CROCODILE projects (source of data: Cordis database, at: https://cordis.europa.eu/projects/en

1 <sup>st</sup> layer	r: direct link t	o the Co value chain	
Keywords	Hits	Keywords	Hits
metal AND "extraction technology"	26	"leaching solutions "	10
Solvometallurgy OR solvometallurgical	1	"WEEE AND sorting"	5
Hydrometallurgy OR hydrometallurgical	8	"battery AND extraction"	16
"leaching solvents "	4	"eutectic solvents" AND metal	1
"metal leaching "	13	"bioleaching"	5
"solvent extraction" AND metal	4	-	-
2 <sup>nd</sup> layer: featuring	advances in	the field of recycling/metallurgy	
Keywords	Hits	Keywords	Hits
cobalt AND batteries	8	cobalt AND refining	2
cobalt AND EV	2	cobalt AND metallurgy	4
cobalt AND electric	1	cobalt AND (hydrometallurgy OR	4
		hydrometallurgical)	
cobalt AND vehicle(s)	2	cobalt AND (pyrometallurgy OR	1
		pyrometallurgical)	
cobalt AND Li	4	cobalt AND extraction	7
cobalt AND catalysts	4	cobalt AND secondary	2
cobalt AND NiMH	1	mining AND cobalt	26
cobalt AND chemicals	5	cobalt AND sludge	1
cobalt AND WEEE	2	cobalt AND waste	8
Cobalt AND "black mass"	1	cobalt AND recycling	3
cobalt AND tailings	3	cobalt AND recovery	9
electric AND battery AND recycling	13	-	-
3 <sup>rd</sup> layer: linke	ed thematical	ly to Critical Raw Materials	
Keywords	Hits	Keywords	Hits
cobalt AND Critical	3	"metal recovery"	8
critical AND metal	90	CRM AND recovery	2



## 10.1.1 H2020 projects – Innovation Actions

## 10.1.1.1 ADIR

Acronym	ADIR (URL)	
Title	Next generation urban mining - Automated disassembly, separation and recovery of materials from electronic equipment	valuable
Abstract	Specific raw materials become increasingly important to manufacture high level industrial Especially electronic equipment contains precious metals and a series of strategic raw material date the material specific recycling is focused on mass stream concepts such as shredder and metallurgy to extract the high-value metallic constituents, i.e. copper, gold, silver. Ho series of critical elements cannot be recovered efficiently or is even lost in dust or residual. The goal of ADIR is to demonstrate the feasibility of a key technology for next generation mining. An automated disassembly of electronic equipment will be worked out to separecover valuable materials. The concept is based on image processing, robotic handling, pulse technology, 3D laser measurement, real-time laser material identification (to detect materior processing (to access components, to selectively unsolder these; to cut off parts of a printionard), and automatic separation into different sorting fractions. A machine concept will be out being capable to selectively disassemble printed circuit boards and mobile phones with stimes to gain sorting fractions containing high amounts of valuable materials. Examples a materials with high economic importance and significant supply risk such as tantalum, relements, germanium, cobalt, palladium, gallium and tungsten. A demonstrator will be dand evaluated in field tests at a recycling company. The obtained sorting fractions will be sturespect to their further processing and recovery potential for raw materials. Refining compidefine requirements and test the processing of sorting fractions with specific material enrich advisory board will be established incorporating three telecommunication enterprises.	derials. To processes owever, a fractions. on urban arate and ed power als), laser ed circuit e worked hort cycle are those are earth eveloped died with anies will
Start Date	01/09/2015	
End Date	31/08/2019	
Contribution (EUR)	5,262,200.00	
Coordinator	FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	DE
Partners	ELECTROCYCLING GMBH H.C. STARCK GMBH I-CUBE RESEARCH INSTYTUT METALI NIEZELAZNYCH OSAI AUTOMATION SYSTEM SPA TRE TAU ENGINEERING SRL PRO AUTOMATION GMBH LSA-LASER ANALYTICAL SYSTEMS & AUTOMATION GMBH AURUBIS AG	DE DE FR PL IT AT DE DE





#### 10.1.1.2 IModBatt

Acronym	iModBatt ( <u>URL</u> )	
Title	Industrial Modular Battery Pack Concept Addressing High Energy Density, Environmental Priendliness, Flexibility and Cost Efficiency for Automotive Applications	onmental
Abstract	iModBatt stands for Industrial Modular Battery Pack Concept Addressing High Energy Environmental Friendliness, Flexibility and Cost Efficiency for Automotive Applications. TI iModBatt is to design and manufacture, with minimum environmental impact, a high energy modular battery pack flexible enough to be used in automotive and small stationary applications battery pack will be suitable for industrial automated assembly with an easy disassemble to make possible the shift from primary applications to secondary ones, and to facilitate recyclability or parts replacement if necessary. The project concept is built around an alread technologically breakthrough, modular battery pack design primarily developed for applications, that has proven excellent performance and cost efficiency in such a manner thambition, wider spread electric vehicle applications seem the natural next developmenta such a concept. The project focuses into maximization of the energy density of a lithium through the optimization of the structural design and components of a battery pack for a form factor. In this sense the strategy is to increase the energy density by reducing the weigh battery pack while keeping structural integrity and easy assembly and manufacturing. Chen BMS work is beyond the scope of the project, which focuses in the structural demanufacturing. The Consortium includes industrial partners of every step of the battery pack in including automotive OEMs, battery parts manufacturers as well as leading European centres with ample experience in the field of batteries.	ne aim of sy density olications. Ity design, the pack y existing specialty nat higher I step for ion pack given cell ght of the histry and esign and ack value
Start Date	01/10/2017	
End Date	30/09/2020	
Contribution (EUR)	5,180,794.00	
Coordinator	FUNDACION CIDETEC	ES
	HEKSAGON MUHENDISLIK VE TASARIM AS	TR
	CLEANCARB SARL	LU
	RENAULT SAS	FR
	PRO AUTOMATION GMBH	FR AT
	ACCUREC-RECYCLING GMBH	DE
Partners	AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH	AT
	MIBA AKTIENGESELLSCHAFT	AT
	RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN	DE
	E.GO MOBILE AG	DE
	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	FR
	RESCOLL	FR
	TYVA ENERGIE	FR





## 10.1.1.3 NEMO

A cropy yes	NEMO (LIPL)	
Acronym	NEMO (URL)	السما
Title	Near-zero-waste recycling of low-grade sulphidic mining waste for critical-metal, minera construction raw-material production in a circular economy	ii and
Abstract	With an estimated volume of 600 Mtonne/yr and a historic stockpile of 28,000 Mto sulphidic mining waste from the production of Cu, Pb, Zn and Ni, represents the largest volong of extractive waste in Europe. When poorly managed, these "tailings" may cause renvironmental problems such as acid mine drainage. In 2016 EIP Raw Materials launched at to arms" to transform the "extractive-waste problem" into a "resource-recovery opportu as "tailings" still contain valuable & critical metals. Using a "4 PILOTS − 2 case-studies" con NEMO develops, demonstrates and exploits, therefore, new ways to valorise sulphidic tai The 2 cases are the Sotkamo Ni-Cu-Zn-REE/Sc mine in Finland and the Las Cruces Cu-mi Spain; the 4 PILOTS are located at key points in the near-zero-waste flowsheet, encompathe recovery of valuable & critical metals, the safe concentration of hazardous elements removal of sulphur as sulphate salts, while using the residual mineral fraction in cerconcrete and construction products. NEMO has established an interdisciplinary consor including 8 industrial partners (2 mining, 4 engineering, 1 machine manufacturing construction material company), 4 research institutes, 2 universities and 1 civil society g NEMO's near-zero-waste technology will provide the EU with both direct and long-indirect advantages. The former range from new resources (e.g. base metals: Cu, Zn, N critical metals: Sc, Nd, Y, Sb; SCM and aggregates etc.), CO2 savings from metal recover the replacement of Ordinary Portland Cement), new job creation (> 150 FTEs), new reverses (> 200 M€/yr) while the latter represent the multiplication of the former benefits (cf. 25 Mtonne of these tailings), while eradicating acid-mine drainage and other environm issues, and ensuring an enhanced dialogue (framework) between industry and civil socie obtain and maintain the License to Operate mines in EU.	olume major a "call nity", ncept lings. ine in assing s, the ment, tium, & 1 roup. term, i, Pb; y and enues 8,000 pental
Start Date	01/05/2018	
End Date	30/04/2022	
Contribution (EUR)	12,407,294.00	
Coordinator	Teknologian tutkimuskeskus VTT Oy	FI
	JACOBS NV	BE
	DMT GmbH & CO. KG	DE
	COMITE ACADEMICO TECNICO DE ASESORAMIENTO A PROBLEMAS AMBIENTALES VZW	BE
	THE UNIVERSITY OF EXETER TERRAFAME GROUP OY	UK FI
	SKYSCAPE OY	FI
	OPTIMIZACION ORIENTADA A LA SOSTENIBILIDAD SL	ES
Partners	COBRE LAS CRUCES SA	ES
	INSTITUTUL NATIONAL DE CERCETARE-DEZVOLTARE PENTRU METALE NEFEROASE SIRARE-IMNR	RO
	RESOURCEFULL	BE
	VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK N.V.	BE
	BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES	FR
	THYSSENKRUPP INDUSTRIAL SOLUTIONS AG	DE
	KATHOLIEKE UNIVERSITEIT LEUVEN	BE





#### 10.1.1.4 NIRSort

Acronym	NIRSort (URL)	
Title	Development and Market Replication of novel NIR-transparent polymer colourants to replace cablack, and allow the sorting of black and coloured polymers from mixed waste streams	arbon
Abstract	Currently, around 25 million tonnes of plastic waste is created each year across Europe, primarily three sources — consumer packaging, WEEE disposal and vehicle dismantling. The requiremen sorting and segregation of polymer types within waste streams are intensifying — more strit targets for recycling are forcing recyclers to segregate more difficult materials that they formerly lose as scrap; increased volumes and high labour costs force the industry to reduce misegregation and increase shredding; this requires more automation of sorting facilities; progregulations increase the responsibility for the supply side to ensure identifiability of the materials provide, through to the point of recycling. Automated sorting operations are all based on Near Red spectroscopy, which can rapidly recognize the NIR signature of different polymers, and act sorting equipment to segregate the polymer types. NIR is the only technique that is fast enopowerful enough and robust enough to be usable on a recycling line. BUT the NIR technique fassee" black materials and some colours, because the carbon black pigment used also absorbs the beam and prevents the reflection of the polymer's characteristic spectrum back to the sensor project, based on our successful previous work, will develop a range of "NIR transparent" alternate carbon black, to enable the NIR sorting operations to segregate black and coloured plastic withey have been unable to before, to a purity that will be usable in high value recycled engine polymers. We will base our market entry strategy on a "spiral economy" approach, where packaging industry uses virgin detectable polymer to make their packaging, and this, with its prolife of under one year, is recycled into high quality engineering plastics for the manufacture automotive and consumer durables to use without waiting for returns from their own end-omaterials.	tts for ngent could anual ducer s they Infrativate ough, ails to be NIR of the NIR atives where eering e the oduct ers of
Start Date	01/06/2017	
End Date	31/05/2019	
Contribution (EUR)	1,005,762.00	
Coordinator	LUXUS LTD	UK
Partners		SE IE



