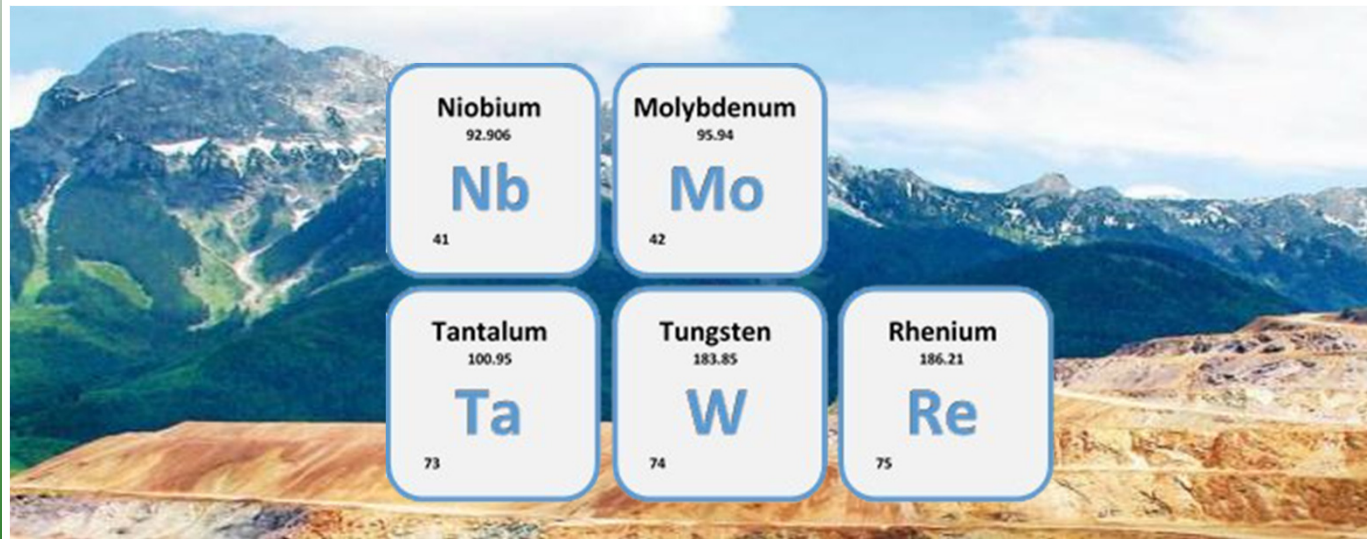


MSP-REFRAM



- MSP-REFRAM -

improving the valorization of the refractory metal resources in Europe



Stéphane BOURG

MSP-REFRAM Coordinator
PROMETIA EXCOM Chairman
Project Manager at CEA

Introduction

Academics

Industry / SME

Institutes

Associated Members

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



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



energie atomique • énergies alternatives

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



Low carbon energies (nuclear, renewables)

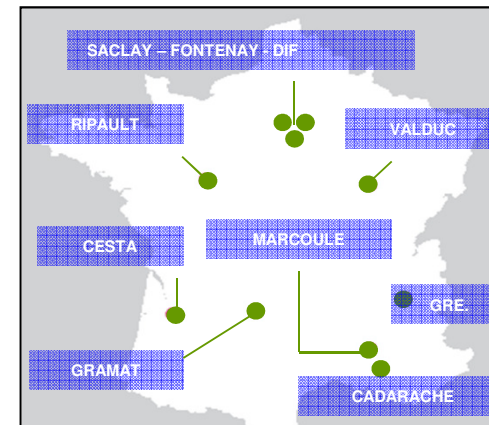
Defense and global security

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
MSP


P R O M E T I A

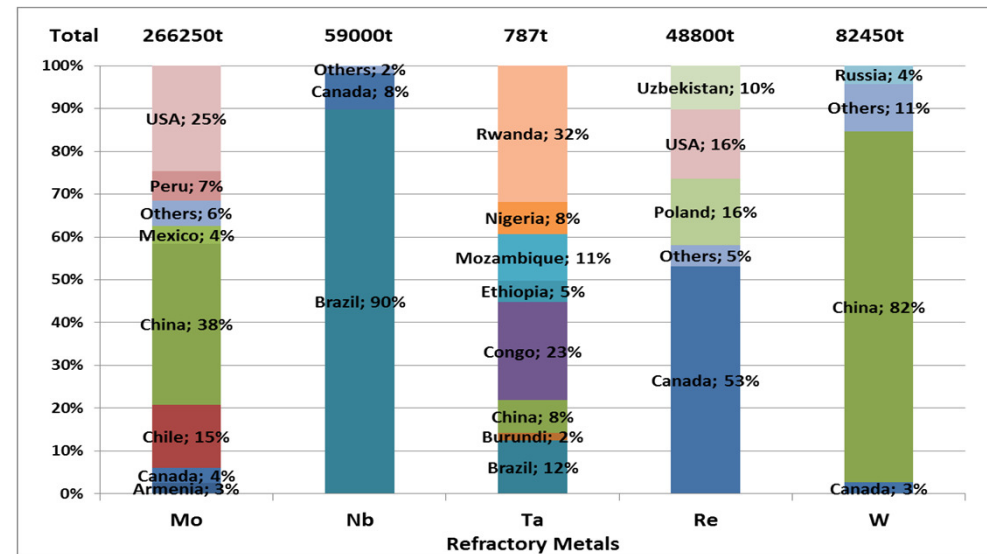
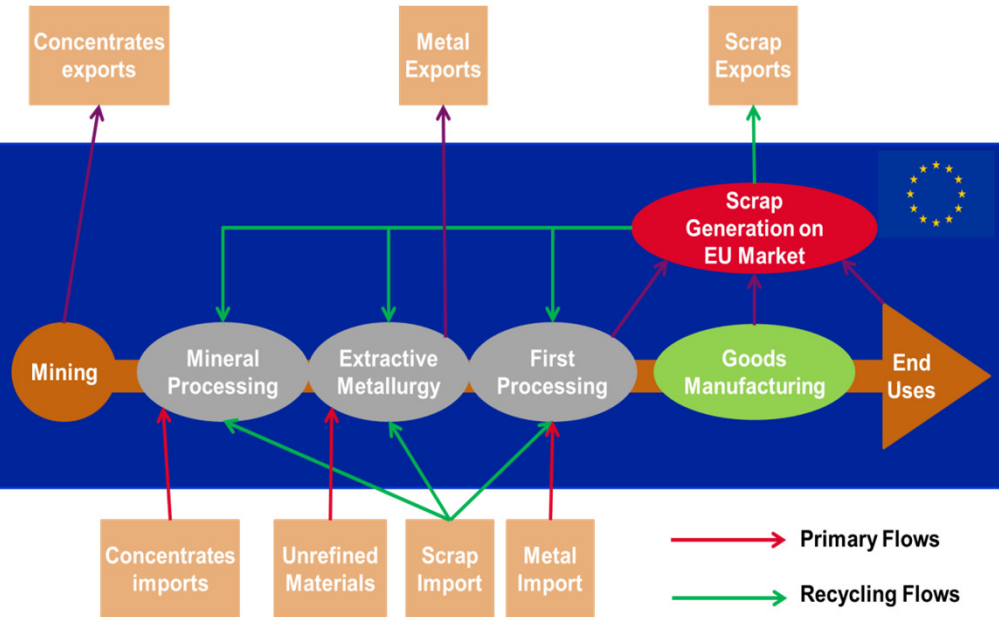


Creation of a common multi-stakeholder platform focused on **the refractory metals** across their whole value chain. This initiative involves partners from across the value chain, including **mining, processing, recycling**, application, public sectors (national/regional/local) and civil society

