EUROPEAN TECHNOLOGY PLATFORM
ON SUSTAINABLE MINERAL RESOURCES

How do we contribute to the EU's Minerals Policy

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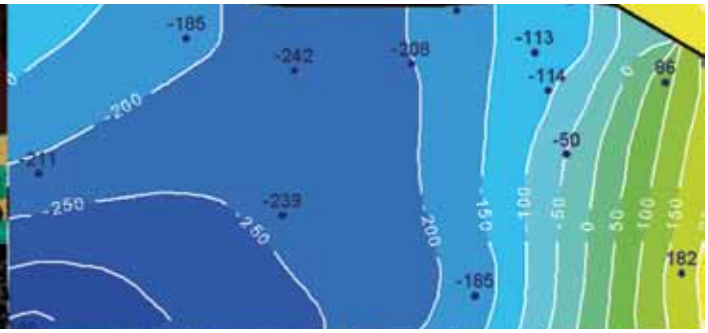

1. The overall EU policy contents

"Delivering stronger, lasting growth and creating more and better jobs", as defined in the revised Lisbon Strategy[1] and **Sustainable Development**, as defined at the 2001 Göteborg EU Summit rank among the highest objectives on the EU policy-making agenda. During the last quarter of 2005 these priorities were developed in four interlinked European Commission Communications:

- ***"Implementing the Community Lisbon Programme: A policy framework to strengthen EU manufacturing - towards a more integrated approach for industrial policy",[2]***
- ***"On the review of the Sustainable Development Strategy. A platform for action",[3]***
- ***"The Thematic Strategy on the Sustainable Use of Natural Resources (TSSUNR)",[4]***
- ***"The Thematic Strategy on the Prevention and Recycling of Waste (TSPRW)",[5]***

In 2008 the Commission added a focus on raw materials by its Commission Communication of the EC (Brussels, 4.11.2008, COM(2008) 699 final).
The new EU 2020 strategy highlights many industrial needs which require new materials.

2. Who we are?

The **minerals industry**, comprising **producers and users of industrial minerals and metals, aggregates and ornamental or dimensional stone, oil, gas and derivates as well as coal and by-products**, provides vital inputs to Europe's economy and social well-being. Because of their great diversity, minerals and their derived products are necessary for almost every aspect of life. Housing and construction, transport, energy supply, health, information and communication technologies, space technologies, and other sectors would either be nonexistent or suffer dramatically without constant mineral supplies to the EU economy. The EU minerals industry is also a significant exporter of both world-class expertise and technologies and of manufactured goods.

3. The EU Raw Materials Initiative

The updated version of the ETP SMR's Strategic Research Agenda relies mostly on the EU Raw Material Policy presented in *Commission Communication of the EC (Brussels, 4.11.2008, COM(2008) 699 final)* and was announced in November 2008. It gives us the opportunity to support implementing the **strategy** in securing access to raw materials which are essential for further development of EU economy. This strategy is based on three pillars:

1. Fair access to raw materials on world markets.
2. The right framework to foster sustainable supply of raw materials from EU sources.
3. Increased resource efficiency and promoting recycling in the EU.

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[1] COM(2005) 24 "Working together for growth and jobs A new start for the Lisbon Strategy"
[2] COM(2005) 474, published on 05/10/05
[3] COM(2005) 658 published on 13/12/05
[4] COM(2005) 670, published on 21/12/05
[5] COM(2005) 667, published on 21/12/05

ETP SMR intends to cooperate with appropriate DG's and support EU RMI programme and its main activities. The main topics are as follows:

1. **Definine and establish critical raw materials base for European industry from EU and non-EU sources;**
2. **Promote skills and focused research on innovative exploration and extraction technologies, recycling, materials substitution and resource efficiency;**
3. **Increase resource efficiency and foster substitution of raw materials;**
4. **Promote recycling and facilitate the use of secondary raw materials in the EU.**

In particular the Policy includes the following aspects:

For the second pillar the RMI states *"To tackle the technological challenges related to sustainable mineral production, the Commission will promote research projects that focus on the extraction and processing of raw materials in its 7th Framework Programme (FP7). The European Technology Platform on Sustainable Mineral Resources focuses on innovative exploration technologies to identify deeply located onshore and offshore resources (including deep sea mining), and new extraction technologies to maximise economic and environmental benefits. The Waterborne Technology platform will undertake research for technologies that allow for a future sustainable exploitation of the seabed" and "the growing problem of skills shortage will have an impact on the future of the European mining industry. In addition there is still limited public awareness of the importance of domestic raw materials for the European economy. More effective partnerships between universities, geological surveys and industry should be encouraged to address these challenges. The Commission will encourage initiatives such as the European Minerals Day 2009 and will also foster the generation of new high skills on geology, earth observation and environmental issues, notably through the Erasmus Mundus Minerals and Environmental Programme (2009-2013) joint master and doctoral study programmes, to help counter this shortage.*

For the third pillar the RMI states:
The Commission is promoting research projects that focus on resource-efficient products and production under FP7. In addition, the Eco-Design Directive includes provisions for the design of resource-efficient products. Research will also play a major role in developing substitutes, in the interests of flexibility in the production process and reduced vulnerability to import dependence. Recently, the OECD recommended that its members promote resource productivity by strengthening their capacity for analysing materials flows. In the EU, the Data Centres on natural resources, products and waste will coordinate Member State input.

This means that a number of key issues need to be addressed:

Supply issues: while abundant geological resources and technological progress remove fears of scarcity, the future availability of the diversity of minerals the EU economy requires is not guaranteed. Within Europe access to available resources ("**access to land**") is tending to become increasingly problematic and in many countries minerals exploration has been very limited in the last two decades ("**limited knowledge about EU minerals potential**"). This gives hope to discover deep deposits. The EU is highly dependent on imports of energy and of metallic minerals from outside its borders. While the EU-25 internally produces less than 10% of the world production of the listed metallic ores, it generally uses 25 to 30% of their production. The dependence of the EU on energy supply imports[7] is also strong and expected to grow further, to reach 70% by 2030! In the industrial minerals segment this dependence is much less, Europe being an important producer of a wide range of industrial minerals such as magnesite, gypsum, kaolin, bentonite and Fuller's earth, perlite, potash and talc. The EU is self sufficient in construction minerals.

The dependence issue, and the particular vulnerability of Europe to imports and to the related geo-strategic issues, is likely to become of rising strategic importance as the coming decades will see a significant increase of the world population, while some highly populated developing countries such as China and India are rapidly developing their industry and their infrastructure, hence creating a huge demand for minerals and intensified competition for these resources ("**excessive dependence on imports and vulnerability to related geopolitical issues**"). A recent Commissions Report on four years of European initiatives[8] related to energy even speaks of "the alarm bells ringing".

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[7] *The Green Paper 'Towards a European strategy for the security of energy supply' (COM(2000) 769 final of 29 November 2000)*
[8] *Energy and Transport DG, European Commission: Report on the Green Paper on Energy: Four Years of European Initiatives. Office for Official Publications of the European Communities, Luxembourg 2005*

Consequently efforts are necessary, for instance through domestic exploration and enhanced cooperation with countries having a high geological potential, to broaden the accessible resources base. For metallic minerals this involves developing technologies to explore for deep concealed deposits that can be mined with much less environmental impacts than outcropping or near-surface deposits.

Competitiveness: the EU minerals industry is not only an important supplier to the EU economy, it is also a world leader supplier of services, technology, engineering, consultancy, finance and equipment. Because of the high environmental standards and the often challenging geological conditions prevailing in Europe, European extractive technology has a leading position and holds about 50% of the relevant world market. Hence Europe is home to world-class companies in these fields. The health of this sector of the EU industry is essential for Europe's growth. Pre-competitive cooperative R&D on a European scale, engaging the industry, academia and research as well as other stakeholders for research on the environmental and social sustainability issues is needed. This should overcome the fragmentation of the research capacities in a domain of high importance to the EU economy and should further develop the products and processes needed to competitively supply Europe and the world, take advantage of the globalisation, foster growth. Among the challenges it has to meet, the industry has to continuously adapt to technology and regulatory shifts and, the phasing out of some types of production while facing sudden changes in the demand for new products[9]; it has to confront growing energy costs and to address a major skills issue due to a rapidly ageing population of professionals resulting from mine closures in the last three decades and industrial restructuring. In its screening of the opportunities and challenges for 27 separate sectors of the EU manufacturing and construction industry[10], the European Commission identified the European Technology Platform for Sustainable Mineral Resources as one of the sector-specific initiatives for the implementation of the Lisbon agenda.