## 10.1.1.5 REE4EU

Acronym	REE4EU (URL)	
Acronym	Integrated high temperature electrolysis (HTE) and Ion Liquid Extraction (ILE) for a stron	ng and
Title	independent European Rare Earth Elements Supply Chain	is allu
Abstract	The REE4EU project will develop, validate and demonstrate in 2 industrially relevant Pilinnovative Rare Earth Alloys (REA) production route from Permanent Magnets (PM) and Secon Batteries (SB) waste. Currently only 1% of RE waste is being recovered as no adequate pro available, so proof-of-concept in REE4EU will open-up a fully new route bringing recovery of Sin-process wastes from PM manufacturing within reach. The targeted integrated solution is barecently developed lab-proven technologies for direct high-temperature electrolyses of production. It will be combined in the pilots with an innovative and proven Ionic Liquid Extractiallored hydrometallurgical pre-treatment to demonstrate dramatic improvements in convironmental performance compared to state of the art technologies. This includes avoida process steps (pure RE extraction and reprocessing), 50% energy savings, and 100% recycling coliquids as opposed to disposal of strong acid leeching agents in state of the art pre-treatment. The project involves in its consortium the full value chain including (SME and large) RE producers, PM manufacturer, SME process engineering companies and LCA experts, (SME and electronics and battery recycling companies, SME technology transfer, innovation specialists as chemical and end-user associations. Together with 4 top research institutes on electrolyses liquids and RE recycling, they will prove technical and economic viability on in-process PM (swarf), as well as End-of-Life (EoL) PM and SB waste, develop urgently required market data RE availability and a triple value-chain business case for a new European secondary Rare Earth (REA) production sector, creating new jobs, increasing Europe's independence from imporproviding valuable raw materials for fast growing European green-technology industries si Electrical/Hybrid vehicles and Wind Turbines.	cess is 90% of sed on of REA tion or st and nce of of ionic steps. metal large) as well s, ionic waste on EoL Alloys ts and
Start Date	01/10/2015	
End Date	30/09/2019	
Contribution (EUR)	7,522,490.00	
Coordinator	STIFTELSEN SINTEF	NO
	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	FR
	FUNDACION TECNALIA RESEARCH & INNOVATION	ES
	UNIVERSITE PAUL SABATIER TOULOUSE III OPTIMIZACION ORIENTADA A LA SOSTENIBILIDAD SL	FR ES
	LESS COMMON METALS LIMITED	UK
	STENA RECYCLING INTERNATIONAL AB	SE
Partners	CONSEIL EUROPÉEN DE L'INDUSTRIE CHIMIQUE	BE
rai tileis	A3I SARL	FR
	SOCIETE NOUVELLE D'AFFINAGE DES METAUX-SNAM	FR
	PNO INNOVATION	BE
	VACUUMSCHMELZE GMBH & CO KG	DE
	ELKEM AS ASSOCIATION EUROPEENNE DES VEHICULES ELECTRIQUES A BATTERIES, HYBRIDES ET A PILE	NO
	A COMBUSTIBLE	BE





#### 10.1.1.6 ReWaCEM

Acronym	ReWaCEM ( <u>URL</u> )	
Title	Ressource recovery from industrial waste water by cutting edge membrane technologies	
Abstract	The ReWaCEM project aims at reducing water use, wastewater production, energy use, was metal resource recovery and water footprint by between 30-90% in the metal plating, galva and printed circuit board industry. In order to achieve these goals, ReWaCem will adopt two edge membrane technologies suitable for the requirements of closed material cycles approach recovery concepts in metal processing industry: Diffusion Dialysis (DD) and Membrane Disti (MD) as an integrated hybrid process. This combination of existing technologies will be adaptif the requirements of 4 pilot demonstration sites in representative industrial applications metallurgical industry in order to evaluate the accomplishment of the ReWaCEM goals. Througevaluation of the demonstration a highly attractive technological solution for low energy wastest treatment will be available to be entered into the large and growing market of metal processing market will profit significantly from the technological outcome of the innovation action, with savings and environmental benefits as relevant rewards. In order to maximise impact, the processorium was selected carefully to represent all relevant stakeholders in the quadrant of end scientific partners, associations and decision makers and SMEs. The consortium will estal dissemination & exploitation board that will create a substantial network of interest group agencies, industry, research SMEs and research centres as well as universities. The sucception of the results will lead to a post project up-scaling of the technology and a step to market introduction. Part of ReWaCEM will be to mobilise all relevant stakeholders into proving the introduction of European directives and policies while creating market opportunity employed in the results will end to a post project up-scaling of the technology and a step to market introduction. Part of ReWaCEM will be to mobilise all relevant stakeholders into proving effective implementation of European directives and policies while creating market opportunity.	enizing cutting es and llation of the gh the ewater g. This ch cost project users, polish a s from cessful by step moting to the
Start Date	01/10/2016	
End Date	30/09/2019	
Contribution (EUR)	5,041,866.00	
Coordinator	FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	DE
	ASSOCIAZIONE ITALIANA ZINCATURA	IT
	DEUTSCHE EDELSTAHLWERKE GMBH	DE
	UNIVERSITAET STUTTGART	DE
	TECNOZINCO SOCIETA A RESPONSABILITA LIMITATA	IT
	CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS- CIEMAT	ES
	SOLARSPRING GMBH	DE
Dartners	VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH	DE
Partners	UNIVERSITA DEGLI STUDI DI PALERMO	IT
	AT & S AUSTRIA TECHNOLOGIE & SYSTEMTECHNIK AKTIENGESELLSCHAFT	AT
	PSE AG	DE
	PSE CONFERENCES & CONSULTING GMBH	DE
	ELECTRONIQUEL SA	ES
	DEUKUM GMBH	DE
	AEE - INSTITUT FUR NACHHALTIGE TECHNOLOGIEN	AT
	DEUTSCHE EDELSTAHLWERKE SPECIALTY STEEL GMBH & CO. KG	DE





## 10.1.2 H2020 projects - Research and Innovation Actions

## 10.1.2.1 CHPM2030

Acronym	CHPM2030 ( <u>URL</u> )	
Title	Combined Heat, Power and Metal extraction from ultra-deep ore bodies	
Abstract	CHPM2030 aims to develop a novel and potentially disruptive technology solution that satisfy the European needs for energy and strategic metals in a single interlinked Working at the frontiers of geothermal resources development, minerals extraction and metallurgy the project aims at converting ultra-deep metallic mineral formations "orebody-EGS" that will serve as a basis for the development of a new type of fa "Combined Heat, Power and Metal extraction" (CHPM). In the technology envisioned the bearing geological formation will be manipulated in a way that the co-production of enmetals will be possible, and may be optimised according to the market demands at a moment in the future. The workplan has been set up in a way to provide proof-of-corthe following hypotheses: 1. The composition and structure of orebodies have advantages that could be used to our advantage when developing an EGS; 2. Metalleached from the orebodies in high concentrations over a prolonged period of time a substantially influence the economics of EGS; 3. The continuous leaching of metals will system's performance over time in a controlled way and without having to use high-reservoir stimulation, minimizing potential detrimental impacts of both heat an extraction. As a final outcome the project will deliver blueprints and detailed specificat new type of future facility that is designed and operated from the very beginning as a context of the provide new images of the provide new	process. electro- into an cility for e metal- ergy and ny given ncept for certain s can be and may increase pressure d metal ions of a ombined petus to s at low-
Start Date	01/01/2016	
End Date	30/06/2019	
Contribution (EUR)	4,235,567.00	
Coordinator	MISKOLCI EGYETEM	HU
Partners	LA PALMA RESEARCH CENTRE FOR FUTURE STUDIES SL KATHOLIEKE UNIVERSITEIT LEUVEN VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK N.V. INSTITUTUL GEOLOGIC AL ROMANIEI FEDERATION EUROPEENNE DES GEOLOGUES ISLENSKAR ORKURANNSOKNIR SVERIGES GEOLOGISKA UNDERSOKNING LABORATORIO NACIONAL DE ENERGIA E GEOLOGIA I.P. UNITED KINGDOM RESEARCH AND INNOVATION SZEGEDI TUDOMANYEGYETEM MINPOL GMBH GUENTER TIESS NATURAL ENVIRONMENT RESEARCH COUNCIL	ES BE RO FR IS SE PT UK HU AT AT UK





## 10.1.2.2 CHROMIC

Acronym	CHROMIC (URL)	
Title	effiCient mineral processing and Hydrometallurgical RecOvery of by-product Metals frograde metal containing seCondary raw materials	m low-
Abstract	Europe is faced with the challenge of sustaining a secure supply of by-product metals, whi a fundamental role in the competitiveness of the manufacturing sector and innovations i tech sectors. To loosen the growth restrictions imposed by the inflexible supply from prining, alternative sources for these metals must be explored. At the same time a we metals is entrapped within the vast amounts of secondary resources still being landfilled in applications where their intrinsic value is not fully utilized. To unlock the potential or resources, a radically new approach to metal recovery must be deployed. Crucial factor this new value chain is the zero-waste approach, which captures not only the contained but also valorises the residual matrix (often >95% of the bulk material). Such an ap requires the development of innovative, highly selective metal recovery technologies th capture the metal-value without impairing the properties of the residual matrix mate valorisation. CHROMIC aims to develop such new recovery processes for critical (Cr, N economically valuable (Mo, V) by-product metals from secondary resources, based on the integration of enhanced pre-treatment, selective alkaline leaching and highly selective recovery across the value chain. An overarching assessment of the related eco environmental and health and safety aspects will be carried out in an iterative way to that the developed technologies meet the requirements of the circular economy whilst be line with current market demand. The technology will be developed for two models so (stainless steel slags and ferrochrome slags) with the potential of replication to nur industrial residues across Europe. Involvement of society from early on will smooth the towards implementation, so that the CHROMIC processes can contribute to securing Eusupply of critical raw materials.	n high- primary palth of pr used f these within metals proach at fully rial for lb) and e smart e metal momic, ensure peing in treams merous he path
Start Date	01/11/2016	
End Date	31/10/2020	
Contribution (EUR)	4,869,687.00	
Coordinator	VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK N.V.	BE
Partners	TECHNICKA UNIVERZITA V KOSICIACH ARCHE VDEH-BETRIEBSFORSCHUNGSINSTITUT GMBH HELMHOLTZ-ZENTRUM DRESDEN-ROSSENDORF EV BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES	DE DE BE SK BE DE DE FR





## 10.1.2.3 DEMOBASE

Acronym	DEMOBASE (URL)	
Title	DEsign and MOdelling for improved BAttery Safety and Efficiency	
Abstract	Electric mobility is a reality we can experience on our roads and cities. Electromobility is not forward, driven by drastic cost reductions, higher performances and improved available support new business models of autonomous driving passenger cars and new vehicle DEMOBASE falls within this context with the main objectives to cut down development testing efforts for e-drivetrains at least by a factor 2 and to improve their efficiency by Safety will be fully managed and new concepts developed for fleet applications. DEMOB composed of 11 leading European partners with activities ranging from cells to vehing recycling. The main gain at vehicle level will come from global optimization taking into actinity interaction of the different specialties. Objectives at battery level will be achieved by midgitalization, substituting the today sequential cell development then battery sidevelopment by a parallelization of these activities. This new process can be achieved only enhanced cells models including safety features to define the cell conception for manufact and realizing in the same time frame battery management. Objectives at vehicle level wachieved with a novel approach to design light-weight chassis. It will be demonstrated urban demo vehicle that will integrate the advanced battery pack and novels wheel-tire sy with low suspension mass and low rolling resistance. To secure project deliveries and rei collaborations which are an innovation key factor, DEMOBASE will be an original close project. In a first loop of the EV development, building blocks and their integration pro will be investigated and their efficiency assessed using Key Performance Indicators. The most efficient bricks and processes will demonstrate their added value in a second stemonths run starting from new high performances cells to operational EV. The DEMOBASE be then evaluated on tracks.	ility to fleets. Int and y 20%. BASE is icle to ccount hassive system y using cturing will be don a ystems inforce d-loop cesses en the ep in 6
Start Date	01/10/2017	
End Date	30/09/2020	
Contribution (EUR)	7,451,520.00	
Coordinator	SAFT	FR
Partners	MA SPA INFINEON TECHNOLOGIES AG K & S GMBH PROJEKTMANAGEMENT IFP ENERGIES NOUVELLES INSTITUT NATIONAL DE L ENVIRONNEMENT ET DES RISQUES INERIS INTERACTIVE FULLY ELECTRICAL VEHICLES SRL ACCUREC-RECYCLING GMBH FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V. FORSCHUNGSZENTRUM JULICH GMBH MODELON AB	IT DE DE FR FR IT DE DE DE SE





