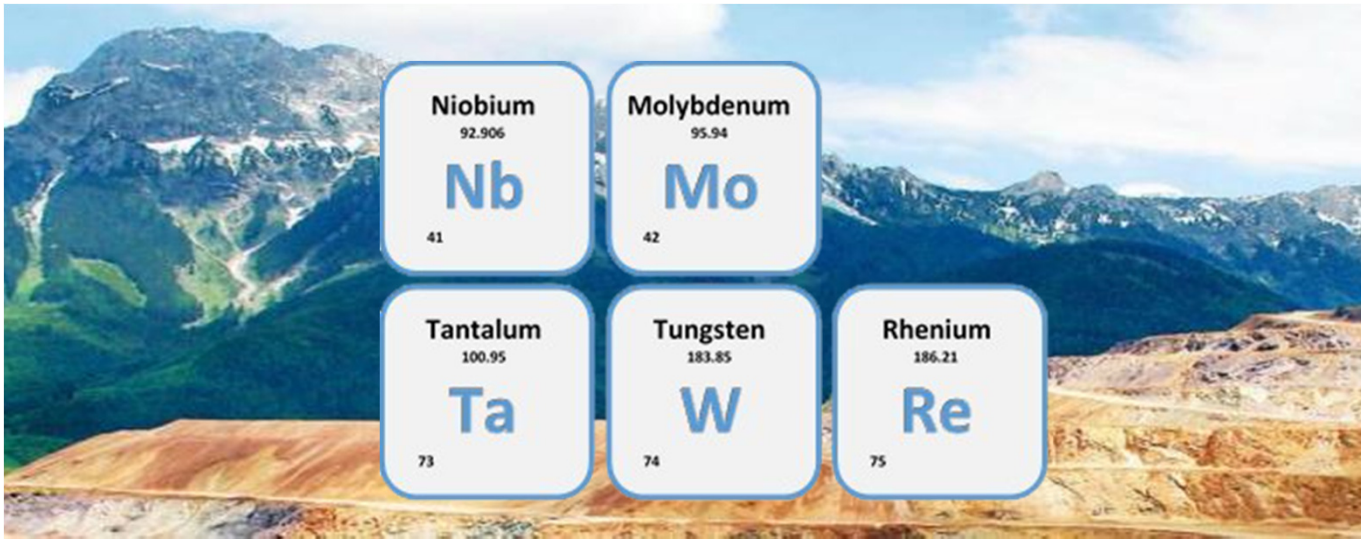
- MSP-REFRAM -

improving the valorization of the refractory metal resources in Europe



Stéphane BOURG

MSP-REFRAM Coordinator

PROMETIA *EXCOM Chairma*

Project Manager at CEA

European Commission

PROMETIA

www.prometia.eu

Introduction

PROPOSED BY PROMETIA

Academics

CHALMERS

Chimie Paris ParisTech

KU LEUVEN RESEARCH & DEVELOPMENT

INP TOULOUSE

TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

LUT Lappeenranta University of Technology

FCT FACULDADE DE CIÊNCIAS E TECNOLOGIA UNIVERSIDADE NOVA DE LISBOA

TU Delft Delft University of Technology

UNIVERSITY OF LEEDS

Industry / SME

AMPHOS 21

VALE

idener

ERAMET

EC Recycling Spin Off

TASMAN METALS LTD

Extracthive

E-MINES

TRISKEM

Institutes

cea

brgm

VTT

GTK

Instytut Metali Nieżelaznych Gliwice

swerea MEFOS

ICCRAM

Centro tecnológico CARTIF

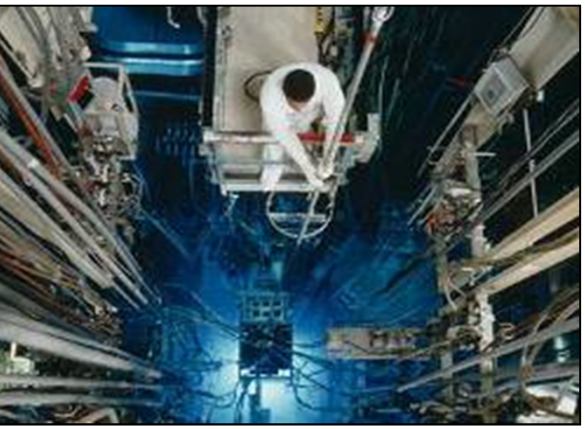
Elkem A Bluestar Company

Associated Members

- Scaron Consulting
- WE Falck
- Jack Lifton
- WMRC
- *SIEMCALSA*
- *Junta Castilla y Leon*

SIEMCALSA

CEA in a few words



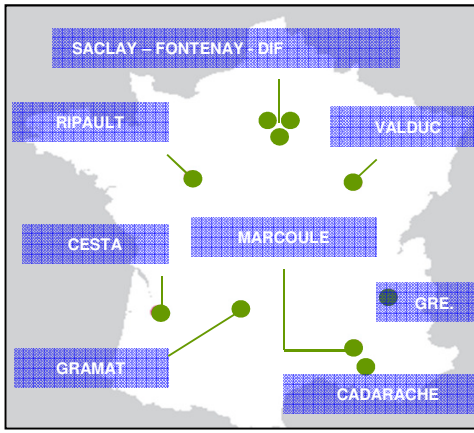
Created in 1945 to give nuclear capacity to France, in 2010 the CEA became :

cea

energie atomique • energies alternatives

A change that **reflects the activities and potentials** of our organization.

- Low carbon energies (nuclear, renewables)
- Defense and global security
- Health and information technologies
- Large research infrastructures
- Training and education
- Valorisation and technological transfer



10 centres de recherche

- ~16000 staff – annual funding : 4,7 billions Euros
- 2013 : 2nd patents applicants in France with 754 patents
- Within 30 years, 157 start-up of spin-off