Decoupling growth from environmental footprints: while in Europe extractive activities comply to strict regulations, most of the environmental footprint related to the extraction of minerals occurs outside the EU borders. Many of the minerals and metals used by Europe are imported, including from developing countries that need support to develop extractive activities with high social and environmental standards in support of their sustainable development. Technological developments are necessary for the continuous reduction of the potential impacts of extraction and downstream activities, including lowering the amount of energy and water used per unit produced, the economical exploitation of lower-grade ores, increasing the recovery of all valuable components of the extracted materials and phasing out hazardous components in the waste and in the emissions generated by the production process (hence making the waste directly usable for other economic processes). The development of substitute materials with better environmental characteristics is also needed. As stated by the European Commission in the recently revised EU Sustainable Development Policy[11]: *"By taking a lead in finding innovative solutions to a better management of resources, the EU can promote a more resource efficient economy and position itself as a world leader in eco-efficient technologies."* The development of the know-how and of the technologies needed to achieve decoupling will also benefit developing countries.

Recent decisions and communicates announcing EU Raw Materials Initiative *(Commission of the EC, Brussels, 4.11.2008, COM(2008) 699 final)* underline that: "**securing reliable and undistorted access to raw materials is increasingly becoming an important factor for the EU's competitiveness and, hence, crucial to the success of the Lisbon Partnership for growth and jobs". The other citation from the Communicate** *(COM(2008) 699 final)* **states it very clear**: „The critical dependence of the EU on certain raw materials underlines that a shift towards a more resource efficient economy and sustainable development is becoming even more pressing".
This Communicate is a first step towards this, building on an in-depth analysis by the Commission and the results of a public consultation in 2008. It should also help the EU to form a common approach in the international discussion on raw materials which has been addressed at the United Nations and by the G8 Summit in June 2007".

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[9] *for instance the production of tantalum for the mobile information and communication systems.*
[10] *COM(2005)474 "Implementing the Community Lisbon Programme: A policy framework to strengthen EU manufacturing - towards a more integrated approach for industrial policy"*
[11] *COM(2005) 658*

ETP SMR is ready to support and fulfill the EU RMI main topics which are listed in the table below.

		Level of response		
		EC	MS	Industry
1.	**Define critical raw materials.**	×	×	×
2.	Launch of EU strategic raw materials diplomacy with major industrialised and resource rich countries.	×	×	
3.	Include provisions on access to and sustainable management of raw materials in all bilateral and multilateral trade agreements and regulatory dialogues as appropriate.	×	×	
4.	Identify and challenge trade distortion measures taken by third countries using all available mechanisms and instruments, including WTO negotiations, dispute settlement and the Market Access Partnerships, prioritising those which most undermine open international markets to the disadvantage of the EU. Monitor progress by issuing yearly progress reports on the implementation of the trade aspects, drawing, as appropriate, on inputs from stakeholders.	×	×	×
5.	Promote the sustainable access to raw materials in the field of development policy through the use of budget support, cooperation strategies and other instruments	×	×	
6.	Improve the regulatory framework related to access to land by: - promoting the exchange of best practices in the area of land use planning and administrative conditions for exploration and extraction		×	
	- developing guidelines that provide clarity on how to reconcile extraction activities in or near Natura 2000 areas with environmental protection	×		
7.	Encourage better networking between national geological surveys with the aim of increasing the EU's knowledge base	×		
8.	**Promote skills and focused research on innovative exploration and extraction technologies, recycling, materials substitution and resource efficiency**	×	×	×
9.	**Increase resource efficiency and foster substitution of raw materials**	×	×	×
10.	**Promote recycling and facilitate the use of secondary raw materials in the EU**	×	×	×

Table 1. The Raw Materials Initiative activities.

The level of response to implement the tasks of RMI shows important role set for both the extractive industry and ETP SMR members. Many real technological breakthroughs are necessary to achieve the EU RM Initiative policy goals extending from exploration and extraction to re-use and recycling. They need significant research efforts to meet all the objectives set by the new mineral policy.