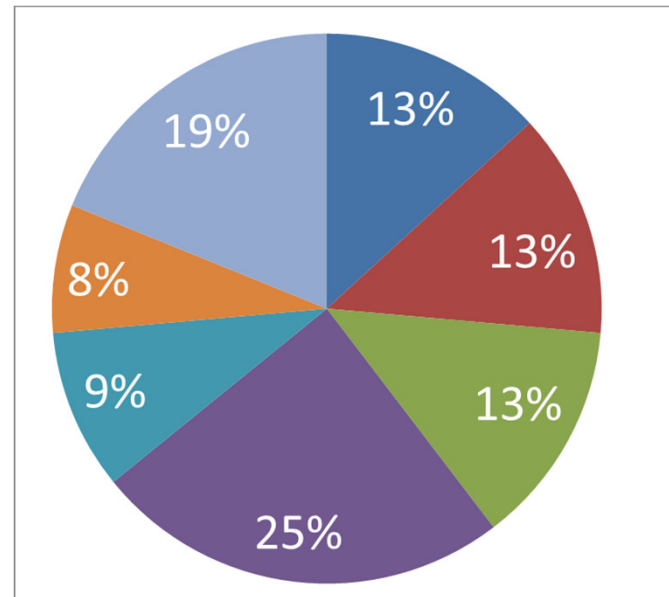
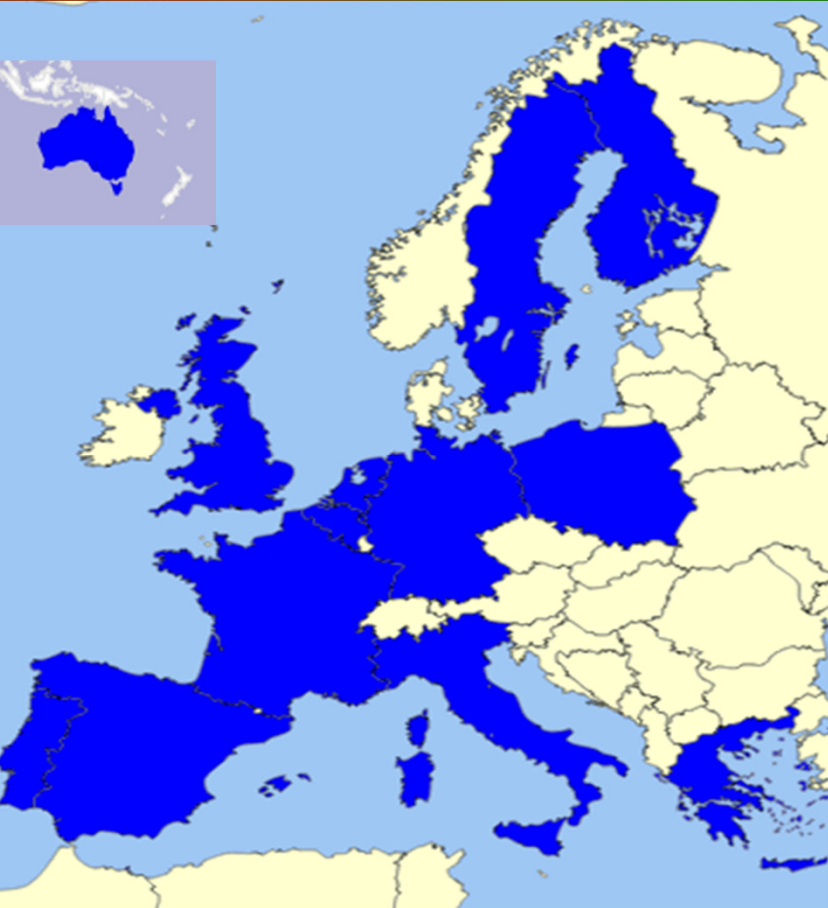
21 consortium members + 30 External Experts

9 Months, 1.5M€

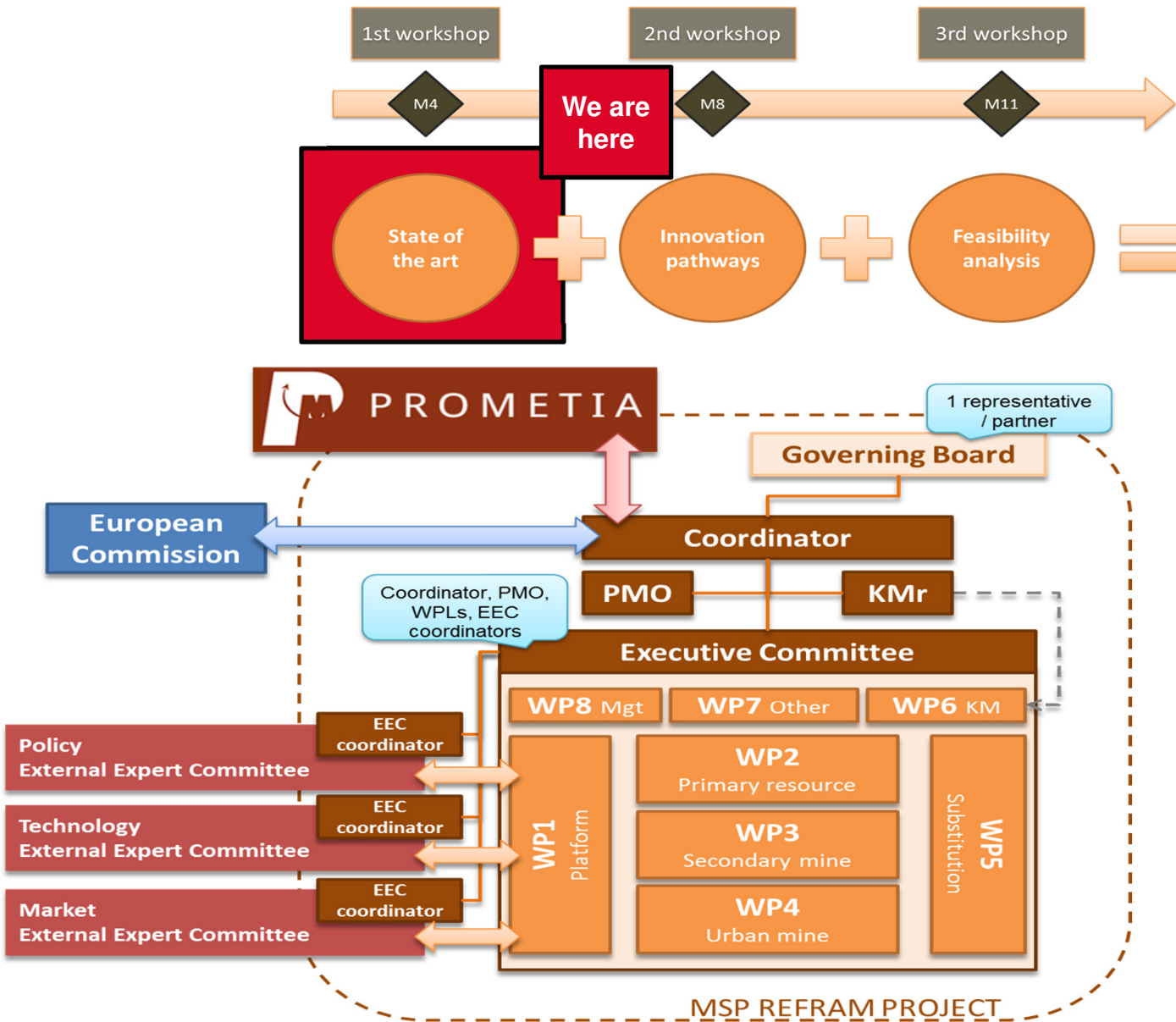
Project funded under the SC5 H2020 work-program, project n° 688993, 2016