MSP
REFRAM


PROMETIA


MSP
REFRAM

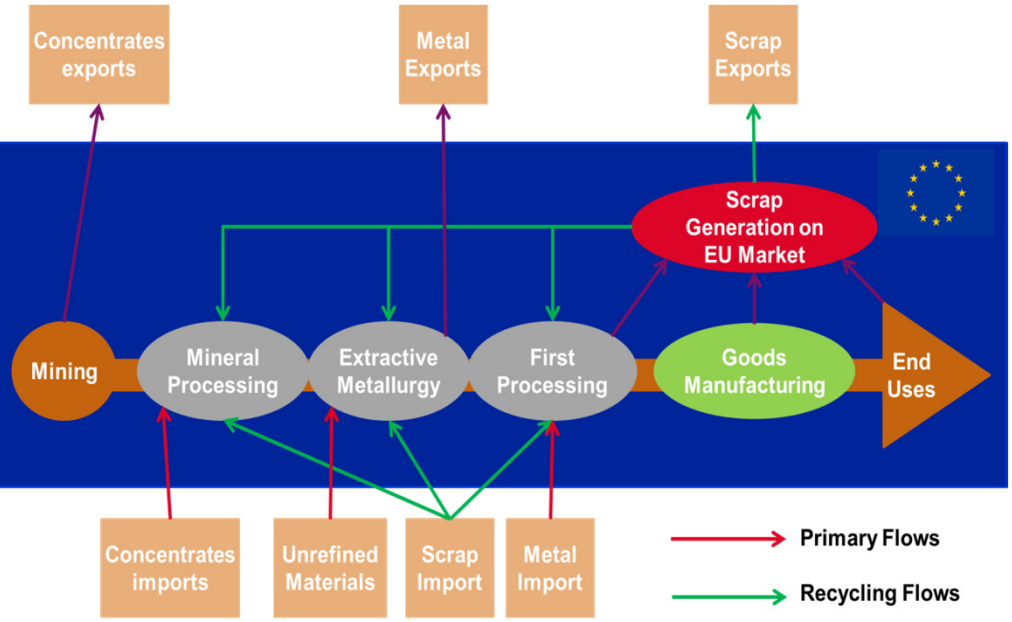
MSP-REFRAM

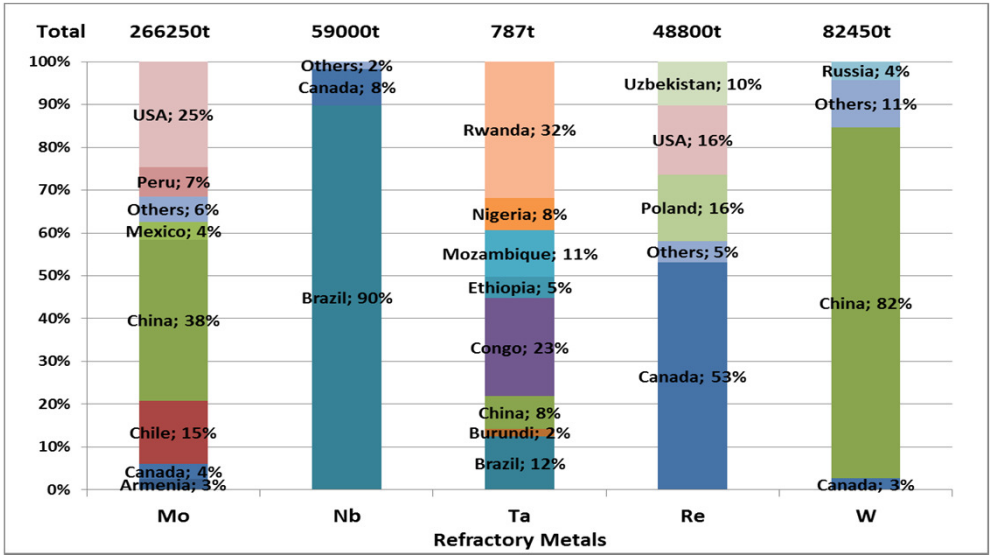
Creation of a common multi-stakeholder platform focused on **the refractory metals** across their whole value chain. This initiative involves partners from across the value chain, including **mining, processing, recycling**, application, public sectors (national/regional/local) and civil society

21 consortium members + 30 External Experts

9 Months, 1.5M€

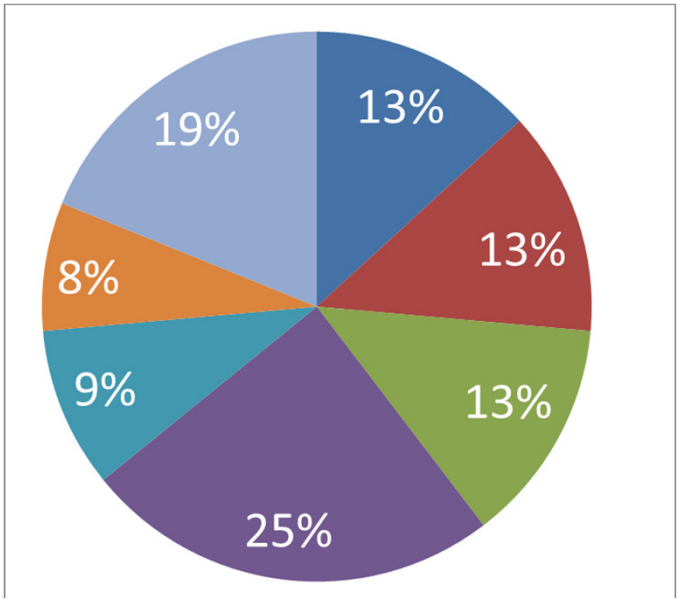
Project funded under the SC5 H2020 work-program, project n° 688993, 2016





The refractory metals world annual production (2014)

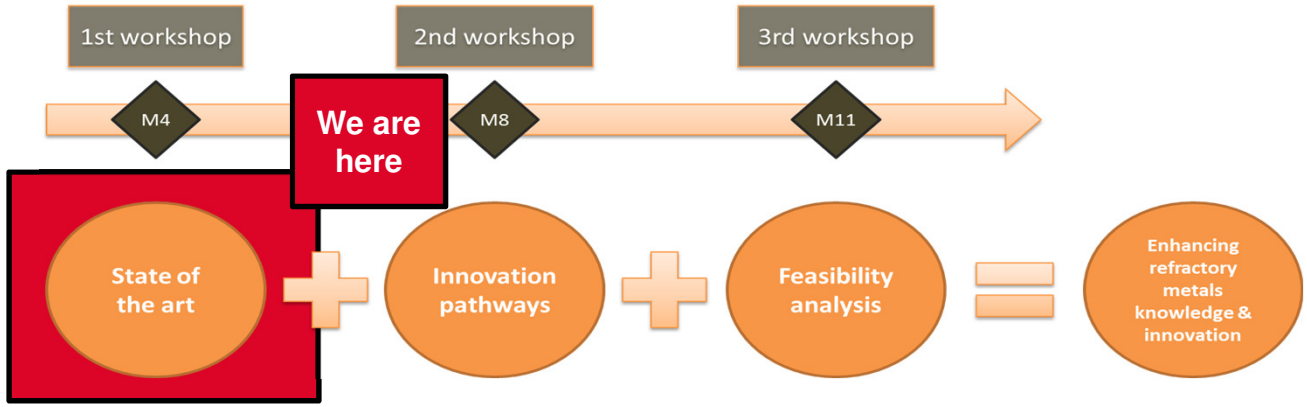
MSP-REFRAM Consortium And Experts

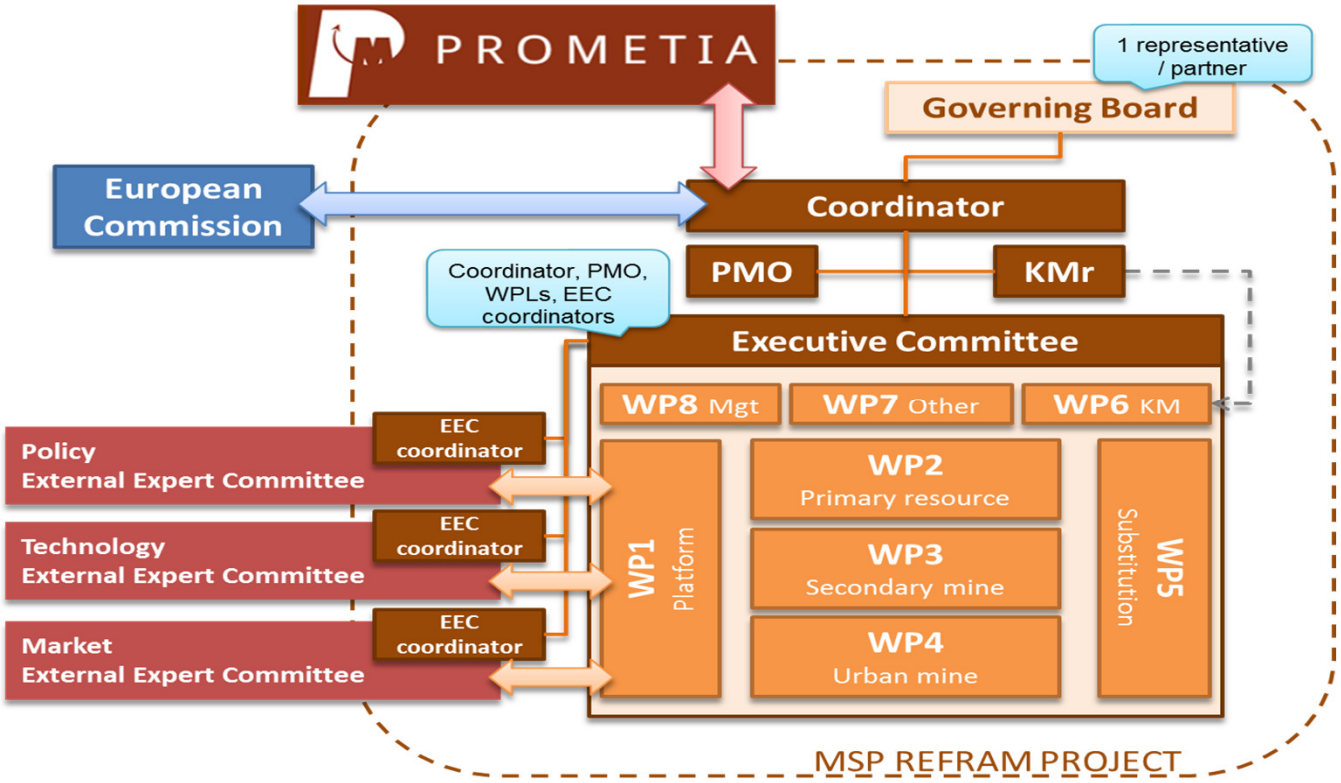


academia
associations
european initiatives
industry/SME
public bodies
experts
RTO