New exploration methods are required to fill resource gaps and to safeguard Europe's future supply of key raw mineral feedstock for its existing and new downstream industries and to reduce dependence on imports. New extraction methods have to maximise resource utilisation and energy optimisation preferably in a fully automated way. After the termination of the extraction, land use has to be optimised and liabilities should be turned into assets for the future.

We want to fulfil expectations of European society in the move towards zero environmental impact and reduced energy consumption. Feedstock recycling and footprint-free production are further issues. The whole production process should in the future be guided by the "Zero Waste" objective.

The sector has to act in close co-operation with customers if it is to maintain its competitiveness. The sector should create new mineral and material product functionality through enhanced product and customer understanding and knowledge building as well as finding new areas of application for mineral products and designing the mineral products for tomorrow.

It is essential that European citizens understand how the European minerals industry contributes to their basic needs and improve their quality of life. In this context, well-functioning interaction between industry and society is crucial.

All the main research priorities identified have a definite short-, medium- or long-term time horizon. This enables the definition of projects common to each of the mineral industry sectors involved in the ETP SMR and clearly addressing the basic needs of the whole minerals industry. Some initial projects have already been identified.

This new Strategic Research Agenda does show the way the mineral industry has to proceed in forthcoming decades if it is to serve European society in the way needed.

Key areas for Research

Investigating what is "critical" for Europe

A European Minerals Intelligence Network (EMINENT)

"Raw materials are essential for the sustainable functioning of modern societies. Access to, and affordability of, mineral raw materials are crucial for the sound functioning of the EU's economy. Sectors such as construction, chemicals, automotive, aerospace, machinery and equipment sectors which provide a total value added of € 1 324 billion and employment for some 30 million people all depend on access to raw materials". The opening statement of the European Commission's COM(2008)699 well depicts the importance of the mineral resources industry.

A steady, reliable input to the EU economy of the wide range of minerals, and of their derived products, produced in line with sustainable development ethics, is essential to our daily lives and to the competitiveness of the EU economy. Global competition for access and control of these vital resources is developing, and likely to become even fiercer as the world population inches towards the 9 billion figure forecast for 2050, and huge economic imbalances persist between developed countries and densely populated developing countries, such as China, India or Brazil.

Therefore it is necessary

- to foster the EU non-energy extractive industry sustainability, to provide an EU information source on the global minerals industry, support a communication with and education of the general public and specific stakeholders.
- to identify gaps and overlaps in existing EU minerals intelligence, and to provide a methodology, an organisation, and an action plan to implement the European Minerals Intelligence Network. It will develop a pan-European network of experts with enhanced coordination, communication and collaboration.

This project aim is to help monitoring and addressing minerals criticality issues, in support to the Raw Materials Initiative. It will co-ordinate the EU minerals intelligence capacity, based on networking of existing public national capacities, in support to public policy-making, the EU minerals industry, investors, media and the general public, and it will provide a wide range of data and analysis (reserves/ resources, production, trade, industry, policy context, research trends, technological shifts …). Existing public capacities in Member States will be combined to achieve a European synergy.

The beneficiaries of the project would be EU and national authorities in the diverse policy sectors impacting on the supply of mineral resources to the EU and national economies (see above), in compliance with sustainable development ethics, private sector (mineral resources industry; consultants, investors, insurance), research and academia, including geological surveys, NGOs, media and the general public.

Looking for new resources for Europe

Critical Minerals Deposits Information System (CriSys)

The EU RMI will identify a series of “critical” raw materials and the question arises what to do concerning their criticality. Since the criticality is a question of secure supply, but eventually also of availability it will be important to identify available and new deposits and other sources of these minerals.