The refractory metals world annual production (2014)



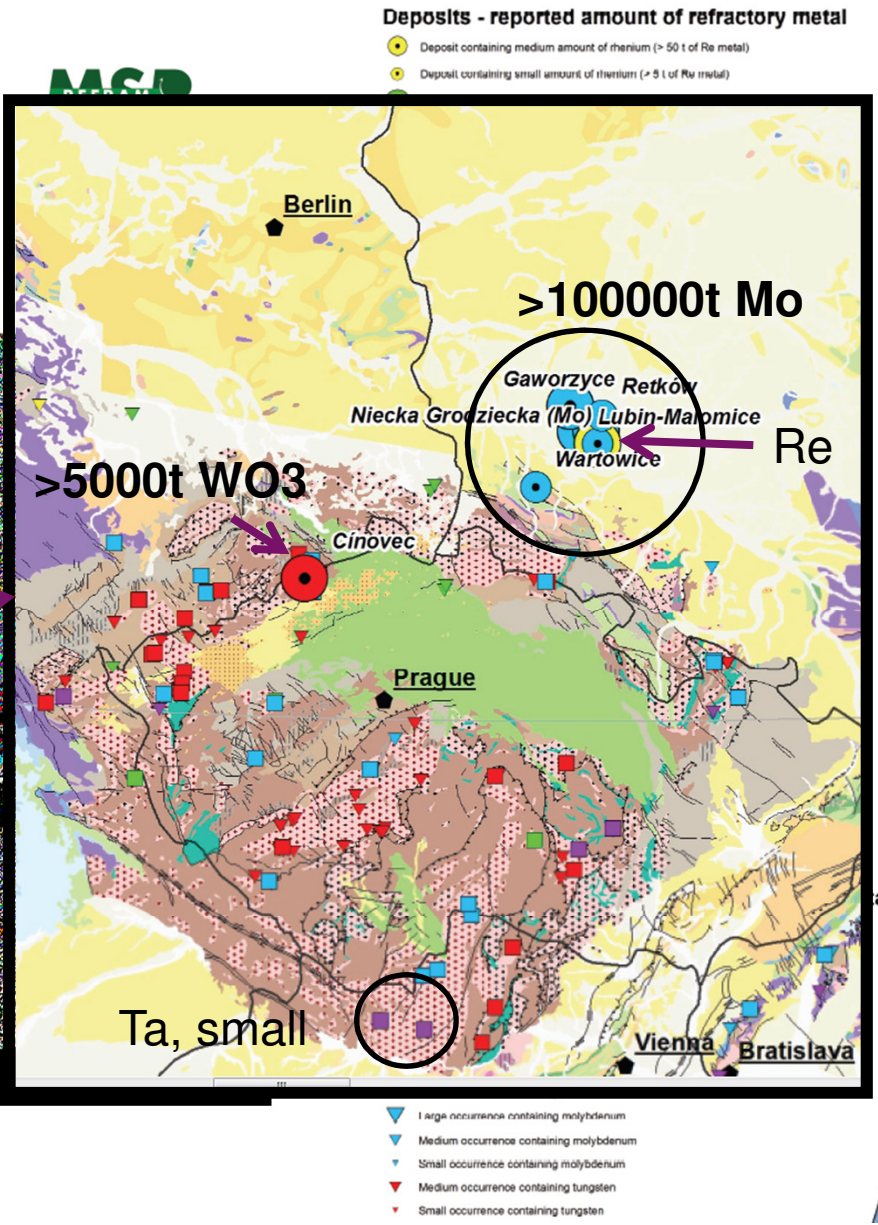
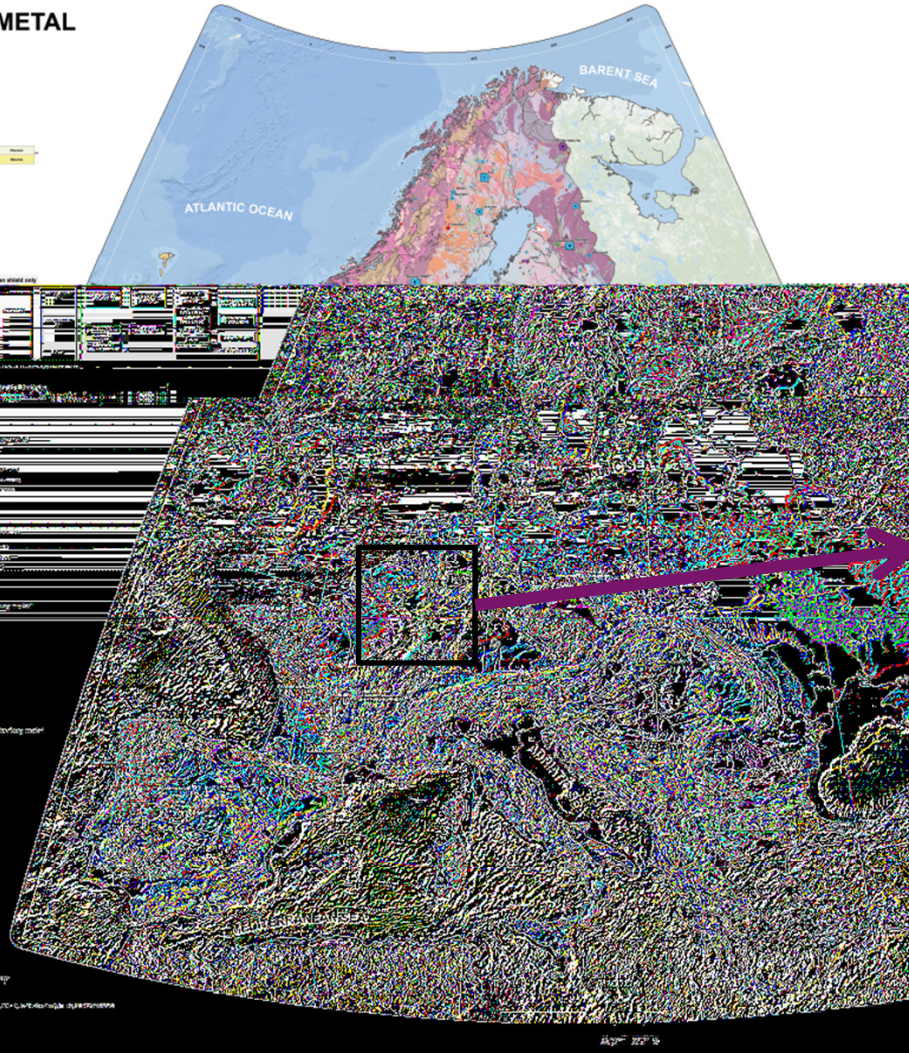
No	Name	Short name	Country
1	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	CEA	France
2	AMPHOS 21 CONSULTING SL	AMPHOS 21	Spain
3	BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES	BRGM	France
4	FUNDACION CARTIF	CARTIF	Spain
5	CHALMERS TEKNISKA HOEGSKOLA AB	CHALMERS	Sweden
6	E-MINES	E-MINES	France
7	ERAMET RESEARCH	ERAMET	France
8	GEOLOGIAN TUTKIMUSKESKUS	GTK	Finland
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	Germany
14	LAPPEENRANNAN TEKNILLINEN YLIOPISTO	LUT	Finland
15	INSTITUT NATIONAL POLYTECHNIQUE DE TOULOUSE	LGC	France
16	SWEREA MEFOS AB	MEFOS	Sweden
17	NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA	NTUA	Greece
18	TECHNISCHE UNIVERSITEIT DELFT	TU Delft	Netherlands
19	Teknologian tutkimuskeskus VTT Oy	VTT	Finland
20	LGI CONSULTING SARL	LGI	France
21	PROMETIA		Belgium