## 10.1.2.4 IMPaCT

Acronym	IMPaCT (URL)	
Title	Integrated Modular Plant and Containerised Tools for Selective, Low-impact Mining High-grade Deposits	g of Small
Abstract	The current mining paradigm promotes extraction from large 'world-class' deposits required innovations in mining techniques to deal with low grades, large infrastructu with high throughputs and large feasibility studies to prove long-term commercial viak investment in operations is no longer available in the current economic climate and m companies have ceased to trade, concentrating production and limiting the ability of materials market to respond to increased demand for raw materials or shortages in ray supply. The problem is most extreme for critical raw materials that are produced quantities relative to traditional metal commodities because the potential return on in is too low. The IMPaCT project proposes a solution that develops a new switch one; (SOSO) mining paradigm to improve the viability of many critical metal and other small deposits. The whole systems approach that we have adopted to realise the SOS paradigm centres around technological innovations in mining equipment design a planning that would reduce the feasibility studies required, throughput of extracted infrastructure, land use, resource consumption and waste. Successful business models mining require that mining and processing technologies can be adapted to multiple decommodities. Risks that are associated with the approach concern geological unmetallurgical variability and social acceptance. The work programme aims to develop to of-concept of total and sustainable mining and processing solutions using case stud West Balkans, and subsequently to examine the step-changes that would be require technology to be applied globally. The companies involved in the project icommercialise the results. Dissemination activities include feedback to European and policy makers, and the mining industry in general.	re to deal collity. High many small of the raw w material din small evestment switch off ll complex in a material, is for SOSO posits and exertainty, the prooflies in the entend to
Start Date	01/12/2016	
End Date	31/05/2020	
Contribution (EUR)	6,991,820.00	
Coordinator	THE UNIVERSITY OF EXETER	UK
Partners	BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES GLOBAL ECOPROCESS SERVICES OY CYMRU COAL LIMITED IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN MINECO LIMITED ITA-SUOMEN YLIOPISTO EXTRACTHIVE RADOS INTERNATIONAL SERVICES LTD	FR FI UK DE UK FI FR UK





#### 10.1.2.5 METGROW PLUS

Acronym	METGROW PLUS (URL)	
Title	Metal Recovery from Low Grade Ores and Wastes Plus	
Abstract	METGROW+ will address and solve bottlenecks in the European raw materials sup developing innovative metallurgical technologies for unlocking the use of potential domes materials. The METGROW+ consortium has received an EIP RM Commitment statu consortium is supported by internationally respected research institutes and universities of the partners (9) are members of EIT KIC Raw Materials consortium as well. The value and business models for metal recovery from low grade ores and wastes are carefully after. Within this project, both primary and secondary materials are studied as potentia resources. Economically important nickel-cobalt deposits and low grade polymetallic viron containing sludges (goethite, jarosite etc.) which are currently not yet being exploit to technical bottlenecks, are in focus. Concurrently, METGROW+ targets innohydrometallurgical processes to extract important metals including Ni, Cu, Zn, Co, In, from low grade ores in a cost-effective way. In addition a toolbox for metallurgical systemated in the project using new methods and combinations. The unused potential of containing fine grained industrial residues are evaluated, while hybrid and hydrometallurgical processes and treatment methods of fines are developed for both mataining and education of new professionals are facilitated within the METGROW+ projeknowledge of raw materials and sustainable technologies will attract new talents in the fiecan flexibly change fields from treatment of secondary to primary resources, which smoothens the economic ups and downs in the primary sector.	stic raw is. The . Many e chain looked I metal wastes, ed due ovative Ga, Ge stem is f metal flexible terials. ct. The
Start Date	01/02/2016	
End Date	31/01/2020	
Contribution (EUR)	7,911,462.00	
Coordinator	TEKNOLOGIAN TUTKIMUSKESKUS VTT OY	FI
	PROFIMA SPOLKA Z OGRANICZONA ODPOWIEDZIALNOSCIA	PL
	FUNDACION TECNALIA RESEARCH & INNOVATION	ES
	JM RECYCLING NV	BE
	VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK N.V.	BE
	RINA CONSULTING SPA	IT
	INSTYTUT METALI NIEZELAZNYCH	PL
	OPTIMIZACION ORIENTADA A LA SOSTENIBILIDAD SL	ES
	RISE RESEARCH INSTITUTES OF SWEDEN AB	SE
Partners	URBASER S.A.	ES
rartifers	POLYTECHNEIO KRITIS	EL
	KATHOLIEKE UNIVERSITEIT LEUVEN	BE
	KERNEOS SA	FR
	UNIVERSITEIT GENT	BE
	ARCHE	BE
	HELLENIC COPPER MINES LTD	CY
	IDP INGENIERIA Y ARQUITECTURA IBERIA SL	ES
	UMICORE	BE
	OUTOTEC (FINLAND) OY	FI





## 10.1.2.6 NEOHIRE

Acronym	NEOHIRE (URL)	
Title	NEOdymium-Iron-Boron base materials, fabrication techniques and recycling solutions to REduce the consumption of Rare Earths in Permanent Magnets for Wind Energy Application	
Abstract	Regarding NdFeB PM technology for WT, it is still necessary to break through 3 impobarriers: Strong dependence on China for supply and high price of REE present in PM difficulty of substitution of REE in PM, and technical and economic barriers that avoid estable commercially viable, large-scale REE recycling framework. In this context, NEOHIRE objective is to reduce the use of REE, and Co and Ga, in WTG. This objective is mainly ach through the development of: a) New concept of bonded NdFeB magnets able to substitu present state-of-the-art sintered magnets for WT, and b) New recycling techniques for these from the future and current PM wastes. In this way, the EU external demand of REE and CFPM in WTG will be reduced in a 50%. The specific objectives are: i) To develop a new Material solution that reduces the use REE and CRM amount in PM for WTG (100% of HRE of LRE Nd/Pr, and 100% of CRM Co and Ga), ii) To increase the deliverable electric power in power electric generators from current 2.74 MW to 3.56 MW per 1Tn of REE owing to electric machine designs, iii) To research and develop two recycling processes to highly incomposed the recovered Nd, separate 100% of Dy and recover 90% of Co) and novel Boundard PM (recycling almost 95% of Nd), iv) To achieve an economic and technically fel large-scale framework for NdFeB PM commercial recycling, and v) To ensure the econom technical sustainability of NdFeB resin-bonded PM developed technologies. NEOHIRE will on PM material RTD experts (CEIT, UOB), material recycling experts (UOB, KU LEUVEN), macharacterisation RTD experts (CEIT, UPV, LBF), JP Powder manufacturer (AICHI) manufacturer (KOLEKTOR), LCA experts (UNIFI) and WT manufacturer (INDAR). AICHI (Japa be involved by providing advice and raw materials to the project.	ortant I, high lishing main nieved te the e CRM RM for NdFeB E, 30% n wind novel crease from 0 onded easible ic and count aterial ), PM
Start Date	01/02/2017	
End Date	31/01/2020	
Contribution (EUR)	4,443,888.00	
Coordinator	ASOCIACION CENTRO TECNOLOGICO CEIT-IK4	ES
Partners	UNIVERSIDAD DEL PAIS VASCO/ EUSKAL HERRIKO UNIBERTSITATEA KOLEKTOR MAGNET TECHNOLOGY GMBH UNIVERSITA DEGLI STUDI DI FIRENZE THE UNIVERSITY OF BIRMINGHAM AICHI SEIKO KABUSHIKI KAISHA KATHOLIEKE UNIVERSITEIT LEUVEN FUNDACION CIDAUT FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V. INDAR ELECTRIC SL	ES DE IT UK JP BE ES DE ES





## 10.1.2.7 PLATIRUS

Acronym	PLATIRUS (URL)	
Title	PLATInum group metals Recovery Using Secondary raw materials	
Abstract	The PLATIRUS project aims at reducing the European deficit of Platinum Group Metals (Poby upscaling to industrial relevant levels a novel cost-efficient and miniaturised PGMs recand raw material production process. The targeted secondary raw materials wautocatalysts, electronic waste (WEEE) and tailings and slags from nickel and copper sme opening-up an important range of alternative sources of these critical raw materials, wit potential to substitute a large amount of primary raw materials which are becoming mor more scarce in Europe. For the first time five of the major research centres in Europe collaborate in developing and fine tuning the most advanced recovery processes for PGMs joint effort will lead to a unique exchange of know-how and best practices between resear all over Europe, aiming at the selection of the recycling process and the preparation of Blueprint Process Design that will set the basis for a new PGM supply chain in the EU primary and secondary material producers with a consolidated business model will carrivalidation of the innovative recovery processes in an industrially relevant environment installing and testing them in an industrially relevant environment and benchmarking wit currently adopted recovery processes. A recycling company will provide a link to mintroduction by manufacturing autocatalysts with second-life PGMs obtained via the PLA technology. Two large automotive companies will validate the material produced throug new recovery process, and ensure end-user industry driven value chains for recovered materials. LCA, economic and environment assessment of the whole process will be less specialized consultancy company. Finally, the PLATIRUS project will be linked to Europea extra-European relevant stakeholders, research activities and industries, with a dissemination, communication and exploitation plan.	overy ill be elters, the the e and e will so This others of the
Start Date	01/11/2016	
End Date	31/10/2020	
Contribution (EUR)	6,994,210.00	
Coordinator	FUNDACION TECNALIA RESEARCH & INNOVATION	ES
	MONOLITHOS KATALITES KE ANAKIKLOSI ETAIREIA PERIORISMENIS EVTHINIS	EL
	CENTRO RICERCHE FIAT SCPA	IT
	JOHNSON MATTHEY PLC	UK
	STIFTELSEN SINTEF TECHNISCHE UNIVERSITAET WIEN	NO AT
	FORD OTOMOTIV SANAYI ANONIM SIRKETI	TR
Partners	VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK N.V.	BE
	SINTEF AS	NO
	ENV-AQUA SOLUTIONS LTD	UK
	KATHOLIEKE UNIVERSITEIT LEUVEN	BE
	PNO INNOVATION	BE
	BOLIDEN HARJAVALTA OY	FI