No	Name	Short name	Count
1	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	CEA	France
2	AMPHOS 21 CONSULTING SL	AMPHOS 21	Spain
3	BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES	BRGM	France
4	FUNDACION CARTIF	CARTIF	Spain
5	CHALMERS TEKNISKA HOEGSKOLA AB	CHALMERS	Swede
6	E-MINES	E-MINES	France
7	ERAMET RESEARCH	ERAMET	France
8	GEOLOGIAN TUTKIMUSKESKUS	GTK	Finlan
9	UNIVERSIDAD DE BURGOS	ICCRAM	Spain
10	OPTIMIZACION ORIENTADA A LA SOSTENIBILIDAD SL	IDENER	Spain
11	INSTYTUT METALI NIEZELAZNYCH	IMN	Poland
12	AGENCIA DE INNOVACION Y FINANCIACION EMPRESARIAL DE CASTILLA Y LEON	ADE	Spain
13	TECHNISCHE UNIVERSITAET KAISERSLAUTERN	UNIKL	Germa
14	LAPPEENRANNAN TEKNILLINEN YLIOPISTO	LUT	Finlan
15	INSTITUT NATIONAL POLYTECHNIQUE DE TOULOUSE	LGC	France
16	SWEREA MEFOS AB	MEFOS	Swede
17	NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA	NTUA	Greece
18	TECHNISCHE UNIVERSITEIT DELFT	TU Delft	Nether
19	Teknologian tutkimuskeskus VTT Oy	VTT	Finlan
20	LGI CONSULTING SARL	LGI	France
21	PROMETIA		Belgi