For each metal:

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

MAP OF REFRACTORY METAL DEPOSITS IN EUROPE (Mo, Nb, Re, Ta, W)



Secondary resources of Molybdene

Type of Material	Company/ Mine	Location	Grade of Mo	Reserve, Mineralogy and Characterization	Ref
Waste tailings Waste 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]
Waste tailings	Knaben Molybdenumines	Norway	40 ppm acid- soluble Mo Molybdenite 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]
Waste 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]
Waste tailing	KGHM Lubin	Poland	15 g/t	Underground mine Tailings: 27 000 000 kt/yr Other minerals: V, N, Co, Ag, As, K	[18]
Waste 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]
Waste tailing	KGHM Rudna	Poland	8 g/t	Underground mine Tailings: 27 000 000 kt/yr Other minerals: V, N, Co, Ag, As, K	[18]
Waste 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/notebook from which capacitors on the motherboard account for 90%, and capacitors on other printed circuit boards PCBs10%.

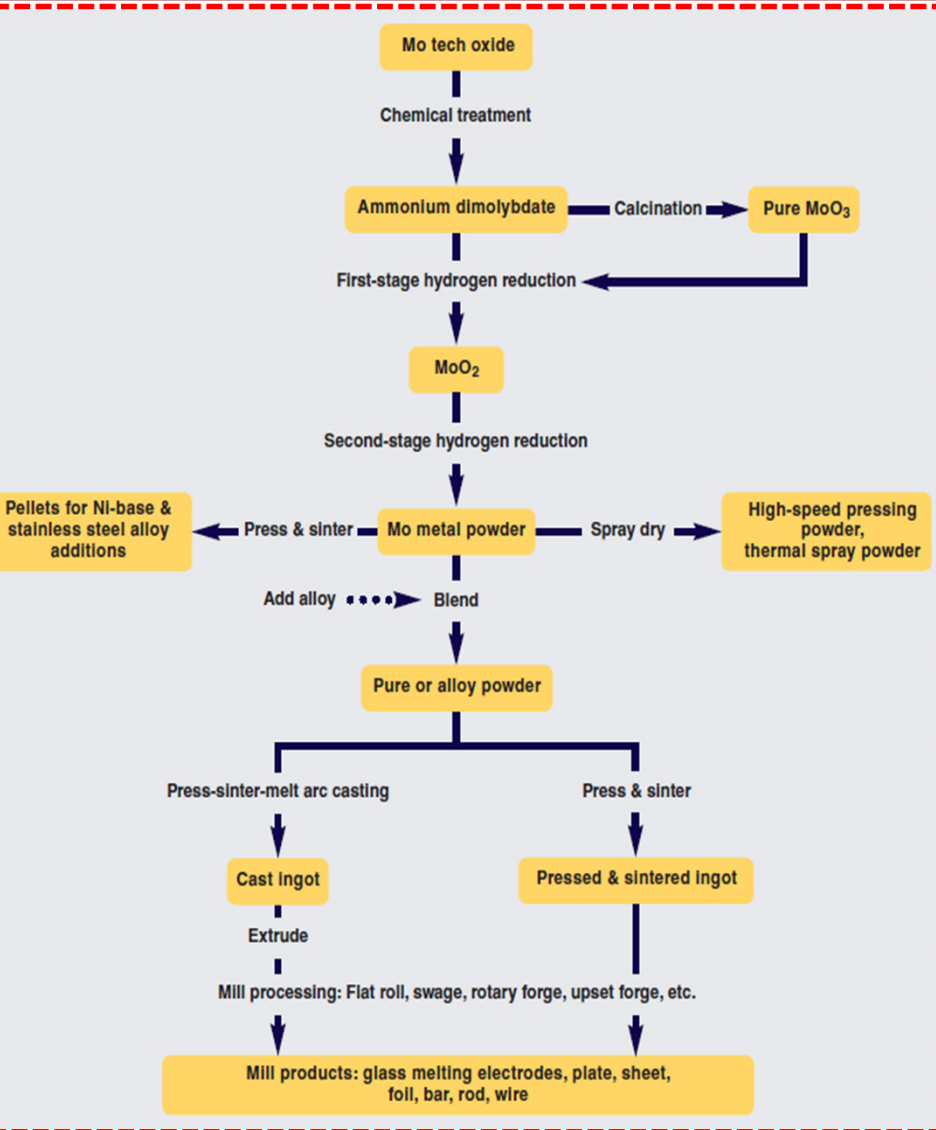


Figure 3 Molybdenum metal and alloy production in the value chains (shown in Figure 1).