#### 10.1.2.8 SCALE

Acronym	SCALE (URL)	
	Production of Scandium compounds and Scandium Aluminum alloys from European metal	lurgical
Title	by- products	. 0
Abstract	Scandium (Sc) is one of the highest valued elements in the periodic table and an element is usually grouped in REEs as it shares many characteristics with Yttrium. Scandium technology applications are unique, as it is a key component in producing Solid Oxide Fuel Cells (Scandilized-Zirconia solid electrolyte layer) or high strength Aluminum alloys used in aer and 3D printing applications (SCALMALLOY®). Yet Scandium supply is limited due to its and the high cost of its production, which currently takes place in Asia and Russia. Europe production of Scandium, but is home to many Sc industrial end-users (Airbus, II-VI, KBM and others). In fact end-users like Airbus, are not deploying their Sc applications due to tof a secure Sc supply. The SCALE project sets about to develop and secure a European Sc chain through the development of technological innovations which will allow the extraction from European industrial residues. Bauxite Residues from alumina production (5 Million to dry basis per year in Europe) and acid wastes from TiO2 pigment production (1.4 Million to dry basis per year in Europe) have Sc concentrations which are considered exploitable, viable extraction technology. SCALE develops and demonstrates the value chain starting residue and finishing to high tech end-product: • SCALE develops innovative technologican extract economically and sustainably Sc from dilute mediums (<100 mg/L) and upgrad to pure oxides, metals and alloys at lower energy or material cost. • SCALE extracts along all other REEs found in the by-products (AoG's BR on an annual base contain 10% of the Europe REEs raw material imports).	ological candia-ospace scarcity has no Affilips he lack supply on of Sc tons on tons on given a leg from les that e them with Sc
Start Date	01/12/2016	
End Date	30/11/2020	
Contribution (EUR)	7,000,000.00	
Coordinator	MYTILINEOS ANONIMI ETAIRIA - OMILOS EPICHEIRISEON	EL
	KUNGLIGA TEKNISKA HOEGSKOLAN	SE
	LESS COMMON METALS LIMITED	UK
	TRONOX PIGMENTS (HOLLAND) BV	NL
	FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	DE
	BUNDESANSTALT FUER MATERIALFORSCHUNG UND -PRUEFUNG	DE
	RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN	DE
	BUDAPESTI MUSZAKI ES GAZDASAGTUDOMANYI EGYETEM	HU
	IOLITEC IONIC LIQUIDS TECHNOLOGIES GMBH	DE
Partners	WAVESTONE LUXEMBOURG SA	LU
	ITRB LTD	CY
	MEAB CHEMIE TECHNIK GMBH	DE
	FACHHOCHSCHULE NORDWESTSCHWEIZ	CH
	NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA	EL
	ALUMINIUM OXID STADE, GESELLSCHAFTMIT BESCHRANKTER HAFTUNG	DE
	KBM MASTER ALLOYS BV	NL DE
	II-VI GMBH STIFTELSEN SINTEF	DE NO
	JIII ILLJUN JINILI	NO





## 10.1.2.9 SLIM

Acronym	SLIM (URL)	
Title	Sustainable Low Impact Mining solution for exploitation of small mineral deposits bas advanced rock blasting and environmental technologies	ed on
Abstract	The main economic, technological and environmental challenges of small mining in reducing high investment costs, reducing generation of waste and large tailings, identifying addressing environmental impacts, and improving flexibility, automation and safe operations. However, at the moment, there is no quick-fix available to reduce the environmimpact from mines, and it is neither realistic to expect production solutions very distant today's technologies. Considering that the present mining technology is based on rock bland mobile mining equipment for loading and transportation, the major challenge is to gerean new sustainable systemic solution that affects positively the relevant mining value chain aims to develop a cost-effective and sustainable selective low impact mining solution based non-linear rock mass fragmentation by blasting models, airborne particulate matter, vibraffections and nitrate leaching mitigation actions for exploitation of small mineral deconficient in the first product of the product of t	ng and ety of nental t from asting nerate . SLIM sed on ration of mass in rock et) and AXAM O (es - t), and cation issue:
Start Date	01/11/2016	
End Date	31/10/2020	
Contribution (EUR)	6,979,200.00	
Coordinator	UNIVERSIDAD POLITECNICA DE MADRID	ES
	LULEA TEKNISKA UNIVERSITET	SE
	INVESTORNET-GATE2GROWTH APS	DK
	3GSM GMBH	AT
	VA ERZBERG GMBH	AT
	BENITO ARNO E HIJOS SA	ES
Partners	BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES	FR
	MINERA DE ORGIVA SL ZABALA INNOVATION CONSULTING, S.A.	ES ES
	MONTANUNIVERSITAET LEOBEN	AT
	MAXAMCORP INTERNATIONAL SL	ES
	MINPOL GMBH	AT
	TECHNISCHE UNIVERSITAET GRAZ	AT





## 10.1.3 H2020 projects - Coordination and Cooperation

## 10.1.3.1 MIREU

Acronym	MIREU (URL)	
Title	Mining and Metallurgy Regions of EU	
Abstract	The project MIREU aims to establish a network of mining and metallurgy regions ac with a view to ensure the sustained and sustainable supply of mineral raw material. The network will help the regions to share knowledge and experiences when challenge to establish and maintain an extractive industry. MIREU will facilitate a between all interested stakeholders in the regions, namely regulatory authorities, padministrative bodies, development agencies, mining companies, non-gorganisations, as well as the general public. The project will develop a shared know taking into account the region-specific geographic and economic features, cultural, alanguage diversity, and their historical developments. The network will also experience in other regions of the World. This knowledge base will allow to under has been conducive and what hampering to the development of extractive and mindustries. It will also provide the context for a bottom-up integration of these act their respective socio-economic and socio-cultural context. Development is about therefore, bringing people into the decision-finding procedure in order to achie license to operate' will be a key aspect of the project. Guidelines and recommer actions to be taken to foster a sustained and sustainable development of the industries will be developed in close co-operation with a range of selected region European Union. These regions will form a nucleus and multipliers for a more extens beyond the life-time of the project.	s to the EU. facing the n exchange political and government redge base, societal and learn from restand what netallurgical ctivities into people and, ve a 'social ndations for e extractive ns from the
Start Date	01/12/2017	
End Date	30/11/2020	
Contribution (EUR)	2,999,725.00	
Coordinator	GEOLOGIAN TUTKIMUSKESKUS	FI
Partners	GEOLOGIAN TUTKIMUSKESKUS  KOSICKY SAMOSPRAVNY KRAJ  GEOKOMPETENZZENTRUM FREIBERG EV  EUROPEAN REGIONS RESEARCH AND INNOVATION NETWORK ASBL  MONTANUNIVERSITAET LEOBEN  NOVA ID FCT - ASSOCIACAO PARA A INOVACAO E DESENVOLVIMENTO DA FCT  BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES  VEREIN STEIRISCHE EISENSTRASSE (VESTE)  LULEA TEKNISKA UNIVERSITET  ASOCIATIEI AGENTIA DE MANAGEMENT ENERGETIC MARAMURES  THE UNIVERSITY OF EXETER  NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA  CORNWALL COUNCIL  INSTITUTO ARAGONES DE FOMENTO  EMPRESA NACIONAL DE MINERIA  REGIONFORBUNDET VASTERBOTTENS LAN  CONSEJERIA DE EMPLEO EMPRESA Y COMERCIO  COMISSAO DE COORDENACAO E DESENVOLVIMENTO REGIONAL DO ALENTEJO  JOENSUUN SEUDUN KEHITTAMISYHTIO JOSEK OY  CONSEJERIA DE ECONOMIA Y HACIENDA JUNTA DE CASTILLA Y LEON	FI SK DE BE AT PT FR AT SE RO UK EL UK ES CL SE ES PT FI ES



# D10.1 List of projects for clustering (vi)



LAPIN YLIOPISTO	FI
REGIONAL COUNCIL OF LAPLAND	FI
COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	FR
SOCIEDAD DE INVESTIGACION Y EXPLOTACION MINERA DE CASTILLA Y LEON S.A.	ES
TECHNICKA UNIVERZITA V KOSICIACH	SK
AKADEMIA GORNICZO-HUTNICZA IM. STANISLAWA STASZICA W KRAKOWIE	PL
INSTYTUT ROZWOJU TERYTORIALNEGO	PL
MINPOL GMBH	AT
COMMUNICATIONS, CLIMATE ACTION AND ENVIRONMENTS	ΙE



#### 10.1.3.2 SCRREEN

Acronym	SCRREEN (URL)	
Title	Solutions for CRitical Raw materials - a European Expert Network	
Abstract	Since the publication of the first list of Critical Raw Materials (CRM) in 2010 by the Working Group on CRM, numerous European projects have addressed (part of) the CR and several initiatives have contributed to gather (part of) the related community into and associations. This led to the production of important knowledge, unfor disseminated. Numerous databases have also been developed, sometimes as duplicate first time in the history, SCRREEN aims at gathering European initiatives, associations and projects working on CRMs into along lasting Expert Network on Critical Raw including the stakeholders, public authorities and civil society representatives. SCR contribute to improve the CRM strategy in Europe by (i) mapping primary and seresources as well as substitutes of CRMs, (ii) estimating the expected demand of variant the future and identifying major trends, (iii) providing policy and the recommendations for actions improving the production and the potential substitutio (iv) addressing specifically WEEE and other EOL products issues related to their material treatment standardization and (vi) identifying the knowledge gained over the last reasing the access to these data beyond the project. The project consortium also acknowledge the case to these data beyond the project. The project consortium also acknowledge are involved to facilitate strategic knowledge-based decisions making to be compared to develop new CRM strategies, which is the core of SCRREEN: policy, society, R&D and industrial makers are involved to facilitate strategic knowledge-based decisions making to be compared to the project consortium also acknowledge-based decisions making to be compared to the project consortium and the potential substitutes and on the need to set up innovative and clean actions for exploration, expressing and recycling.	RMs value of clusters ortunately es. For the standard will secondary ous CRMs echnology of CRM, oping and owledges ich is why decisionarried out olic on our crials with
Start Date	01/11/2016	
End Date	30/04/2019	
Contribution (EUR)	2,999,500.00	
Coordinator	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	FR
Partners	BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES  AMPHOS 21 GROUP SL  ECODOM-CONSORZIO ITALIANO PER IL RECUPERO E RICICLAGGIO ELETTROD  MINPOL GMBH  NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA  ASSOCIATION FRANCAISE DE NORMALISATION  CHALMERS TEKNISKA HOEGSKOLA AB  FUNDACION TECNALIA RESEARCH & INNOVATION  GEOLOGIAN TUTKIMUSKESKUS  TECHNISCHE UNIVERSITEIT DELFT  UNITED KINGDOM RESEARCH AND INNOVATION  OPTIMIZACION ORIENTADA A LA SOSTENIBILIDAD SL  LGI CONSULTING SARL  SVERIGES GEOLOGISKA UNDERSOKNING  BUNDESANSTALT FUER GEOWISSENSCHAFTEN UND ROHSTOFFE  AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO  ECONOMICO SOSTENIBILE	FR FR ES IT AT EL FR SE ES FI NL UK ES FR SE DE IT



# D10.1 List of projects for clustering (vi)



SWEREA MEFOS AB	SE
UNITED NATIONS UNIVERSITY	JP
UNIVERSITEIT LEIDEN	NL
TEKNOLOGIAN TUTKIMUSKESKUS VTT OY	FI
GEOLOGICAL SURVEY OF DENMARK AND GREENLAND	DK
INSTYTUT METALI NIEZELAZNYCH	PL
PNO INNOVATION	BE
FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	DE
JRC -JOINT RESEARCH CENTRE- EUROPEAN COMMISSION	BE
NATURAL ENVIRONMENT RESEARCH COUNCIL	UK
GEOLOSKI ZAVOD SLOVENIJE	SI
KNOWLEDGE TRANSFER NETWORK LIMITED	UK
UNIVERSIDAD DE BURGOS	ES
ENCO SRL	ΙT