Developping new value chains

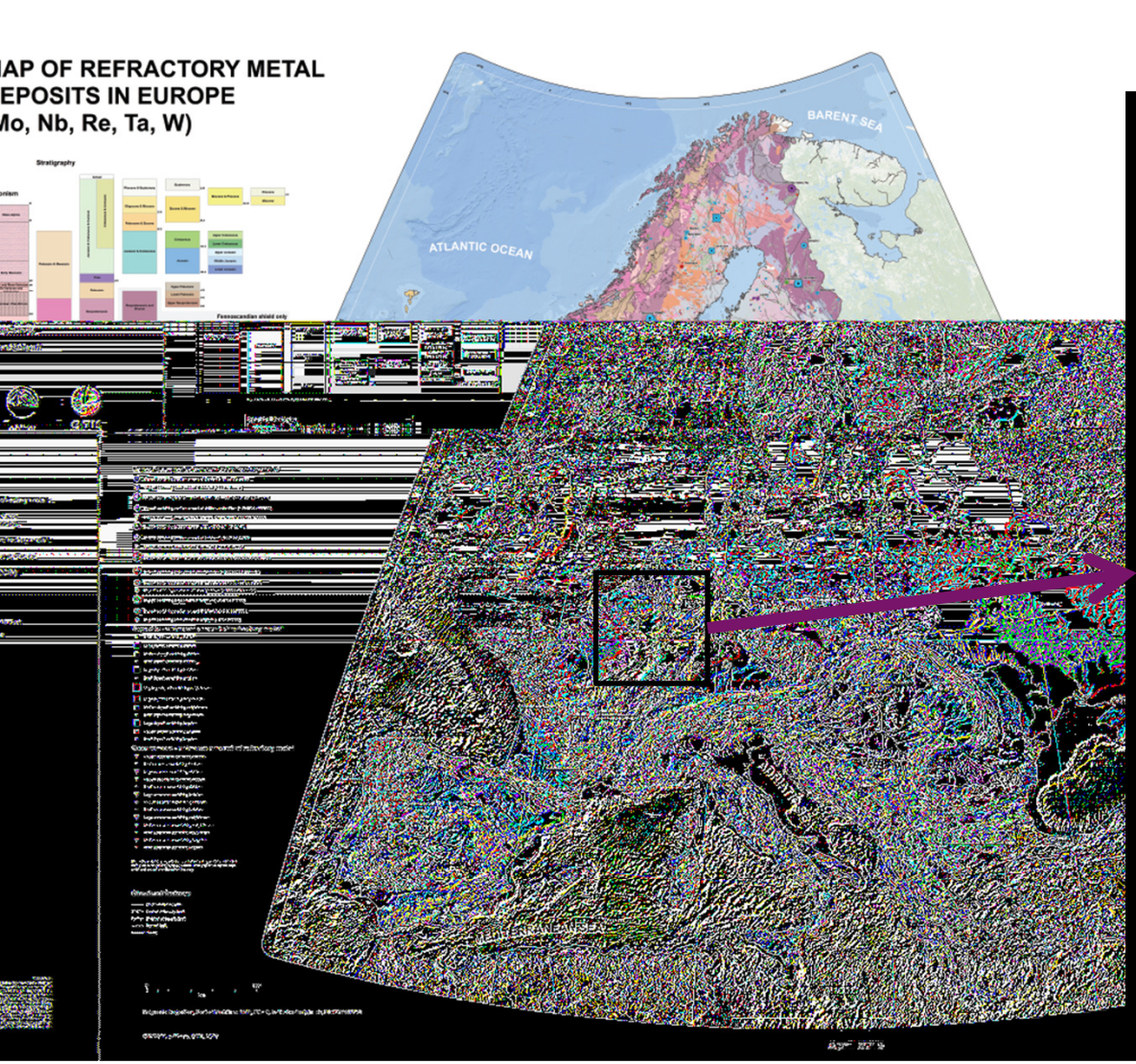


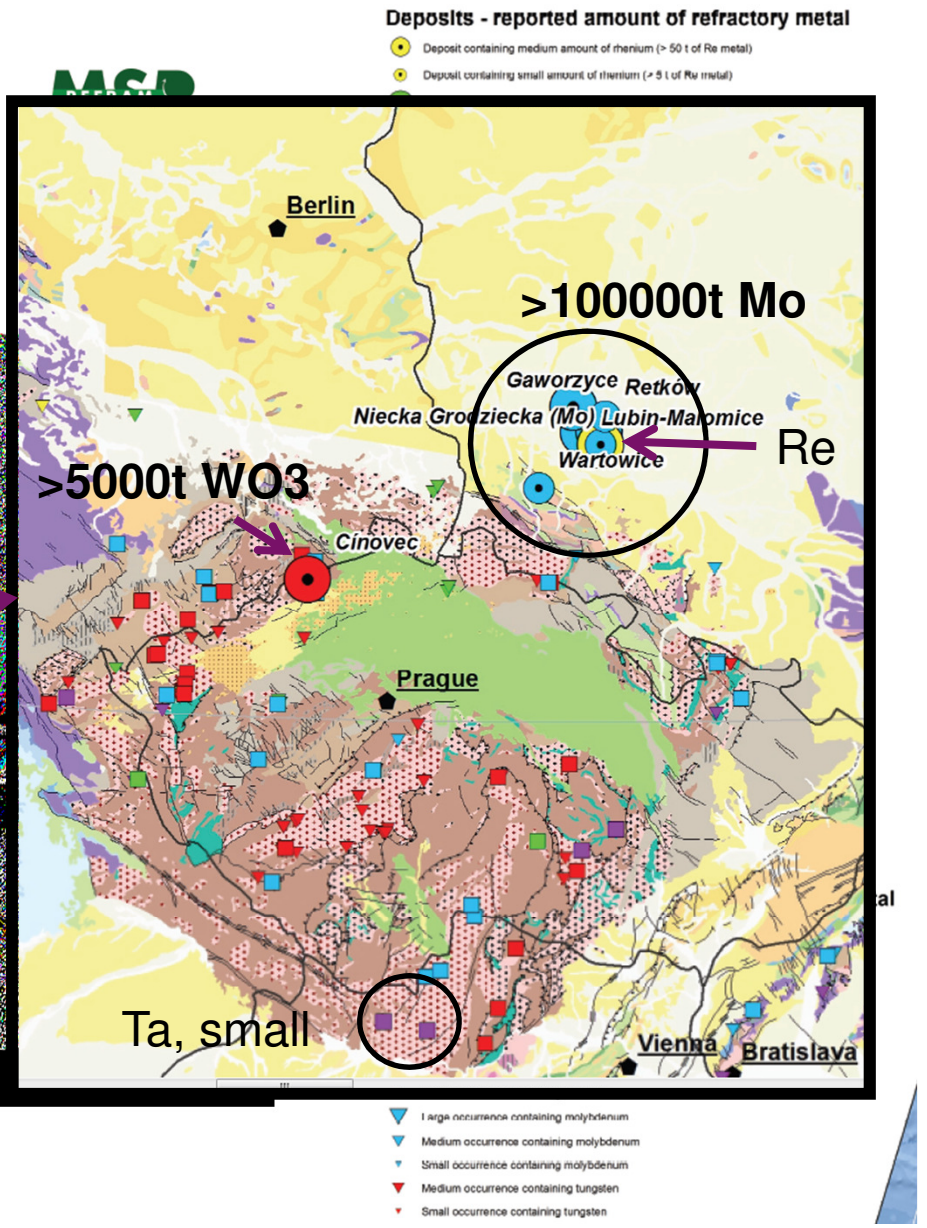


For each metal:

- Mining/collection
- (mineral) processing
- Extractive metallurgy
  - Hydro
  - Pyro
- Waste/ Environmental impacts
- Substitution
- Policy issues/regulations

Mapping of the primary resources in Europe





Mapping of the secondary resources in Europe

Secondary resources of Molybdene

Type of Material	Company/ Mine	Location	Grade of Mo	Reserve, Mineralogy and Characterization	Ref
ste tailings ste rock	Boliden Aitik	Sweden	0.00027%	Aitik porphyry Cu-Au-Ag-(Mo) deposit Ore feed, 36 000 with a Mo concentration of 0.849 kt. Tailing produced of 17 700 000 and 26 000 Kt/year of waste rock	[35], [18]
ste tailings	Knaben Molybdenumines	Norway	40 ppm acid-soluble Mo Molybdenita and Molybdate (MoO_4^{2-}) Associate with fine-grained silicates or oxidates. Size particle: 0.2-0.9	Inactive mine. 8 million tonnes of waste material produced and deposited in two ponds. 420000 tonnes have been washed and deposited sabdbars of the river. Chemical ccomposition of tailing pond: Cu 215, Mo 51. Other materials: Ba, Cu, K, La, Li, Mg, Mn, Mo, S, Th, Y, Zn	[36]
ste tailing	Boliden Garpenberg	Sweden	2.9 mg/Kg	500 000 tonnes of tailings/yr Other minerals: Pb, S, As, Ba, Fe, Ni, P, V, Zn, Cu.	[18]