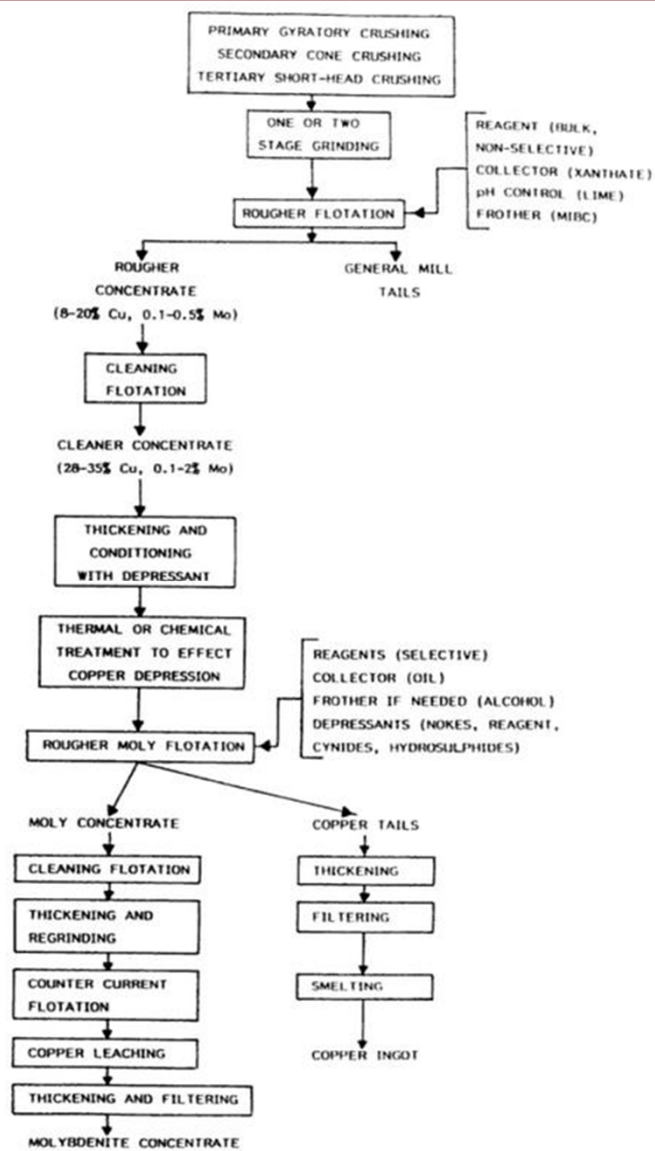
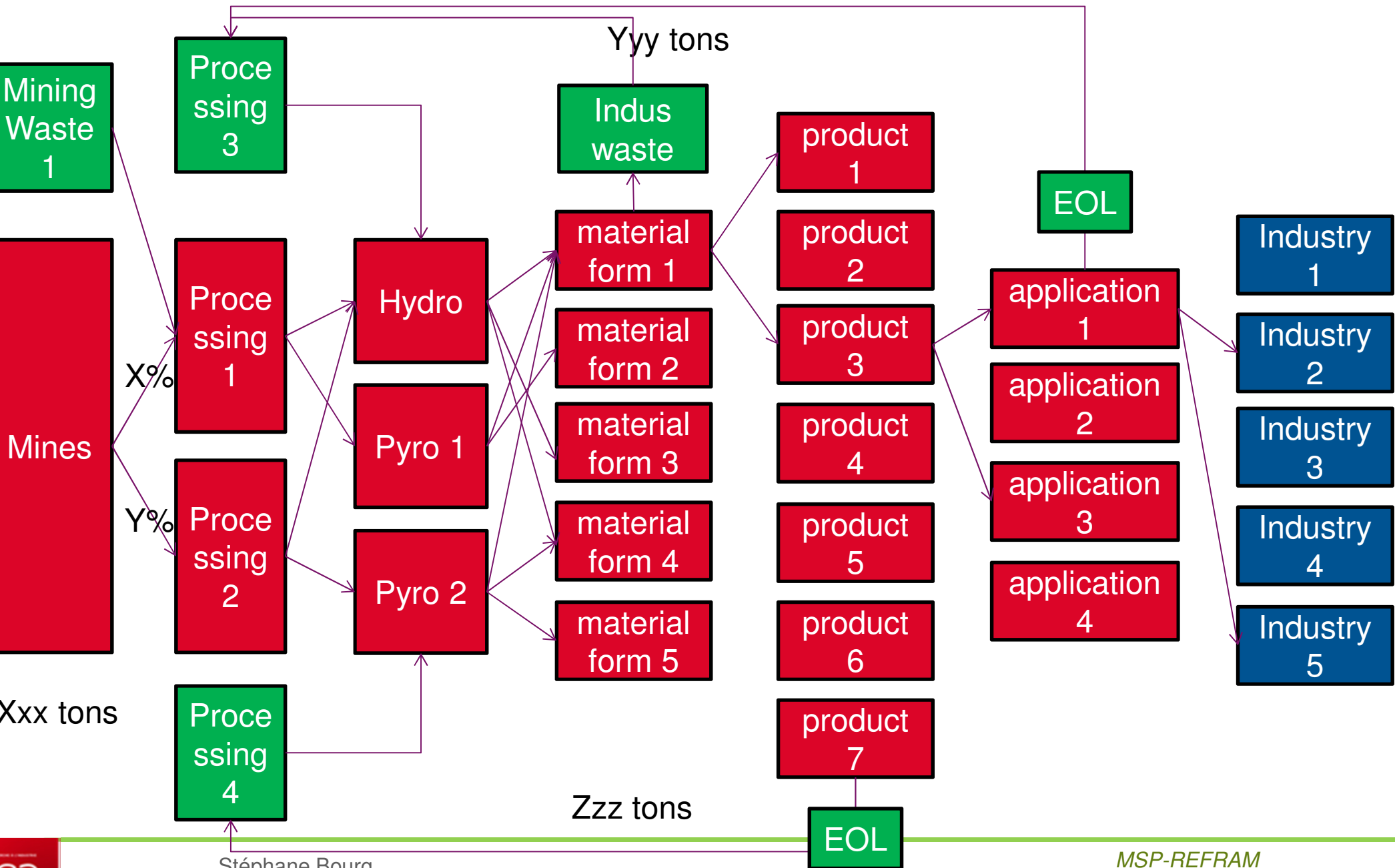
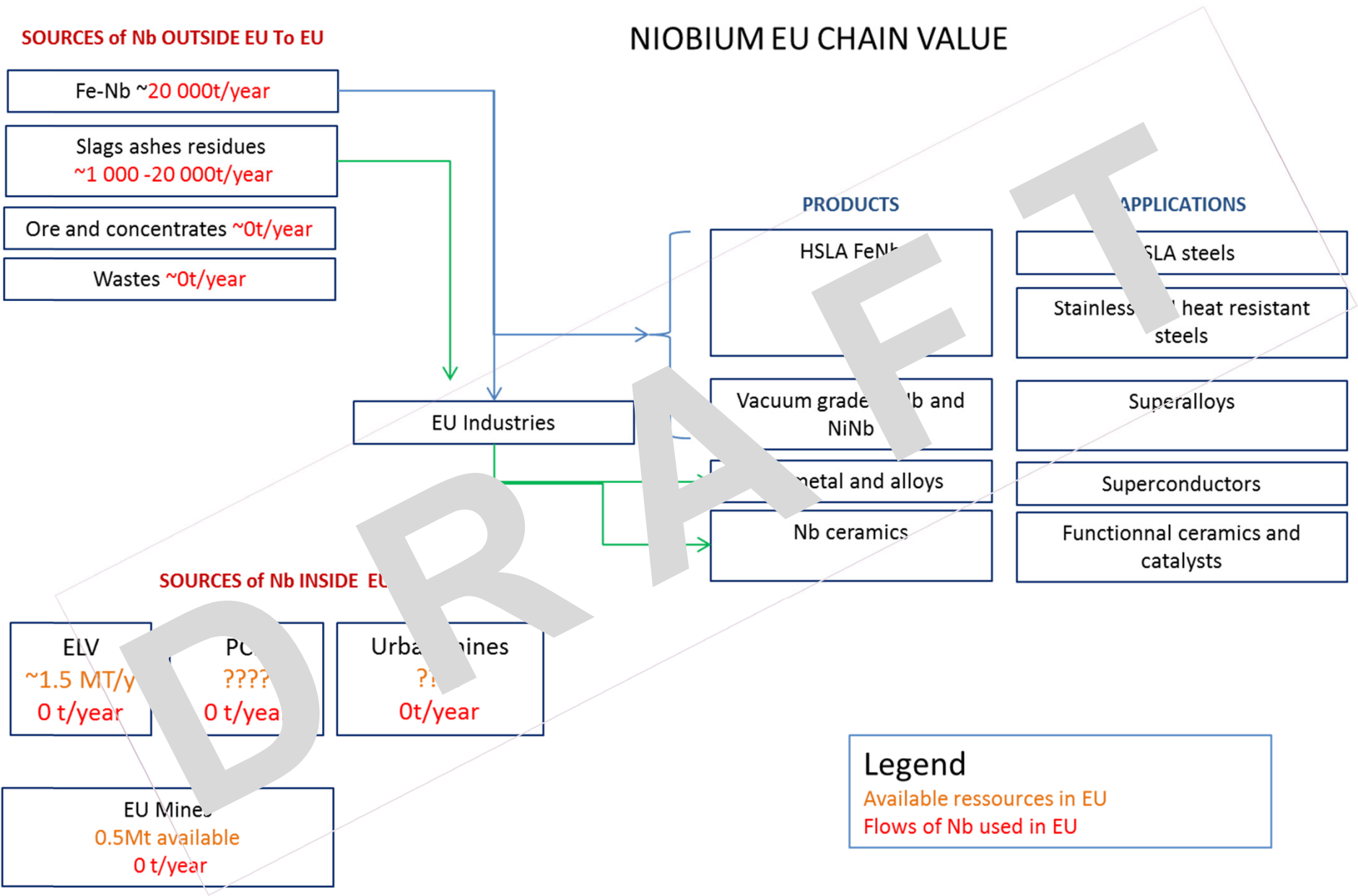