## 10.1.4 H2020 projects – European Training Networks

## 10.1.4.1 DEMETER

Acronym	DEMETER (URL)	
Title	Training Network for the Design and Recycling of Rare-Earth Permanent Magnet Mot Generators in Hybrid and Full Electric Vehicles	ors and
Abstract	Hybrid and Full Electric Vehicles ((H)EVs) are essential for the transition towards sustain mobility. The permanent magnets in motors/generators of (H)EVs are either NdFeB or magnets, which contain large quantities of rare earths, which are critical metals with the supply risk for Europe. As highlighted by the European Rare Earths Competency N recycling of rare-earth magnets from (H)EVs should receive top priority. Reclaiming of ramagnet motors/generators used in (H)EVs is a major challenge because the magnets are to remove from the assemblies. The conventional hydrometallurgical routes for the receiver earths from End-of-Life permanent magnets have a high environmental impact inefficient use of chemicals, whereas the conventional pyrometallurgical routes production of magnet master alloys are energy-inefficient. DEMETER, the European Network for the Design and Recycling of Rare-Earth Permanent Magnet Motors and Ger in Hybrid and Full Electric Vehicles, concurrently develops (1) innovative, environming friendly direct and indirect recycling strategies for the permanent magnets in the motogenerators of (H)EVs that are currently already on the market and (2) design-for-reuses for motors and generators in the (H)EVs of the future. An intersectoral and interdisc consortium of leading EU universities, research institutes and manufacturers frautomotive and magnet sector trains 15 Early Stage Researchers (ESRs). The research chinclude the development of hydrogen-based grain-refinement technologies to nanograin magnets directly from scrap magnets, the recovery of rare earths from Sn NdFeB magnets of motors/generators by ionometallurgical methods, and the demotors/generators with reusable magnets, where the designs are based on 2D and 3D fluas well as non-traditional materials.	or SmCo highest etwork, re-earth difficult overy of due to for the Training nerators ientally-cors and olutions ciplinary om the allenges or oduce nCo and esign of
Start Date	01/09/2015	
End Date	31/08/2019	
Contribution (EUR)	3,802,512.00	
Coordinator	KATHOLIEKE UNIVERSITEIT LEUVEN	BE
Partners	ECOLE NATIONALE SUPERIEURE D'INGENIEURS DE CAEN INSTITUT JOZEF STEFAN INSTITUT POLYTECHNIQUE DE GRENOBLE GRANTA DESIGN LTD LESS COMMON METALS LIMITED THE UNIVERSITY OF BIRMINGHAM AALBORG UNIVERSITET CENTRO RICERCHE FIAT SCPA MAGNETI LJUBLJANA PODJETJE ZA PROIZVODNJO MAGNETNIH MATERIALOV DD VALEO EQUIPEMENTS ELECTRIQUES MOTEUR SAS	FR SI FR UK UK UK TK TK TF





## 10.1.4.2 NEW-MINE

Acronym	NEW-MINE (URL)	
Title	EU Training Network for Resource Recovery through Enhanced Landfill Mining	
Abstract	Europe has somewhere between 150,000 and 500,000 landfill sites, with an estimated 50 them being "non-sanitary" landfills, predating the EU Landfill Directive of 1999. These landfills tend to be filled with municipal solid waste and often lack any environmental prot technology. In order to avoid future environmental and health problems, many of these law ill soon require expensive remediation measures. This situation might appear bleak, but in present us with an exciting opportunity for a combined resource-recovery and remediately, which will drastically reduce future remediation costs, reclaim valuable land, we the same time unlocking billions of tonnes of valuable resources contained within these land However, the widespread adoption of Enhanced Landfill Mining (ELFM) in the EU, as envity NEW-MINE, urgently requires skilled scientists, engineers, economists and policy maked can develop cost-effective, environmentally friendly ELFM practices and regulatory framedall this demands a European commitment to concerted, inter- and transdisciplinary reand innovation. The NEW-MINE project trains 15 early-stage researchers (ESRs) in all the a of landfill mining, in terms of both technological innovation and multi-criteria assessment ELFM. The technological innovation follows a value-chain approach, from advanced exploration, mechanical processing, plasma/solar/hybrid thermochemical conversion upcycling, while the multi-criteria assessment methods allow the ESRs to compare con resource-recovery/remediation ELFM methods with the "Do-Nothing", "Classic remediand "Classic landfill mining with (co-)incineration" scenarios. By training the ESRs in scietechnical and a range of soft skills, all based on a collaboration involving EU-leading inst they become highly sought-after scientists and engineers for the rapidly emerging ELFI recycling industries.	e older rection and fills it does diation hile at a ndfills. isaged rs who works. search spects and fill and abined ration" entific, itutes,
Start Date	01/09/2016	
End Date	31/08/2020	
Contribution (EUR)	3,844,721.00	
Coordinator	KATHOLIEKE UNIVERSITEIT LEUVEN	BE
	EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH	CH
	UNIVERSITEIT GENT	BE
	JM RECYCLING NV	BE
	MONTANUNIVERSITAET LEOBEN	AT
	UNIVERSITA DEGLI STUDI DI PADOVA	IT o=
	LINKOPINGS UNIVERSITET	SE
	KUNGLIGA TEKNISKA HOEGSKOLAN ITAL CEMENTI FABBRICHE RIUNITE CEMENTO SPA	SE IT
Partners	ASA ABFALL SERVICE HALBENRAIN GESMBH	AT
	BERGISCHER ABFALLWIRTSCHAFTSVERBAND	DE
	CRANFIELD UNIVERSITY	UK
	SCANARC PLASMA TECHNOLOGIES AB	SE
	STADLER ANLAGENBAU GMBH	DE
	RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN	DE
	SHANKS VALORIZATION & QUARRY	BE
	UNIVERSITEIT ANTWERPEN	BE





## 10.1.4.3 REDMUD

Acronym	REDMUD (URL)	
Title	European Training Network for Zero-waste Valorisation of Bauxite Residue	
Abstract	To tackle its (critical) raw material dependency, Europe needs comprehensive strategies on sustainable primary mining, substitution and recycling. Freshly produced flows and st landfilled industrial residues such as mine tailings, non-ferrous slag and bauxite residue (provide major amounts of critical metals and, concurrently, minerals for low-carbon be materials. The European Training Network for Zero-Waste Valorisation of Bauxite F (REDMUD) therefore targets the vast streams of new and stockpiled BR in the EUcontains several critical metals, is associated with a substantial management cost, where have led to major environmental incidents, including the Ajka disaster in Hungary. To dat waste valorisation of BR is not occurring yet. The creation of a zero-waste BR valorindustry in Europe urgently requires skilled scientists and engineers, who can tackle the best odevelop fully closed-loop environmentally-friendly recovery flow sheets. REDMUD the researchers in the S/T of bauxite residue valorisation, with emphasis on the recovery of Ti and rare earths (incl. Sc) while valorising the residuals into building materials. An intersand interdisciplinary collaboration of EU-leading institutes and scientists has been established covers the full value chain, from BR to recovered metals and new building materials which covers the full value chain, from BR to recovered metals and new building materials in the figure of the properties of the preparation of new building materials in the prepara	ocks of BR) can building Residue 28. BR as spills e, zero-risation parriers ains 15. Fe, Al, ectoral blished, terials. e earths als with allurgy, cement me the
Start Date	01/12/2014	
End Date	31/10/2019	
Contribution (EUR)	3,720,893.00	
Coordinator	KATHOLIEKE UNIVERSITEIT LEUVEN	BE
	UNIVERSIDADE DE AVEIRO	PT
	MEAB CHEMIE TECHNIK GMBH	DE
	NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA	EL
	TITAN CEMENT COMPANY AE	EL
	TASMAN METALS AB	SE
Partners	RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN HELSINGIN YLIOPISTO	DE Fl
Partners	ALOUMINION TIS ELLADOS VIOMICHANIKI KAI EMPORIKI ANONYMOS ETAIREIA VEAE	EL
	KUNGLIGA TEKNISKA HOEGSKOLAN	SE
	MYTILINEOS ANONIMI ETAIRIA - OMILOS EPICHEIRISEON	EL
	PANEPISTIMIO PATRON	EL
	TARTU ULIKOOL	EE
	BAY ZOLTAN ALKALMAZOTT KUTATASI KOZHASZNU NONPROFIT KFT.	HU





#### 10.1.4.4 SOCRATES

Acronym	SOCRATES (URL)	
Title	European Training Network for the sustainable, zero-waste valorisation of (critical) containing industrial process residues	metal
Abstract	Unlike China, Russia or South Africa, the EU-28 Member States are not in the fortunate por of having vast, easily accessible ore deposits containing valuable metals. However, Europhave large quantities of secondary industrial residues (tailings, sludges, slags and ashese contain sig-nificant concentrations of both critical and economically important metal Euro-pean Training Network for the Sustainable, zero-waste valorisation of critical-containing industrial process residues (SOCRATES) targets ground-breaking metalliprocesses, incl. plasma-, bio-, solvo-, electro- and ionometallurgy, that can be integrated environmentally friendly, zero-waste valorisation flow sheets. By unlocking the potenthese secondary raw materials, SOCRATES contributes to a more diversified and sustain supply chain for critical metals (cf. Priority area 3 in EC Circular Economy Action COM(2015)614/2). The SOCRATES consortium brings together all the relevant stakehalong the value chain, from metal extraction, to metal recovery, and to residual valorisation in added-value applications, such as supplementary cementitious matinorganic polymers and catalysts. To maximise applicability, SOCRATES has selected commonly available and chemically complementary residue families: (1) flotation tailing primary Cu production, (2) Fe-rich sludges from Zn production, (3) fayalitic slags from ferrous metallurgy, and (4) bottom ashes from incineration plants. As a basis for a coneffort to strengthen the EU's critical-metal supply chain for Ge, In, Ga and Sb, SOCRATES 15 early-stage researchers (ESRs) in technological innovation: metal extraction (WP1), recovery (WP2), residual matrix valorisation (WP3) and integrated assessment (WP training the ESRs in scientific, technical and soft skills, they are the next generation of employable scientists and engineers in the raw-materials sector.	e does s) that s. The metal- urgical ed into tial of inable Plan; olders matrix erials, d four s from a non-certed trains metal 4). By
Start Date	01/09/2016	
End Date	31/08/2020	
Contribution (EUR)	3,858,940.00	
Coordinator	KATHOLIEKE UNIVERSITEIT LEUVEN	BE
Partners	TEKNOLOGIAN TUTKIMUSKESKUS VTT OY TECHNISCHE UNIVERSITAET BERGAKADEMIE FREIBERG AVR-AFVALVERWERKING B.V. METALLO-CHIMIQUE N.V. RHEINISCHE FRIEDRICH-WILHELMS-UNIVERSITAT BONN UMICORE AALTO KORKEAKOULUSAATIO SR KERNEOS SA UNIVERSITY OF LEICESTER BOLIDEN KOKKOLA OY UNIVERSITEIT UTRECHT OUTOTEC (FINLAND) OY	FI DE NL BE DE FI FR UK FI NL FI