ste tailing	KGHM Lubin	Poland	15 g/t	Underground mine Tailings: 27 000 000 kt/yr Other minerals: V, N, Co, Ag, As, K	[18]
ste tailing	KGHM Polkowice-Sieroszowice	Poland	12 g/t	Underground mine Tailings: 27 000 000 kt/yr Other minerals: V, N, Co, Ag, As, K	[18]
ste tailing	KGHM Rudna	Poland	8 g/t	Underground mine Tailings: 27 000 000 kt/yr Other minerals: V, N, Co, Ag, As, K	[18]
ste tailing	Kiruna and Svappavaarra Mine	Sweden	15-11 ppm	Iron mine Other minerals: Cu, Nb, Ni, Pb, V, W, Zn...	[18]

Estimated Rhenium production from recycled materials

Country	Rhenium production, Mg
Germany	4.0
Poland	0.5
France	1.0
Estonia	1.0
Czech Republic	0.5
Global	**7.0**

Total quantities of WEE collected in the EU28+ Norway in 2012

Tal

Category	Equipment collected, tons
Large household appliances	1 495 000
Small household appliances	224 500
IT and telecommunications equipment	615 000
Consumer equipment	572 500
Other	187 000
Total WEEE	3 474 000

Buchert et al. (2012) give a rough estimate about Ta content in notebooks 1 700 mg/noteb from which capacitors on the motherboard account for 90%, and capacitors on other printe circuit boards PCBs10%.

Processing and extractive metallurgy

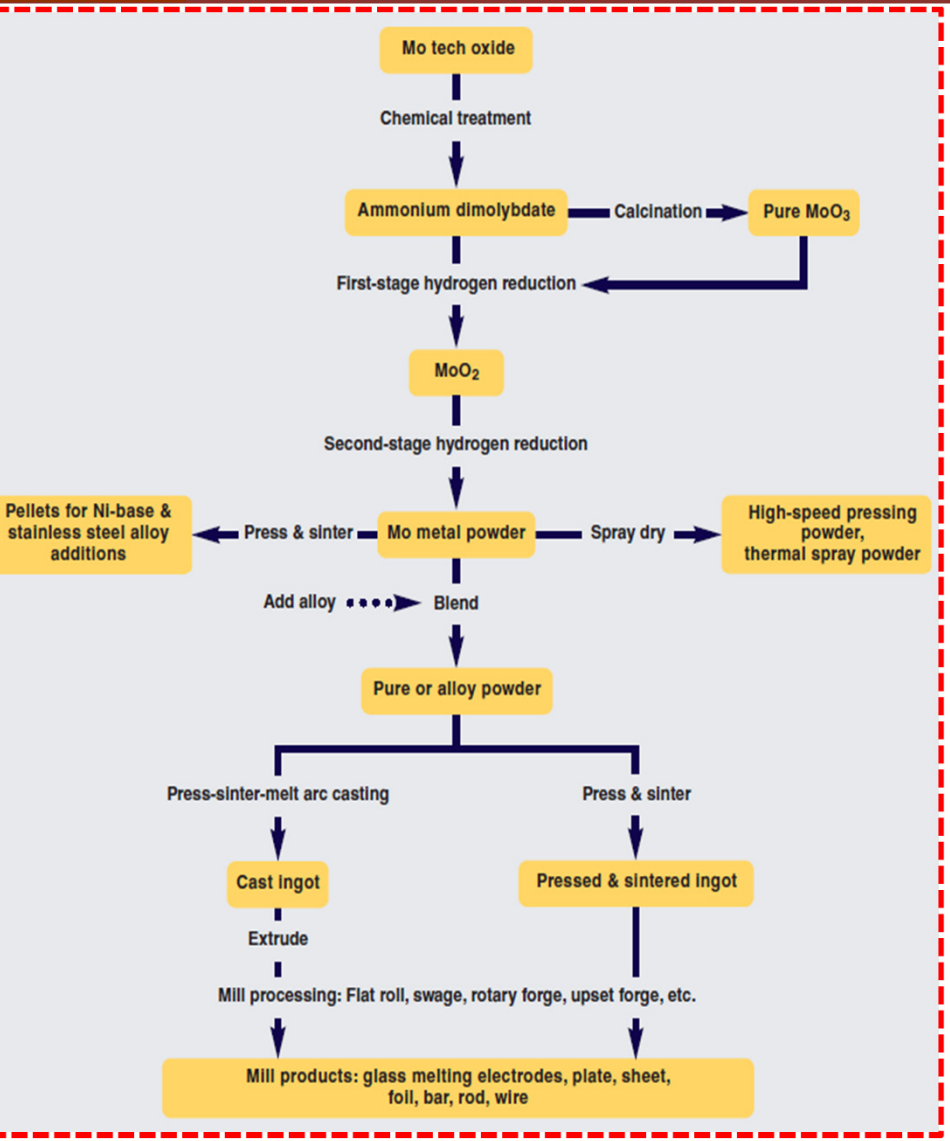


Figure 3 Molybdenium metal and alloy production in the value chains (shown in Figure 1).