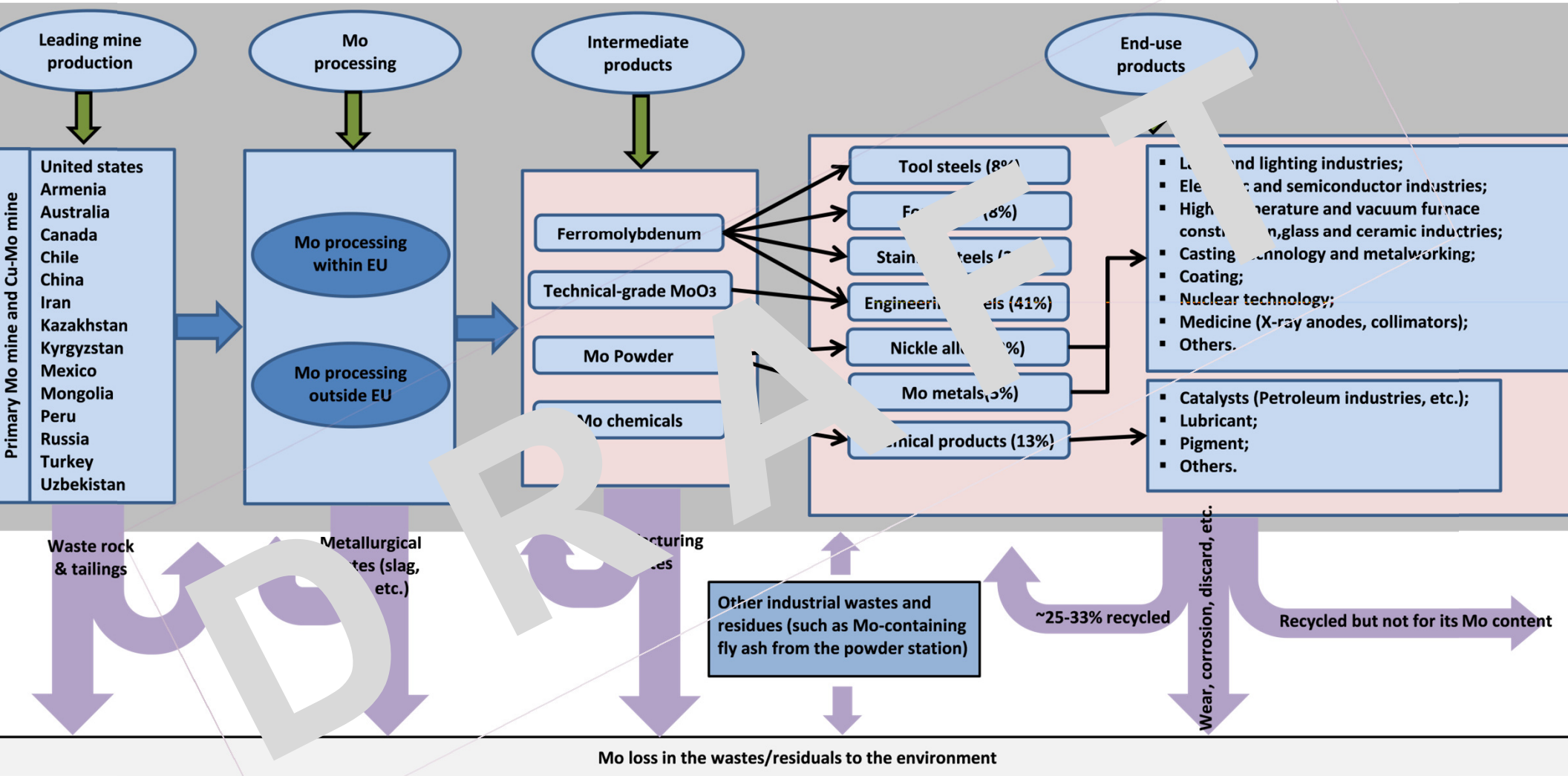
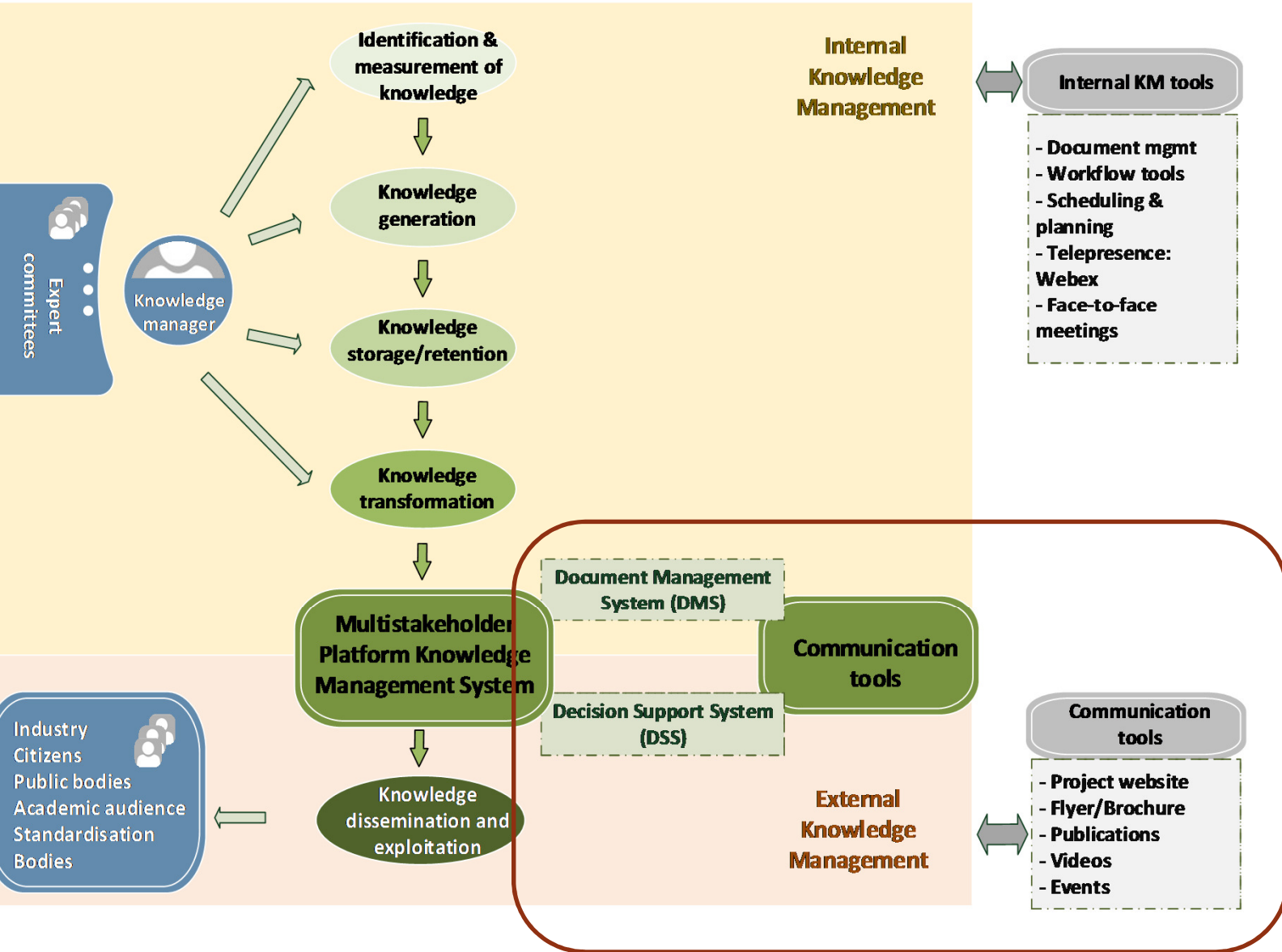