# 10.1.5 H2020 projects – Other funded projects

## 10.1.5.1 ERA-MIN 2

Acresum	EDA MIN 2 (LIDI )	
Acronym	ERA-MIN 2 (URL)	
Title	Implement a European-wide coordination of research and innovation program materials to strengthen the industry competitiveness and the shift to a circular economic program.	
Abstract	Building on the experience of ERA-MIN FP7 funded project, the objective of the ERA-N on Raw Materials (ERA-MIN 2) is to strengthen the coordination of national an research programmes in the field of non-energy non-agricultural raw materials by impone joint call for proposals resulting in grants to third parties with EU co-funding. If the integrated strategy proposed in the EU Raw Materials Initiative and the Implementation Plan of the European Innovation Partnership on Raw Materials, the Call topics will address the three segments of the non?energy non-agricultural raw metallic, industrial and construction minerals and will cover the whole value chain: exextraction, processing/refining, as well as recycling and substitution of critical raw ERA-MIN 2 supports the objectives of the EIP on Raw Materials, particularly in the research and innovation co-ordination; improve synergy, co-ordination and coherence regional, national and EU funding in the relevant research fields through integration; reduce fragmentation of raw materials research and innovation effective improve use of human and financial resources in the area of raw materials resinnovation. As measures to maximise impact, ERA-MIN 2 will cooperate with the initiatives, projects and associations, by establishing an effective communication assure that all dissemination activities, including the promotion and follow up of projective will reach out to a wider audience of stakeholders, therefore strengthening the raccommunity. To further increase its impact and to better fulfil the overarching object MIN-2 will develop and implement at least two additional joint calls without EU cotopics of common interest and based on the updated Roadmap provided by CSA VER	d regional plementing in line with e Strategic ERA-MIN 2 materials: exploration, materials. The area of the between ternational ports across search and the existing aiming to ect results, w material tives, ERA-funding, in
Start Date	01/12/2016	
End Date	30/11/2021	
Contract type	ERA-NET Cofund	
Contribution (EUR)	4,999,890.00	
Coordinator	FUNDACAO PARA A CIENCIA E A TECNOLOGIA	PT
	CENTRO PARA EL DESARROLLO TECNOLOGICO INDUSTRIAL.	ES
	DEPARTMENT OF SCIENCE AND TECHNOLOGY	ZA
	TURKIYE BILIMSEL VE TEKNOLOJIK ARASTIRMA KURUMU	TR
	AGENCE NATIONALE DE LA RECHERCHE	FR
	INSTITUTO PARA LA COMPETITIVIDAD EMPRESARIAL DE CASTILLA Y LEON	ES
	FINANCIADORA DE ESTUDOS E PROJETOS  MINISTRSTVO ZA IZOBRAZEVANJE, ZNANOST IN SPORT	BR SI
Partners	FONDS FLANKEREND ECONOMISCH EN INNOVATIEBELEID	BE
	MINISTERIO DE CIENCIA, TECNOLOGÍA E INNOVACIÓN PRODUCTIVA	AR
	FORSCHUNGSZENTRUM JULICH GMBH	DE
	NARODOWE CENTRUM BADAN I ROZWOJU	PL
	AGENCE DE L'ENVIRONNEMENT ET DE LA MAITRISE DE L'ENERGIE	FR
	FONDS VOOR WETENSCHAPPELIJK ONDERZOEK-VLAANDEREN	ВЕ
	MINISTERIO DE ECONOMIA, INDUSTRIA Y COMPETITIVIDAD	ES



# D10.1 List of projects for clustering (vi)



UNITATEA EXECUTIVA PENTRU FINANTAREA INVATAMANTULUI SUPERIOR, A CERCETARII,	RO
DEZVOLTARII SI INOVARII	ΚÜ
INNOVAATIORAHOITUSKESKUS BUSINESS FINLAND	FI
VERKET FÖR INNOVATIONSSYSTEM	SE
COMMUNICATIONS, CLIMATE ACTION AND ENVIRONMENTS	ΙE
MINISTERO DELL'ISTRUZIONE, DELL'UNIVERSITA' E DELLA RICERCA	IT
COMISION NACIONAL DE INVESTIGACION CIENTIFICA Y TECNOLOGICA	CL



## 10.1.5.2 e.THROUGH

Acronym	e.THROUGH (URL)	
Title	Thinking rough towards sustainability	
Abstract	To tackle its critical raw material (CRM) dependency, Europe needs comprehensive st based on sustainable primary mining, recovery from secondary resources and recycling classified 20 CRMs due to their high economic importance and high risk of supply inter e.THROUGH has the ambitious vision of turning the challenge of CRMs dependence strategic strength for Europe, contributing towards declassifying some CRMs, as to indium, gallium and chromium, by: 1) Promoting new trends in the characterizate exploration of mineral deposits; 2) Mapping CRMs between EU mining regions; 3) knowledge on innovative processes for recovery secondary CRMs; 4) Redesign consimaterials using secondary materials, closing loops, strongly supporting waste minimizatife Cycle Assessment (LCA) for the evaluation of global environmental impacts; 6) Transemly generated knowledge to stakeholders, both for policy development and standard and for shaping responsible behaviours. e.THROUGH is an intersectoral and interdisconsortium of EU & Third Country partners of leading institutions that see waste as a recover CRMs, influencing the whole value chain. By training human resources in CRM chain, their recovery, recycling, further reuse and LCA, they become the much neede and senior scientists and engineers for the growing EU CRM industry. The consortium of 40% industry and 60% research partners. This should help push Europe to the forefront sectors, providing eco-friendly alternatives in supply. The generated scientific knowledge will be transferred to shape industries, communities and individual behaviour, fostering corporate sustainability performance, important to influence eagents' choices. e.THROUGH will generate a win-win situation for both the environment economy, promoting the required transition towards a sustainable society.	The EC ruption. e into a ungsten, ion and Gaining truction ation; 5) asferring dization, ciplinary resource d young emprises t in CRM relevant conomic
Start Date	01/01/2018	
End Date	31/12/2021	
Contract type	Marie Sklodowska-Curie Research and Innovation Staff Exchange (RISE)	
Contribution (EUR)	693,000.00	
Coordinator	NOVA ID FCT - ASSOCIACAO PARA A INOVACAO E DESENVOLVIMENTO DA FCT	PT
Partners	NORTHEASTERN UNIVERSITY LEHIGH UNIVERSITY CORPORATION UNIVERSIDAD DE MALAGA LOMARTOV SL AMPHOS 21 CONSULTING SL DANMARKS TEKNISKE UNIVERSITET ECO RECYCLING SOCIETA A RESPONSABILITA LIMITATA E-MINES	US US ES ES DK IT FR



## 10.1.5.3 GREENLIGHT\_REDCAT

Acronym	GREENLIGHT_REDCAT (URL)
Title	Towards a Greener Reduction Chemistry by Using Cobalt Coordination Complexes as Catalysts and Light-driven Water Reduction as a Source of Reductive Equivalents
Abstract	The development of alternative greener synthetic methods to transform renewable feedstocks into elaborated chemical structures mediated by solar light is a prerequisite for a future sustainable society. In this regard, this project entails the use of visible light as driving force and water as a source of hydrides for the synthesis of high-value chemicals. The project merges photoredox catalysis with 1st row transition coordination complexes catalysis to open a new avenue for greener selective catalytic reduction processes for organic substrates. The ground-breaking nature of the project is: A) Develop light-driven region- and/or enantioselective catalytic reductions using well-defined cobalt coordination complexes with aminopyridine ligands, initially developed for water reduction. Sterics, electronics and supramolecular interactions (apolar cavities and chiral pockets) will be studied to proper control of the selectivity in the reduction of i) C=E and C=C bonds and ii) in the C-C inter- and intramolecular reductive homo- or heterocouplings. B) Fundamental understanding of the light-driven cobalt catalysed reductions characterizing intermediates that are involved in the reactivity, kinetics and labelling studies as well as performing computational modelling of reaction mechanisms. The basic understanding of operative mechanisms will expedite a new methodology for electrophile-electrophile umpolung couplings. C) Enhance catalytic performance of the light-driven cobalt catalysed reductions by self-assembling of catalyst-photosensitizer into carbon based pi-conjugated materials through noncovalent supramolecular interactions. Likewise, it will allow electrode immobilization for electrocatalysed reductions using water as a source of protons and electrons. As a proof of concept, cobalt catalysts based on aminopyridine ligands have been shown highly active in the light-driven reduction of ketones and aldehydes to alcohols, using water as the source of hydrogen atom.
Start Date	01/07/2015
End Date	30/06/2020
Contract type	Consolidator Grant
Contribution (EUR)	1,999,063.00
Coordinator	FUNDACIO PRIVADA INSTITUT CATALA D'INVESTIGACIO QUIMICA ES
Partners	-





#### 10.1.5.4 IL-E-CAT

Acronym	IL-E-CAT (URL)
Title	Enhancing electrocatalysis in low temperature fuel cells by ionic liquid modification
Abstract	The commercialization of low temperature fuel cells is restricted by the high cost and low durability of cathode catalysts. Intense efforts have been devoted to tackle this issue by engineering the structure of Pt-based catalysts. Herein, a novel concept towards enhancing the performance of low temperature fuel cell catalysts is proposed, namely by tuning the local active site microenvironment with an immobilized ionic liquid (IL) phase. As demonstrated by the applicant in preliminary work, a suitable IL layer strongly influences the active catalytic site in a very promising manner, apparently via a highly complex interplay of solvent-, ligand- and electrostatic-stabilization effects. As the structural versatility of ILs allows for rational engineering of this modification at molecular level, the proposed project aims for a full scientific exploration of the remarkable activation and stabilization effects in ORR, to enable the realization of an innovative fuel cell cathode with dramatically enhanced performance. To achieve this ambitious goal, a sound fundamental understanding of the interaction of ILs with electrocatalytic sites will be derived by making use of the excellent research infrastructure and longstanding experience in ionic liquid design and catalytic materials at our institute. To demonstrate the general applicability, the deduced principals will also be applied to CO2 electrochemical reduction. The approach will not stop at the design of novel catalyst systems, but will address solutions to ensure long-term stability of the IL modification. To avoid IL leaching from the catalyst over time, the recent success of the applicant in the synthesis of novel core/shell carbon materials will be employed. The IL will be synthesized in situ within a mesoporous core and the steric demanding ions fixed through a molecular sieving shell surrounding each catalyst particle. A model-assisted strategy will be applied for optimization of the core/shell pore structures.
Start Date	01/05/2016
End Date	30/04/2021
Contract type	Consolidator Grant
Contribution (EUR)	1,999,465.00
Coordinator	TECHNISCHE UNIVERSITAT DARMSTADT DE
Partners	-