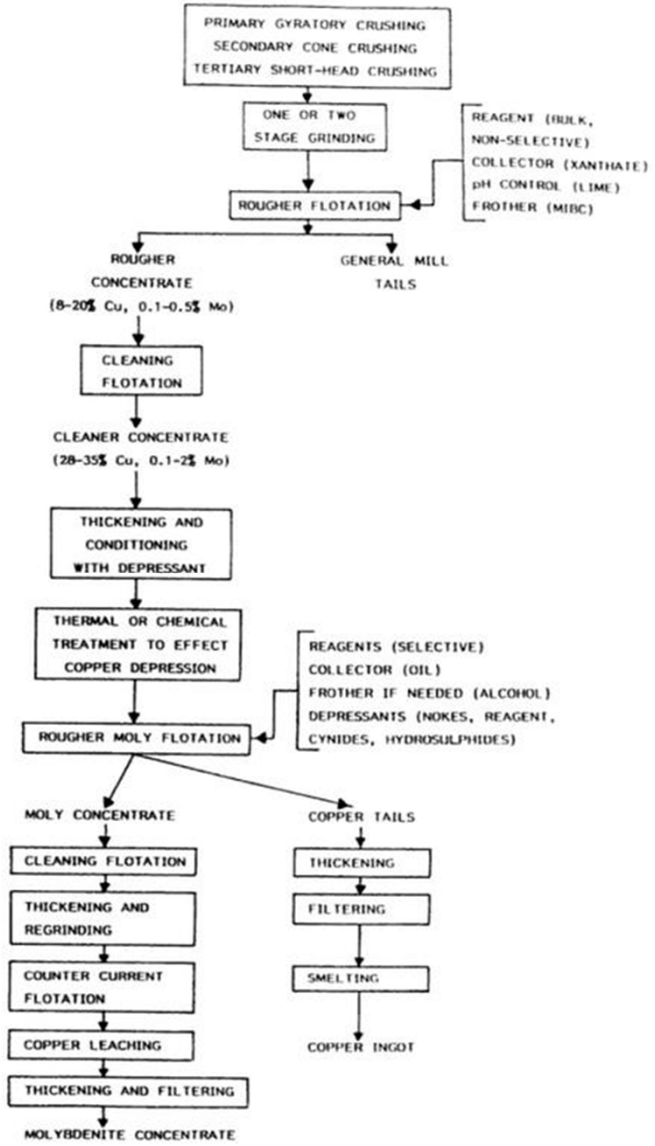
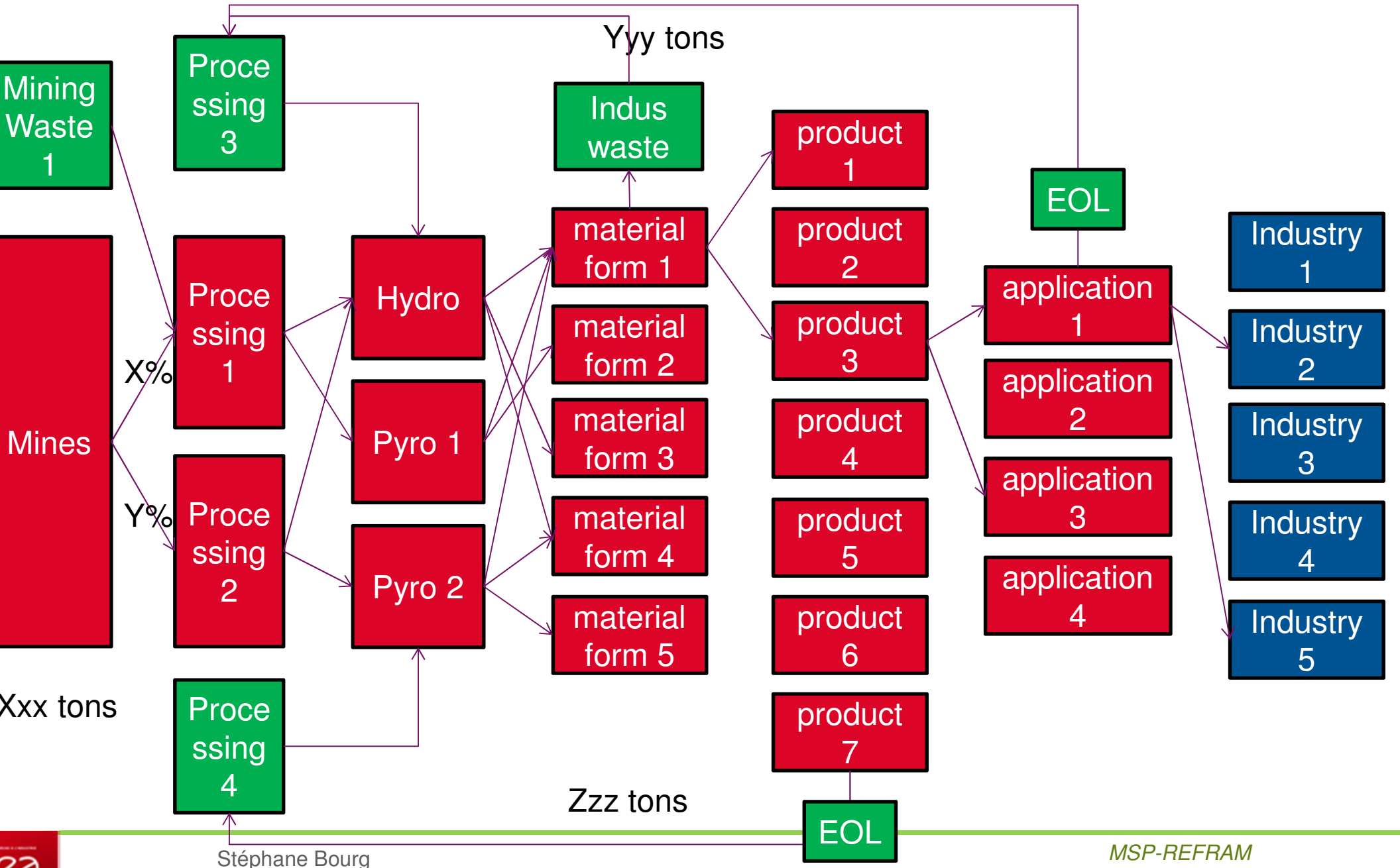
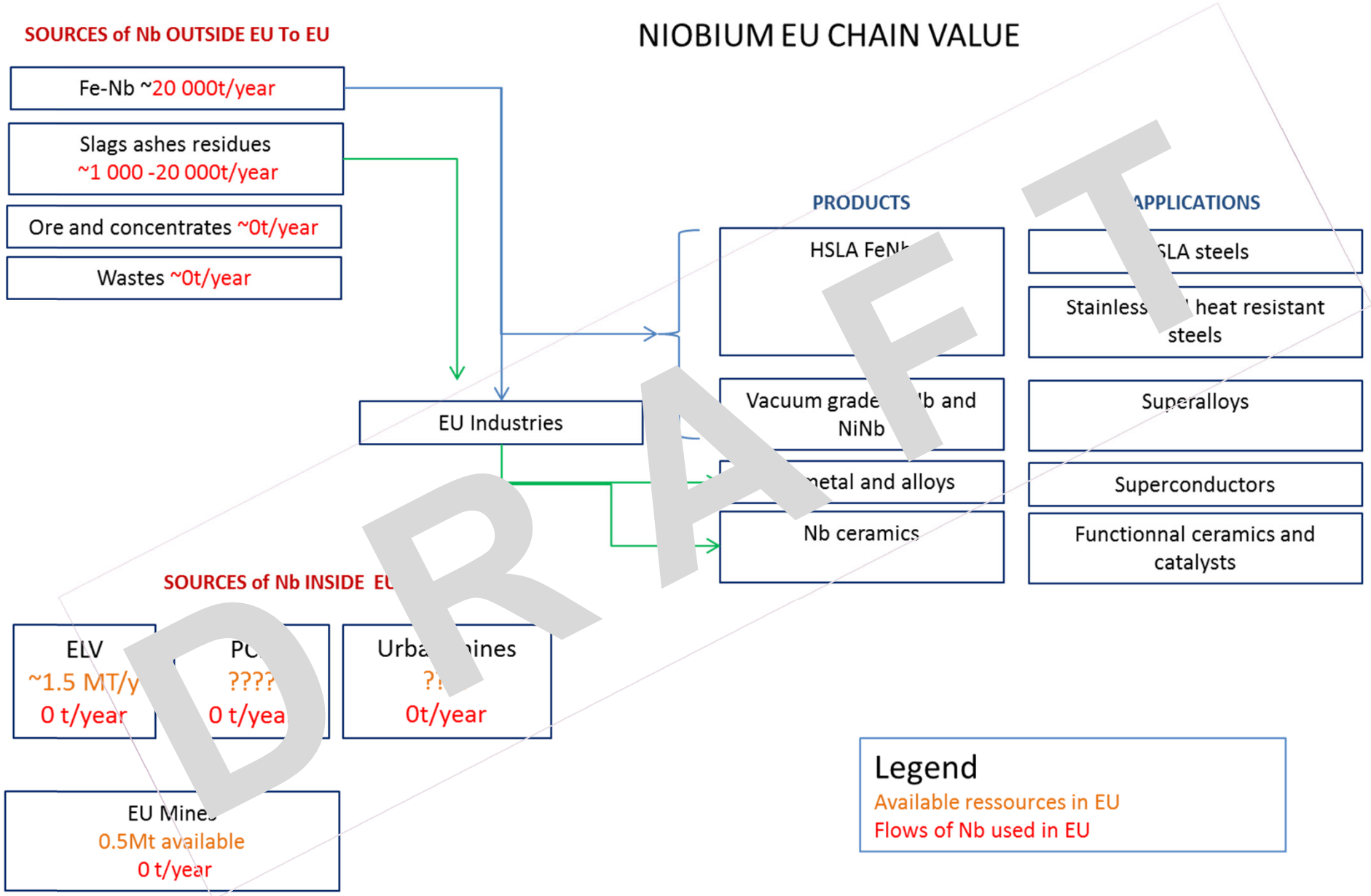