Figure 3-2 A basic by-product Mo recovery flowsheet from porphyry coppers







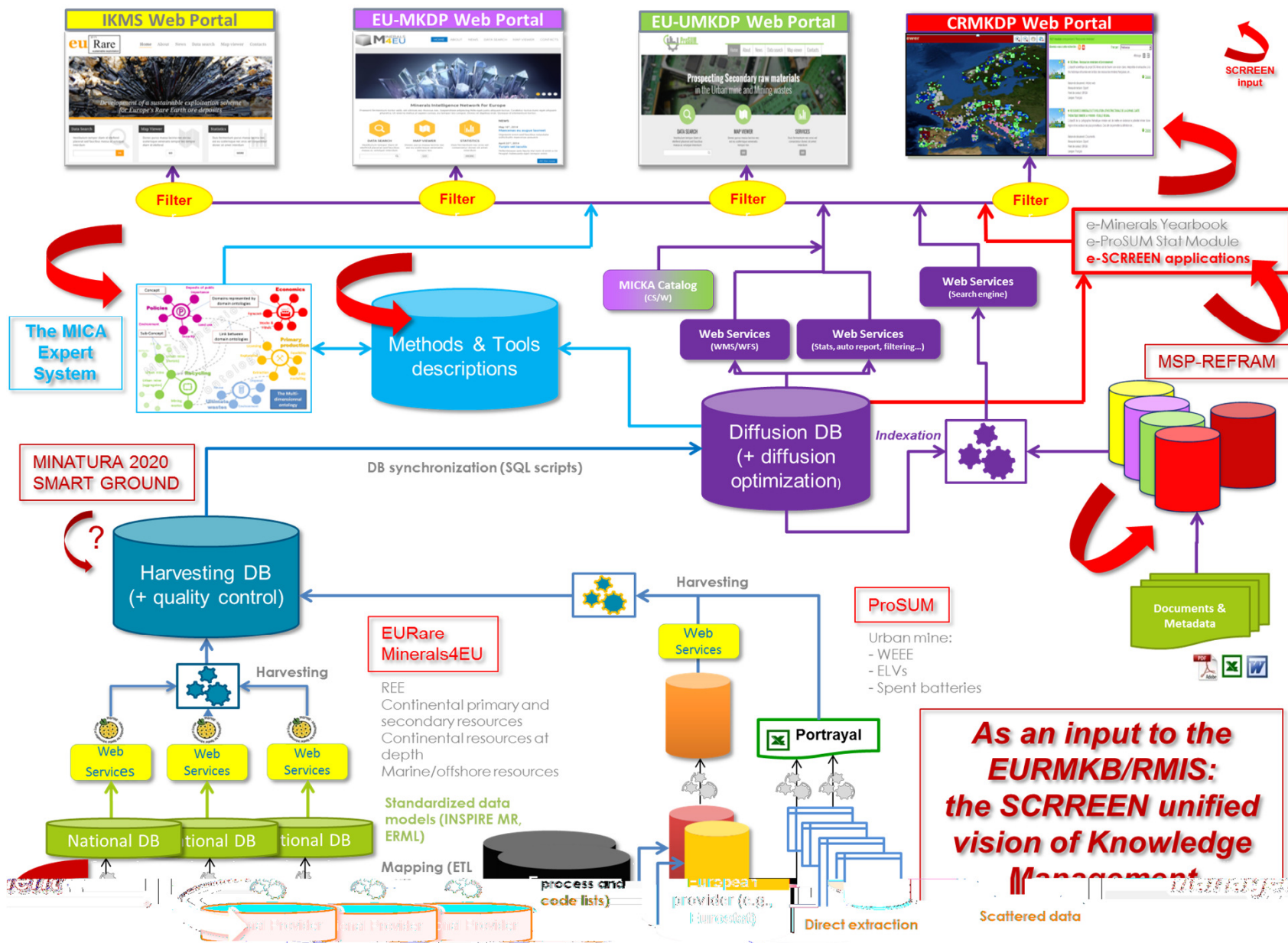


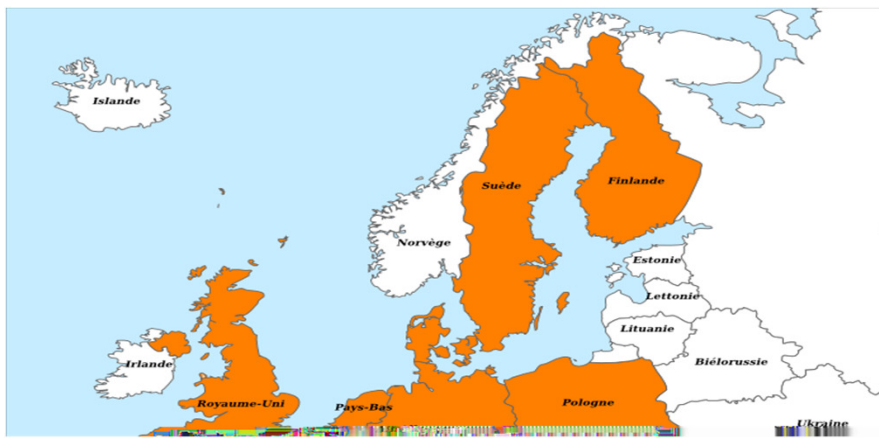
Diffusion of the information through the PROMETIA association





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





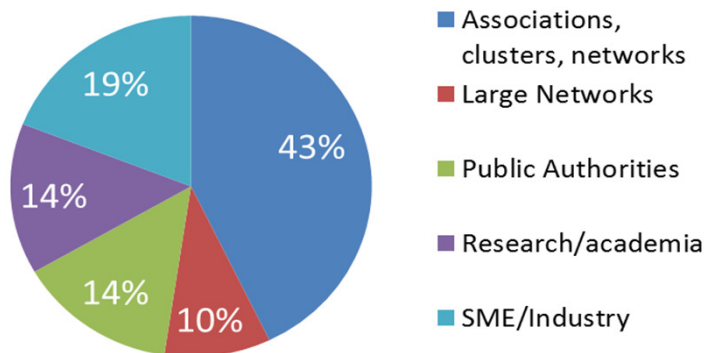
30 Partners in the Consortium
+ 60 in the wide Network