## 10.1.5.5 INDESMOF

Acronym	INDESMOF (URL)	
Title	International Network on Ionic Liquid Deep Eutectic Solvent Based Metal Organic Frame Mixed Matrix Membranes	eworks
Abstract	The main objective of INDESMOF Marie Curie RISE action is to establish a new and research consortium to improve and exchange interdisciplinary and intersectoral knowle the design, synthesis, and characterization of advanced composite adsorben environmental remediation of heavy metal polluted water sources, able to provide high cand high selectivity filters for the industry. The main research core of INDESMOF is based nano-encapsulation of Deep Eutectic Solvents (DES) within the ordered porous structured Metal Organic Frameworks (MOF), in order to obtain a highly porous MOF material, conwith the metal chelation and solvation specificity of DES. Incorporation of high-capacity selectivity adsorbent materials within polymeric support is a crucial challenge far INDESMOF towards the real application of the MOF@DES materials in water filtering sy indispensable for mining and industrial water environmental remediation technor Development and improvement of advanced filtering technologies requires the joint efformultidisciplinary researcher collective, involving the expertise of participants on didisciplines including physics, chemistry, environmental chemistry, materials and posicience and engineering. Background knowledge and knowhow of INDEMOF's partners conthect through innovation and breakthrough actions towards the fabrication of advanced and so filters for polluted water remediation. Results will be widely disseminated through public workshops, post-graduate courses to train new researchers, a dedicated webpage, and workshops, post-graduate courses to train new researchers, a dedicated webpage, and workshops, post-graduate courses to train new researchers, and their performance are lawater polluted samples.	dge on ts for apacity on the ures of mbined y high- aces in restems, ologies. ort of a fferent olymer ombine d effort specific ations, risits to nology
Start Date	01/03/2018	
End Date	28/02/2022	
Contract type	Marie Sklodowska-Curie Research and Innovation Staff Exchange (RISE)	
Contribution (EUR)	774,000.00	
Coordinator	FUNDACION BCMATERIALS - BASQUE CENTRE FOR MATERIALS, APPLICATIONS AND NANOSTRUCTURES	ES
Partners	UNIVERSIDAD DE CHILE UNIVERSIDAD DE BUENOS AIRES THE REGENTS OF THE UNIVERSITY OF CALIFORNIA UNIVERSIDAD DEL PAIS VASCO/ EUSKAL HERRIKO UNIBERTSITATEA AGENCIA VASCA DEL AGUA URA TEKNIMAP AMBIENTAL SL UNIVERSITA DEGLI STUDI DI TORINO	CL AR US ES ES ES





## 10.1.5.6 **SOLCRIMET**

Acronym	SOLCRIMET (URL)
Title	Solvometallurgy for critical metals
Abstract	The recent "rare-earth crisis" has brought about the widespread realisation that the long-term availability and cost stability of many materials – not just the rare earths – can no longer be guaranteed. Increasing the levels of critical metal recycling from pre-consumer, manufacturing waste and complex, multicomponent end-of-life consumer products is considered as arguably the most important and realistic mitigation strategy. However, extracting a critical metal from complex waste is a very different challenge to that faced when attempting to produce a pure metal from a primary ore deposit. SOLCRIMET therefore develops a ground-breaking, novel approach called "solvometallurgy", a new branch within metallurgy, next to conventional hydroand pyrometallurgy. SOLCRIMET's aim is to successfully apply this approach to the extraction of specific critical metals, i.e. rare earths, tantalum, niobium, cobalt, indium, gallium, germanium and antimony. As these critical metals are essential components for clean-tech and high-tech applications, they are key enablers of the required transition to a low-carbon, circular economy. The approach involves the discovery of non-aqueous solvent pairs that are immiscible and allow the extraction of metal complexes at moderate temperatures, leading to high-purity recycled metals. The idea is certainly high risk, but the preliminary results already obtained are highly encouraging. The main outcomes of the project will be lab-scale demonstrators that show the enhanced efficiency, utility and applicability of the new solvometallurgical process, with respect to conventional hydro- and pyrometallurgy. SOLCRIMET's impact on chemistry, chemical technology, metallurgy and materials engineering science will be game-changing. The possibility to recycle critical metals with energy-efficient, low-cost processes could have a significant impact on the global recycling rates of these metals.
Start Date	01/09/2016
End Date	31/08/2021
Contract type	Advanced Grant
Contribution (EUR)	2,496,250.00
Coordinator	KATHOLIEKE UNIVERSITEIT LEUVEN BE





# 10.2 Section 6.1 Identification of projects funded through LIFE programme for the purpose of clustering activities

#### 10.2.1.1 LIFE BIOTAWE

Acronym	LIFE BIOTAWEE (URL)	
Title	BIOLEACHING OF WEEE WASTES FOR THE RECOVERY OF VALUABLE METALS	
Abstract	Waste electrical and electronic equipment (WEEE) is one the fastest growing waste stream the EU (3-5% per year) and is expected to reach more than 12 million tonnes per year by 2 WEEE is made up of complex mixture of materials, including potentially toxic substances su lead, mercury, cadmium and beryllium. These pose considerable environmental and health if not treated properly. Rare, precious and expensive metals are also used to make elect goods, for example, 10% of the world's gold. For the EU, which accounts for less than 1 global gold output, this means depending on imports. Collection, treatment and recyclic WEEE is essential to improve environmental management, enhance resource efficience making more secondary raw materials available, and contribute to the development of a cire economy.	2020. uch as n risks tronic 1% of ng of cy by
Start Date	01/07/2018	
End Date	31/12/2020	
Contribution (EUR)	544,426.00	
Coordinator	REYDESA RECYCLING, S.L.	ES
Partners	BIOTATEC LTD	EE



#### 10.2.1.2 LIFE LIBAT

Acronym	LIFE LIBAT (URL)	
Title	Recycling of primary Lithium BATtery by mechanical and hydrometallurgical operations	
Abstract	The increase in the use of devices needing portable energy has subsequently led to the in in the consumption of batteries. Some 211.000 tonnes of portable batteries were imported the European Economic Area(EEA) market in 2013. Such heavy usage raises concerns about management of the hazardous waste stream of end-of life batteries. These concerns addressed by the Battery Directive, which regulates the disposal and recycling of batteries sets collection rates and recycling efficiency targets; in particular, 25% and 45% man collection rates to be achieved by 2012 and 2016, respectively. While the 25% collection rates achieved in 2012, with a few exceptions, many Member States fell short of achieving the objective in 2016. The problem becomes more critical when considering lithium-mangane MnO2) batteries. Few industrial or recycling plants in Europe, actually none in Italy, curprocess end-of-life primary -namely not rechargeable lithium batteries- rendering development of an innovative recycling processes essential.	rted in out the ns are es, and datory ite was ne 45% ese (Li-rrently
Start Date	01/07/2017	
End Date	31/12/2020	
Contribution (EUR)	856,822.00	
Coordinator	ECO RECYCLING SRL	IT
Partners	SAPIENZA UNIVERSITY DEPARTMENT OF CHEMISTRY	IT



# 10.3 Section 6.1 Identification of projects funded through the EIT for the purpose of clustering activities

#### 10.3.1.1 AutoBatRec2020

Acronym	AutoBatRec2020 (URL)	
Title	Automotive Battery Recycling 2020	
Abstract	In the project AutoBatRec2020, the close cooperation of the battery recycler Umicor battery producer Samsung, the automotive group Daimler and the recycling plant manufal ImpulsTec, covering the whole value chain and supported by the respective R&D skills of Freiberg, CEA and Fraunhofer in batteries, recycling, process automation and restrategies, will give the chance to change the game in that field. The holistic approach to crain industrialized battery recycling process with high efficiency, high throughput, and recovery rate is essential for the sustainable implementation of electric mobility and energy in Europe. AutoBatRec2020 will bring automotive battery recycling to a new level the aim to develop an industrialized recycling process in Europe that provides a sustainable materials source for its high-tech industry.	TU BA source reating d high green . It has
Start Date	01/01/2018	
End Date	31/03/2021	
Coordinator	FRAUNHOFER-GESELLSCHAFT ZUR FÖRDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	DE
Partners	FRENCH ALTERNATIVE ENERGIES AND ATOMIC ENERGY COMMISSION (CEA) DAIMLER AG IMPULSTEC SAMSUNG SDI BATTERY SYSTEMS GMBH AUSTRIA TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG (TUBAF) UMICORE NV	FR DE DE AT DE BE



#### 10.3.1.2 CarSiFer

Acronym	CarSiFer (URL)	
Title	Innovative Recycling Solution for waste containing Carbon, Silicon and Iron	
Abstract	Nowadays, most ores and metals are imported to Europe, which, inherently, already cons a growing geopolitical concern. In the meantime a great deal of valuable industrial wast high metallic content is also unused, diluted with other waste streams or dumped in la However, most of the time, these wastes contain a mix of carbon/graphite, iron, silico valuable metals as manganese, copper and nickel, which could be valorized by the indus allow greater reuse of these materials, speed up the recycling and extend activities related the circular economy, this project aims to develop a new concept: the production of materials dedicated to foundries from wastes containing carbon/graphite, silicon and such as carbon, silicon and iron (CarSiFer). To transform waste into a useful metallurgical profoundries, the project will be addressing several aspects ranging from the identification collection of waste streams to the actual treatment of the material through briquetting finally deliveries to foundries for validation.	ndfills. on and try. To ited to of raw metals roduct on and
Start Date	01/01/2019	
End Date	30/06/2022	
Coordinator	RECYCLAGE ET VALORISATION TECHNIQUE	BE
Partners	CENTRE DE RECHERCHES MÉTALLURGIQUES ASBL (CRM GROUP) ECO'RING FRAUNHOFER-GESELLSCHAFT ZUR FÖRDERUNG DER ANGEWANDTEN FORSCHUNG E.V. (FRAUNHOFER) SUEZ GROUPE SAS	BE FR DE FR



## 10.3.1.3 FLAME

Acronym	FLAME (URL)	
Title	FLy Ash to valuable MinErals	
Abstract	The FLAME project is perfectly aligned with the KIC Raw Materials vision of turning materials dependence into a strategic strength for the European economy. The DPS tecan become key in increasing resource efficiency by enabling dry (ultra)fine mineral class and extraction of valuable minerals from both primary and secondary resources. contribute to closing material loops by minimizing losses of unused materials along to chain. At large, the project results may trigger alternative applications of the DPS technother resource streams and thus benefit the wider KIC community active in (manufacturing for) resource extraction. The provision of large amounts of high-quality (minerals to the market is expected to engender the development of more performant and sustainable materials and products in related markets such as high-value commaterials and composite materials. Within the project, intense knowledge exchange mineral end-users, power central customers and machine builders will enable desempertise, sharing of expertise and further build-up of competences of skilled R&D and personnel. In addition, student internships and engagement of engineering master (MSc theses) will be organized and eventually these training/education activities providing a recruitment base for the commercialising partner.	chnology sification This will he value hology to machine ultra) fine durable struction between siloing of technical students
Start Date	01/04/2017	
End Date	31/03/2020	
Coordinator	VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK NV	BE
	ATLAS COPCO AIRPOWER NV	SE
	ATLAS COPCO ROCK DRILLS AB	SE
	KAUNO TECHNOLOGIES UNIVERSITETAS (KTU)	LT
Partners	TALLINNA TEHNIKAÜLIKOOL, TTÜ – TALLINN UNIVERSITY OF TECHNOLOGY	EE
	VALUE ASH TECHNOLOGIES NV (VASHT NV)	BE
	ZAVOD ZA GRADBENISTVO SLOVENIJE, ZAG (SLOVENIAN NATIONAL BUILDING AND CIVIL ENGINEERING INSTITUTE)	SI