Figure 3-2 A basic by-product Mo recovery flowsheet from porphyry coppers

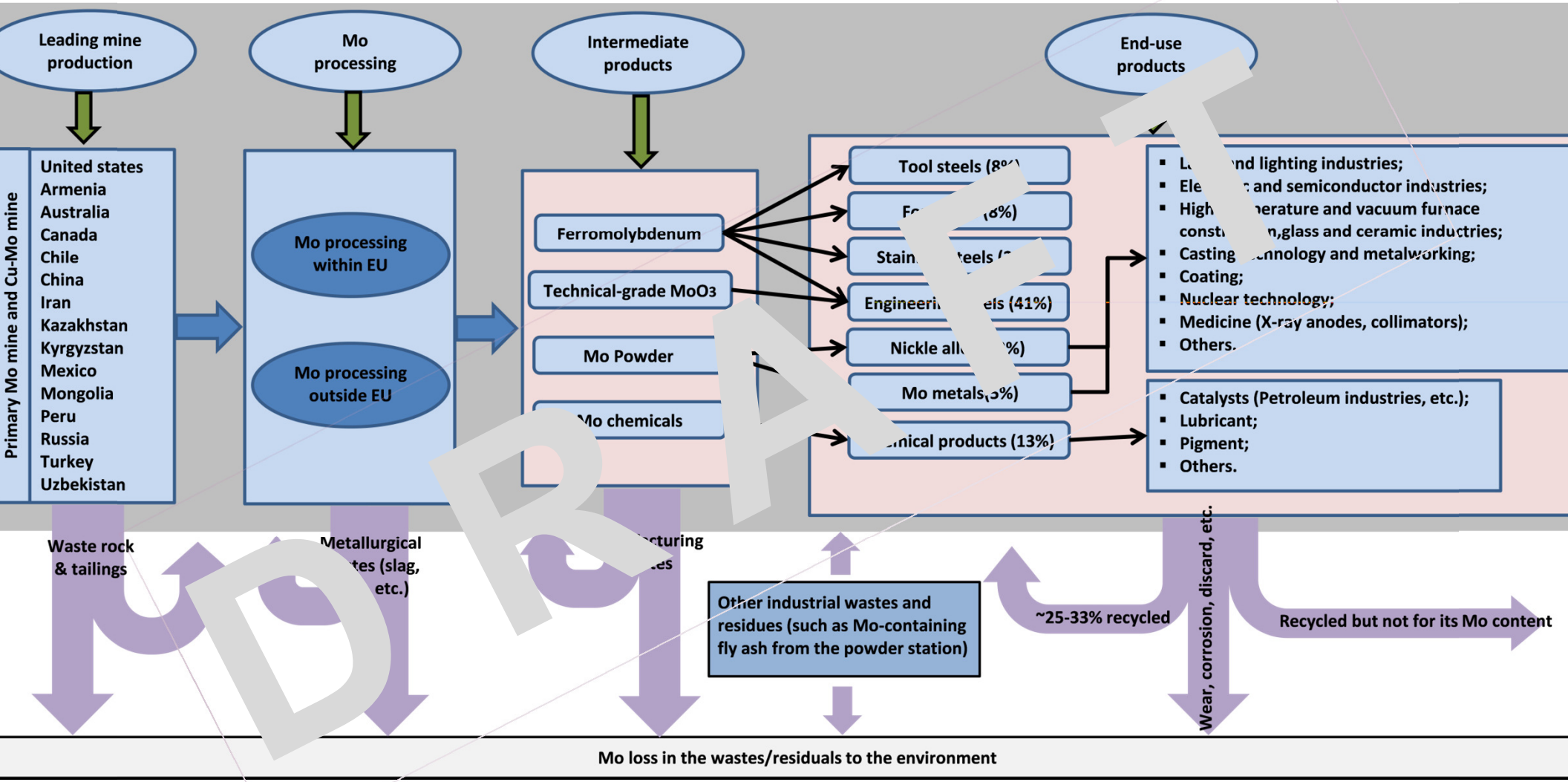
The value chains under drawing…



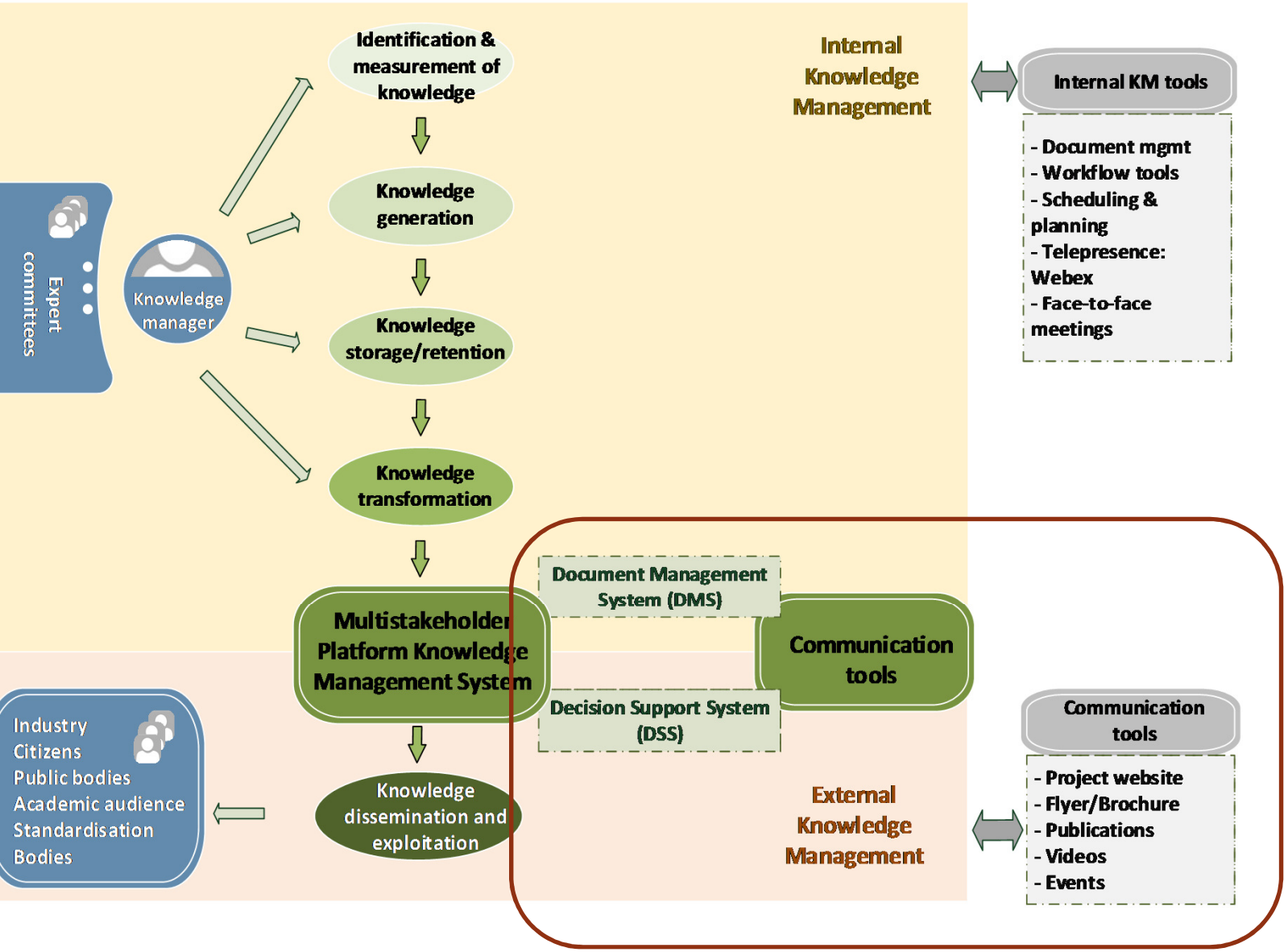
The value chains under drawing… Nb



The value chains under drawing… Mo

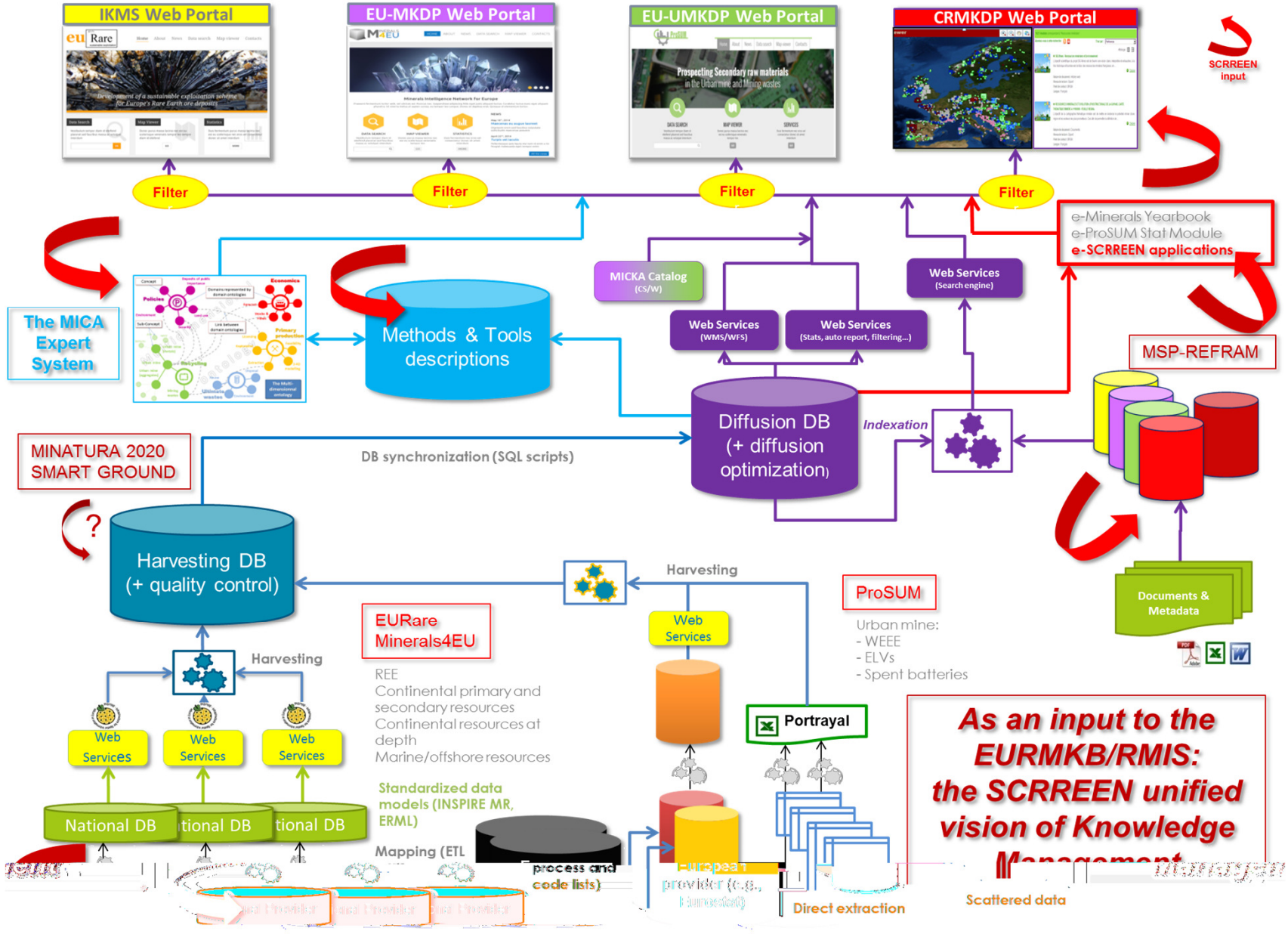


A Comprehensive Knowledge Management Structure

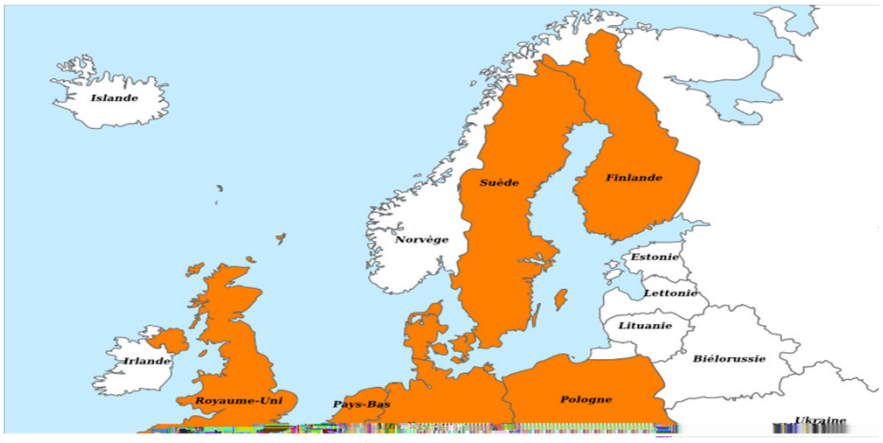


Diffusion of the information through the PROMETIA association

A common approach between MSP-REFRAM and SCRREEN: A Comprehensive Knowledge Management Structure