30 month , 3M€

Coordinated by CEA

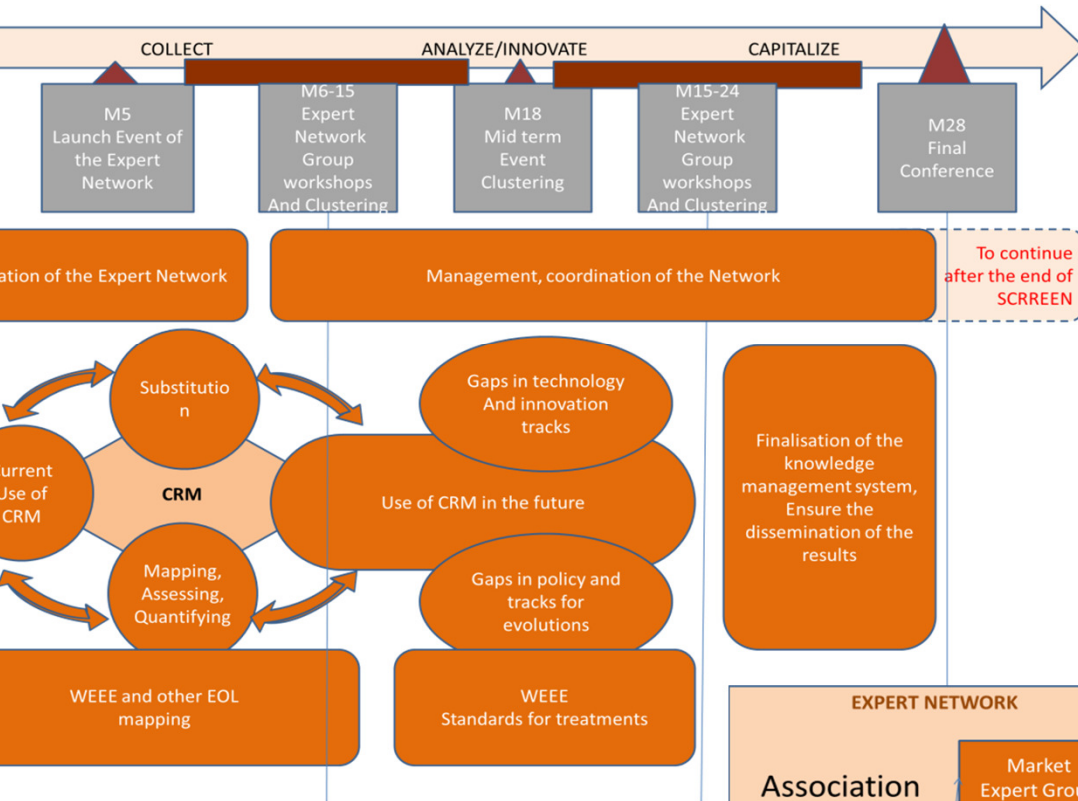
Built by merging two initiatives, one driven by PROMETIA, the other by former CRM_INNONET Partners

Will start in December 2016



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

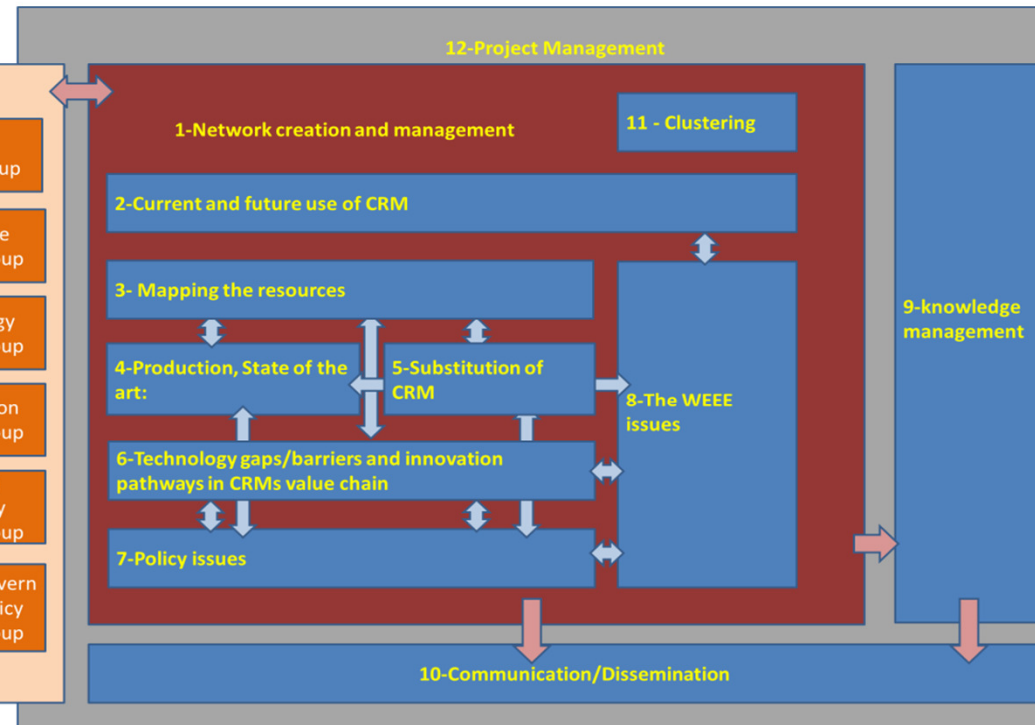
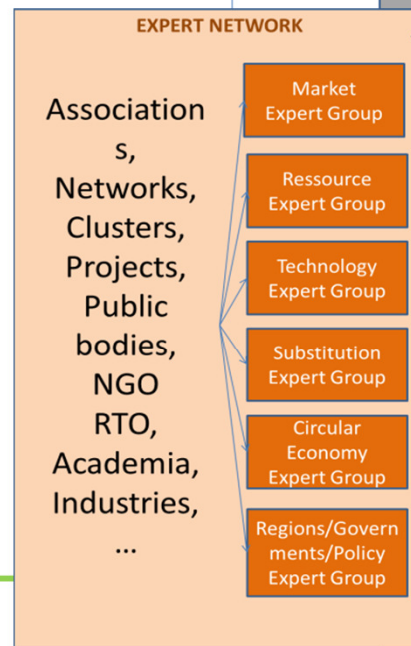
SCRREEN: Solutions for Critical Raw Materials A European Expert Network



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



- 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/



THANK YOU



Multi-Stakeholder Platform for a Secure Supply of Refractory Metals

CONTEXT

A secure access to refractory metals is highly strategic for Europe. Their resistance to extremely high temperatures, corrosion and wear in addition to several other unique characteristics make them extremely beneficial for various manufacturing applications in strategic EU industries, such as aerospace, energy and toolmaking.

Today with the exception of rhenium produced in Poland (15% of the world's production), and tungsten produced in Austria, Spain and Portugal (2.7% of the production), these metals are mainly imported from China, Brazil, Chile, the USA and Canada.

Although primary refractory metal resources are limited in Europe, they can be found in secondary resources (industrial waste and urban mines) and are already being recycled from super alloys to some extent. The value chain in the coming years could be improved if industry develops a better use of these secondary resources, optimises the use of external resources such as energy and water and at the same time reduces the amount and the toxicity of the waste.

In this context, members of the PROMETIA association, whose expertise cover the whole refractory value chain, gathered to address this challenge by setting up the MSP-REFRAM project.

Niobium Nb	Molybdenum Mo	Rhenium Re
Tantalum Ta	Tungsten W	

OBJECTIVES

MSP-REFRAM aims to establish a durable multi-stakeholder network that will carry out a comprehensive analysis of the entire value chain of key refractory metals including mining, processing, recycling and final applications (and potential substitution opportunities), and taking account of crosscutting aspects: policy, technology and market.

- MSP-REFRAM WILL CONTRIBUTE TO IMPROVING THE REFRACTORY METALS SUPPLY CHAIN BY IDENTIFYING:
 - Primary and secondary resources of refractory metals available in Europe
 - New technologies that could be developed for the production of refractory metals with a focus on secondary resources
 - Substitution strategies, trends and pathways related to these metals
 - New markets and business models
 - Regulations and standards to be changed or established to facilitate the emergence of new markets

All of the knowledge and results generated in the project will be shared widely with stakeholders to lift barriers and boost the creation of new markets in Europe.

CONSORTIUM

The MSP-REFRAM consortium includes industry, SMEs, research and technology centres, academia, a public authority and the PROMETIA association.



EXPERTS COMMITTEE

Three External Expert Committees (Society/Policy, Technology, and Environment) will bring together experts from different organisations.

They will participate actively in the project workshops and the final conference organised by MSP-REFRAM and will be responsible to identify the necessary knowledge and discuss and validate the results of the project.



MSP-REFRAM has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 644...