#### 10.3.1.4 GREENY

Acronym	GREENY (URL)	
Title	GRinding Energy EfficiencY	
Abstract	The GREENY project focuses on increasing the energy efficiency of comminution and enthe beneficiation of difficult to process secondary raw materials. The raw slag, containing than cost beneficially required of extractable metals, is to be used as a separate product construction materials after comminution. During the project, emphasis is placed on impand upscaling suitable crushing and grinding technologies for slag material to enhance energy efficiency and performance of crushing equipment in demanding operational conditions. The processes are developed in general with difficult to refine secondary raw materials in for example, materials which contain both brittle and ductile phases. These objectives as by upscaling new crushing and grinding processes and applying them to presently use sources of secondary raw materials. As a use case, the GREENY project takes on the effective of the steel industry's slag that is a side product in steel making. The design optimization methodologies, processes and equipment that are developed are applicabely to other slags and secondary raw materials. In the GREENY use case, the slag contains valued that can be extracted by a combination of selective comminution and metal liber from the slag.	ng less act for roving the the itions. mind, re met mused ficient in and le also luable
Start Date	01/01/2019	
End Date	30/06/2021	
Coordinator	METSO MINERALS OY	FI
Partners	ERAMET IDEAS LULEÅ UNIVERSITY OF TECHNOLOGY (LTU) TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG (TUBAF) TEKNOLOGIAN TUTKIMUSKESKUS VTT (TECHNICAL RESEARCH CENTRE OF FINLAND LTD. VTT)	FR SE DE FI



## 10.3.1.5 LiRef

Acronym	LiRef (URL)	
Title	Multi-feed Lithium Technology	
Abstract	A number of global political, environmental and technological trends are driving the detowards a rapid increase in Lithium-ion batteries, turning it to a strategically important defor both industry and society. The increase in demand puts pressure on raw material supply processing. Critical elements for which global supply shortage may occur include Cobal Lithium. According to the European Commission Report "Lithium-ion battery value charelated opportunities for Europe", the EU industry has some production base in all segments the battery value chain, but it is far from being self-sufficient. In the raw and production materials, cell component and cell manufacturing value chain segments Europe hold a share of the market. The proposed project shall validate the technological, economic, leg social viability of a novel electrochemical process, using hydro-electric power, to directly of spodumene concentrate into high purity lithium hydroxide. Spodumene concentrate we sourced primarily from European producers, thereby fostering the development of a susta European value chain. This project's plans also include setting up a European refinery while become operational from 2023.	omain oly and lt, and in and ents of cessed minor gal and onvert will be ninable
Start Date	01/01/2019	
End Date	30/06/2021	
Coordinator	LITHREF AB	SE
Partners	ECM LITHIUM AT GMBH FLSMIDTH A/S KELIBER OY LULEÅ UNIVERSITY OF TECHNOLOGY (LTU) NEMASKA LITHIUM INC OUTOTEC (FINLAND) OY OUTOTEC OYJ SAVANNAH RESOURCES WOXNA GRAPHITE AB	AT DK FI SE CA FI UK SE



#### 10.3.1.6 MORECOVERY

Acronym	MORECOVERY (URL)	
Title	Modular recovery process services for hydrometallurgy and water treatment	
Abstract	The need for raw materials, especially Rare Earth Elements (REE), is increasing rapidly in and globally. At the same time, the amount of mine waste is increasing drastically toget concerns related to the environmental effects of mining. The mining industry can achie eco-efficient and selective raw material production by enhancing the utilization of side and mine waste. This development highlights the need to develop more efficient methods and to efficiently remove dissolved metals from mine water streams while secu surrounding environment and ecosystem. This project aims to enhance the eco-effici sustainable use of natural resources by creating a modular recovery process service pachydrometallurgy and water treatment. In addition, the organic adsorbents will be te efficient applications in semi-passive drainage water treatment and REE and bas recovery. The modular recovery process service package including a mobile pilot plant cowith innovative SME technologies and eco-efficient organic adsorbents will be a powerful developing utilization and cleaning of mining side streams.	her with we more streams recovery uring the ient and kage for sted for e metal ombined
Start Date	01/01/2019	
End Date	31/12/2021	
Coordinator	GEOLOGIAN TUTKIMUSKESKUS, GTK	FI
Partners	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS M.P., CSIC LTU BUSINESS AB SAVONIA UNIVERSITY OF APPLIED SCIENCES LTD SUOMEN MALMIJALOSTUS OY (FORMERLY TERRAFAME GROUP OY) UNIVERSITY OF EASTERN FINLAND UNIVERSITY OF HUELVA	ES SE FI FI FI ES



## 10.3.1.7 RECOVER

Acronym	RECOVER (URL)	
Title	Innovation in Motion: Red mud and Copper slag Valorisation in Engineered Products	
Abstract	The general objective of this Upscaling project is to produce full-scale final inorganic pol products, from Metallo copper slag and Aughinish red mud, at the respective companies' using a modular and mobile upscaling unit. The generated products need to deliver prope similar to or better than traditional market substitutes and will be evaluated in term properties (i.e. leaching, durability, fire resistance,), to allow for their market uptake wit years after the project. Next to realizing the target of TRL 7 by the completion of the project on-site production of final products at Metallo and Aughinish plants and the rematchmaking events will contribute to the level of customer readiness by demonstratif reasibility to local construction companies and policymakers, thereby providing a nucleu industrial symbiosis. The utilization of Fe-rich semi-vitreous industrial residues as precursor engineered fire-resistant and porous materials that can enter the European construmaterials market will lead to products with lower environmental footprint and renders metallurgical industries important raw materials suppliers that run integrated zero-verocesses. This valorization of secondary resources in construction materials will yield a posenvironmental impact by substantially lowering CO2 emissions (reducing cement produce responsible for over 8% of anthropogenic CO2 emissions) and by avoiding the need for lands and the related environmental burden. The modular and mobile unit that is used to proproducts on-site of the residue producer, allows to reach out to the (traditional) construindustry and have them witness the transformation of residues to products in first personallows them to make a fact-based judgment about the extent to which their existing installa can be used to make these products or which adaptations and investments may be neces After the project, the unit can be used to train their employees and have them acquire skills. The matchmaking events set-up at each of the involved residue producers will show the	sites, erties in soft hin 3 t, the lated ing its its for retion is the vaste stilling in the s
Start Date	01/04/2017	
End Date	31/03/2020	
Coordinator	KATHOLIEKE UNIVERSITEIT TE LEUVEN	BE
Partners	BOLIDEN COMMERCIAL AB BOLIDEN MINERAL AB BUNDESANSTALT FÜR MATERIALFORSCHUNG UND -PRÜFUNG (BAM) CENTRE DE RECHERCHES MÉTALLURGIQUES ASBL (CRM GROUP) METALLO CHIMIQUE NV NATIONAL TECHNICAL UNIVERSITY OF ATHENS RESOURCEFULL BVBA	IE SE SE DE BE BE EL BE
	ZAVOD ZA GRADBENISTVO SLOVENIJE, ZAG	SI





## 10.3.1.8 RED\_SCOPE

Acronym	RED_SCOPE (URL)	
Title	Recovery of Effluent Discharge for Sustainable Copper Processing in Europe	
Abstract	The project will assess the technical and economic feasibility study of a new process aimed maximizing the water recovery from the aqueous effluents of a Copper Smelter. The new process will enable an optimal use of Raw Materials within Europe and will contribute to the current strategy on Circular Economy. The goal of RED_SCOPE is to enable the treatment of composition copper concentrates, which is aligned to the knowledge & innovation theme of increas resource efficiency in mineral and metallurgical processes. This means the development of lexible economic treatment of complex materials, thereby addressing the issue of removing increasing amount of impurities and enabling greater reuse of process residues (recycliteated wastewater). The project will improve the industrial competitiveness of copper smelts. The project actively contributes to achieving this impact because if improved wastewateratment is implemented, it will make it possible to smelt complex copper and comply with environmental limits on the discharge of concentrates. Also, the RED_SCOPE process reduvater and energy consumption (compared to conventional technologies), improves resource efficiency and reduces water management costs. Considering the new wastewater treatment as a new production unit, RED_SCOPE closes the material cycle for the water resource strengthens the impact because it channels all effluent flows for treatment.	cess t EU plex ased of a the cling ters. ater the uces urce nent
Start Date	01/04/2017	
End Date	31/12/2019	
Coordinator	ATLANTIC COPPER	ES
Partners	IVL SWEDISH ENVIRONMENTAL RESEARCH INSTITUT SUEZ ENVIRONMENT COMPANY AQUATEC, PROYECTOS PARA EL SECTOR DEL AGUA, S.A.U CETAQUA, CENTRO TECNOLÓGICO DEL AGUA, FUNDACIÓN PRIVADA	SE FR ES ES



## 10.3.1.9 ReSiELP

Acronym	ReSiELP (URL)	
Title	Recovery of Silicon and other materials from End-of-Life Photovoltaic Panels	
Abstract	Millions of Photovoltaic Panels (PV) modules have been installed worldwide over the padecades without implementation of a circular value-chain by now. In order to ke containing critical and precious metals in the loop, RESIELP brings together technologic different fields to recover and purify critical and precious raw materials (Si, Ag) as we product materials (glass, Al, Cu) in an environmentally friendly and circular economic with a product-centric zero-waste approach. The project involves several industrial pready to push the technology to market within 3 years after the end of the project, we EoL PV market starts to grow fast. TRL 7 will be reached at the end of the project (beging 2020) and TRL 9 within another 3 years (2023), when the European market growth expected. Added value is represented by multiple potential end users, inside and out value chain, making the pilot case a great example of circular economy demonstrator.	eep the less from a by-process artners, hen the nning of start is
Start Date	01/04/2017	
End Date	31/03/2020	
Coordinator	COMMISSARIAT À L'ÉNERGIE ATOMIQUE ET AUX ÉNERGIES ALTERNATIVES, CEA	FR
	AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE (ENEA)	IT
	BAY ZOLTAN NONPROFIT LTD. FOR APPLIED RESEARCH	HU
	CENTRO DI RICERCHE EUROPEO DI TECNOLOGIE, DESIGN E MATERIALI (CETMA)	IT
Partners	I.T.O. SRL	IT
Partifers	MAGYARMET (MAGY)	HU
	PROJEKTKOMPETENZ.EU – GESELLSCHAFT FÜR PROJEKTENTWICKLUNG UND MANAGEMENT M.B.H. (PROKO)	DE
	RELIGHT S.R.L.	IT
	UNIVERSITÀ DEGLI STUDI DI PADOVA (UNIVERSITY OF PADOVA)	IT

# D10.1 List of projects for clustering (vi)



#### 10.3.1.10SUPRIM

Acronym	SUPRIM (URL)	
Title	Sustainable Management of Primary Raw Materials through a better approach in Life Cycle Sustainability Assessment	
Abstract	Solutions and services to address resource depletion in sustainability assessments is materials sector. The consortium will develop and validate a service, enabling stake integrate resource depletion in sustainability assessments, and thus assisting in the towards a more sustainable management of raw material extraction. The project will novel models for cause-and-effect chains enabling an accurate and accepted estimate impacts of resource depletion. To implement the methodology, appropriate LCI day required, building on site-specific production data from existing mining open transparent approach for the data collection, data quality assurance, and exploitation database by a neutral and trustful body will be investigated.	transition Ill develoption of the tasets are rations. A
Start Date	01/04/2017	
End Date	31/12/2019	
Coordinator	GHENT UNIVERSITY	BE
Partners	BOLIDEN MINERAL AB	SE
	COBRE LAS CRUCES, S.A.	ES
	EUROPEAN ASSOCIATION OF MINING INDUSTRIES, METAL ORES & INDUSTRIAL MINERALS (EUROMINES)	BE
	FUNDACIÓN TECNALIA RESEARCH & INNOVATION	ES
	LEIDEN UNIVERSITY	NL
	LULEÅ UNIVERSITY OF TECHNOLOGY (LTU)	SE