SCRREEN: Solutions for Critical Raw Materials
A European Expert Network



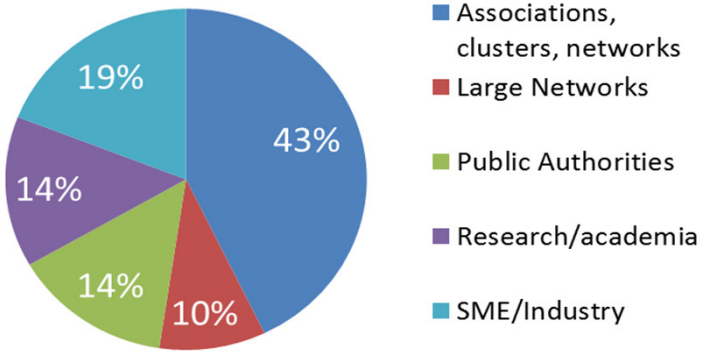
30 Partners in the Consortium
+ 60 in the wide Network

30 month , 3M€

Coordinated by CEA

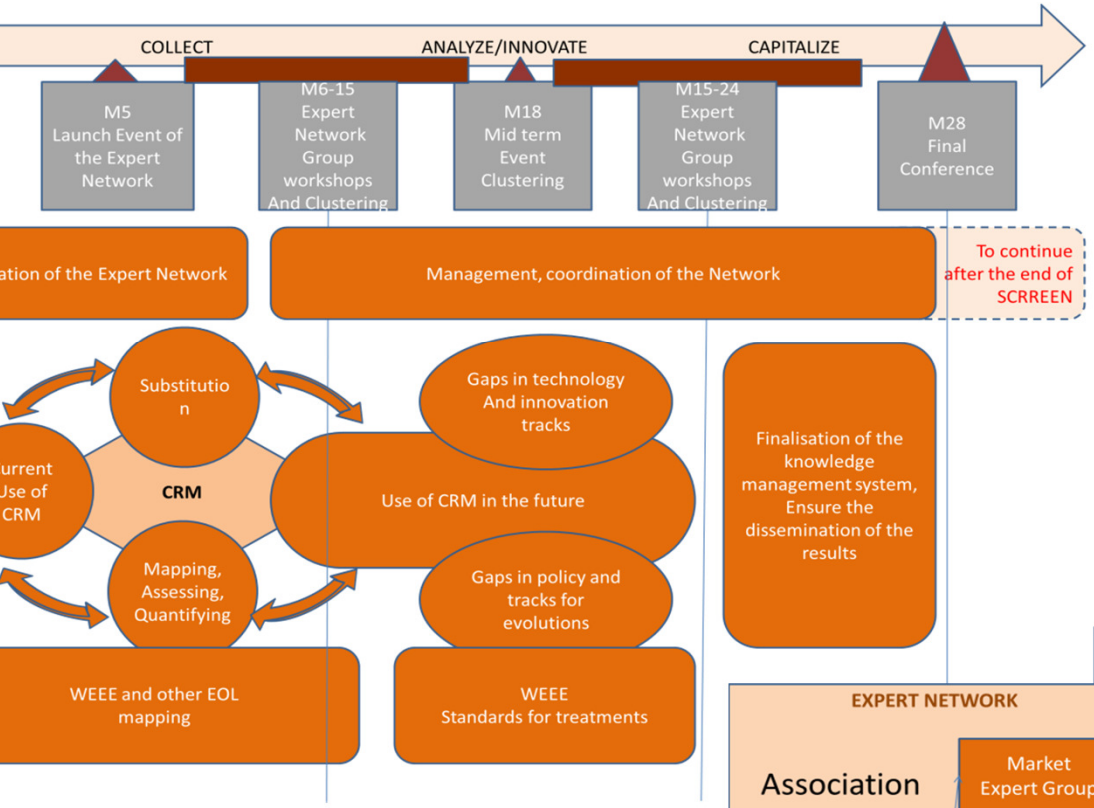
Built by merging two initiatives, one driven by PROMETIA, the other by former CRM_INNONET Partners

Will start in December 2016



Create a long lasting European Network orienting the CRM strategy in Europe

SCRREEN: Solutions for Critical Raw Materials
A European Expert Network

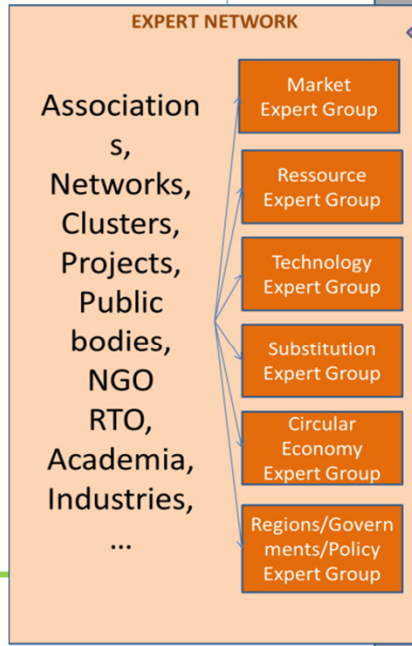


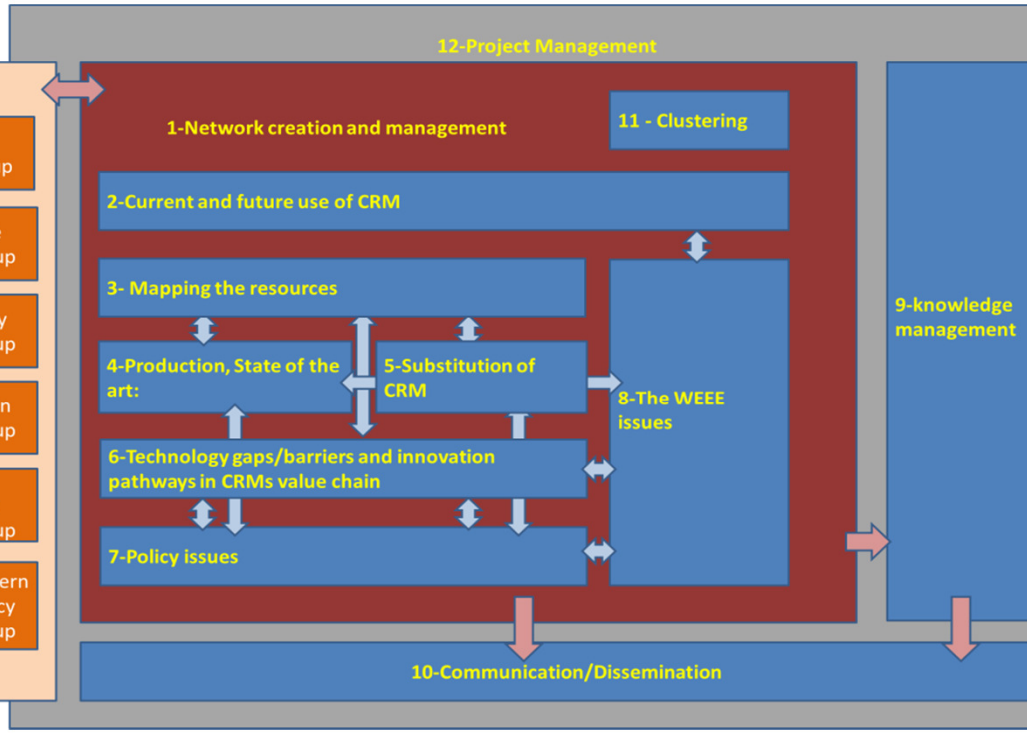
The concept:

- analysing the value chains of the CRM,
- proposing innovative value chains,
- identifying gaps/barriers in technology and policy that would limit their evolution,
- proposing actions for improving the supply of CRM in Europe

Preparatory work made by the consortium

Results discussed with the experts during dedicated workshops





Stéphane Bourg
Christophe Poinssot

CONCLUSION

- A comprehensive knowledge of the refractory metals metal value chain
  - Primary and secondary resources mapping.
  - Production routes
  - Needs and demand
- Tracks for potential innovation/breakthrough in these value chains
  - Implement new R&D programs in Europe
  - Increase the part of refractory metals produced in Europe both from primary and secondary resources
- With the limitations…
  - regulations, standards, policy…
- A flagship project for PROMETIA
- To be extended to all the CRM within SCRREEN

www.prometia.eu/msp-refram/

MSP REFRAM

European Commission

PROMETIA