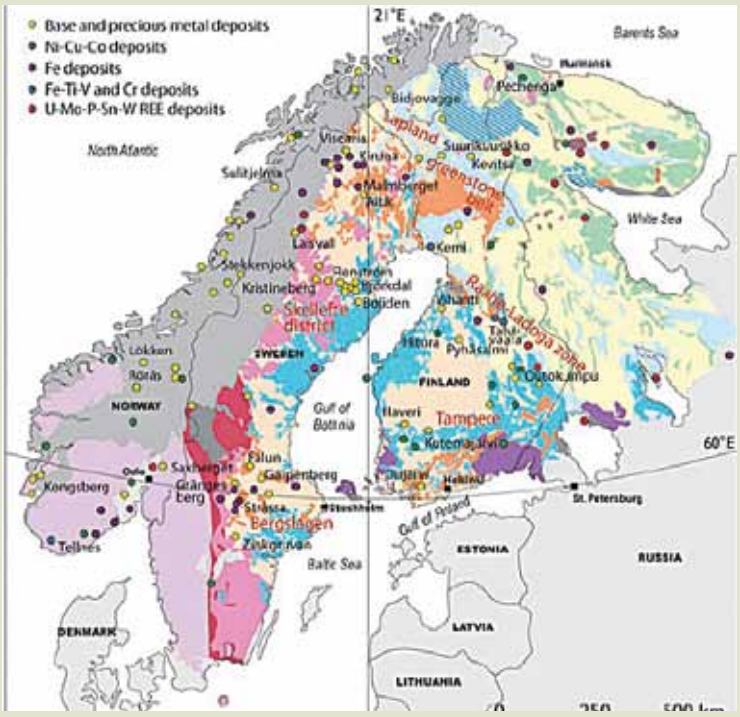
To this end the ETP SMR has several projects to increase the supply and optimise the reuse/recycling of resources.

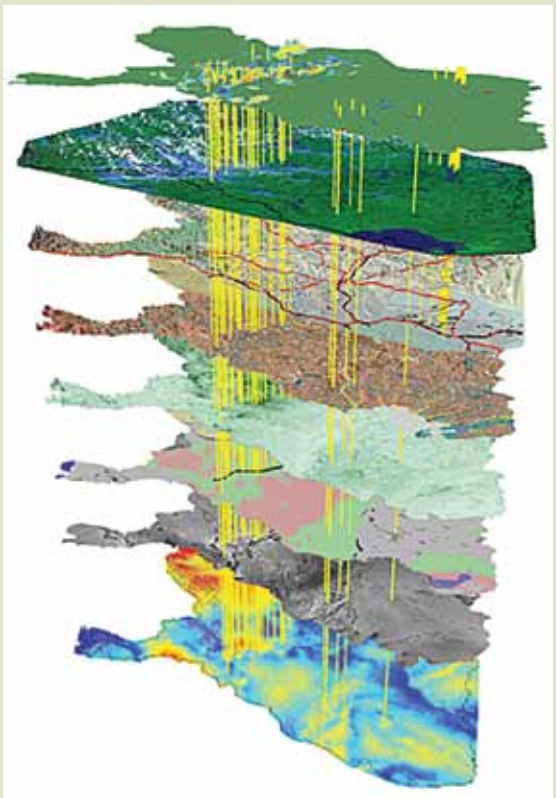
The information on critical minerals is limited, scattered, hard-to-identify and not necessarily easily to access.
In particular information is lacking on:
- the geological controls of their deposits (or of the deposits of the main mineral(s) to which they are locally associated as a by-product,
- on the geological and geographical distribution of the deposits, on the various minerals containing them,
- of their properties, of the methods of processing these minerals and of the production of the marketable products.

Furthermore there is no data interoperability for ore deposits data.

Hence this project aims at building on the outputs of the ProMine project and aims at:
- developing the interoperability of mineral deposits related geographic information in line and beyond the INSPIRE Directive requirements;
- collecting, organising and making available the public EU knowledge on critical mineral resources, be they on-shore or off-shore resources, to policy-makers and industry; plan for further research on the basis of identified knowledge gaps.

In particular the work programme will include the:
- Identification and link to international OGC compliant ore deposits data interoperability initiatives;
- Development of the GeoSciML based interoperability mechanism for EU ore deposits related public digital data, down stream from PROMINE;
- Integration of the interoperability in the PROMINE generated EU and other existing public digital mineral resources geographic databases;
- Development of an e-compendium for all critical minerals identified by the Raw Minerals Initiative integrating all available public knowledge on deposits, resources, processing, metallurgy;
- Identification of research needs to fill in gaps in geological and technological knowledge.





SUBSEA Mining

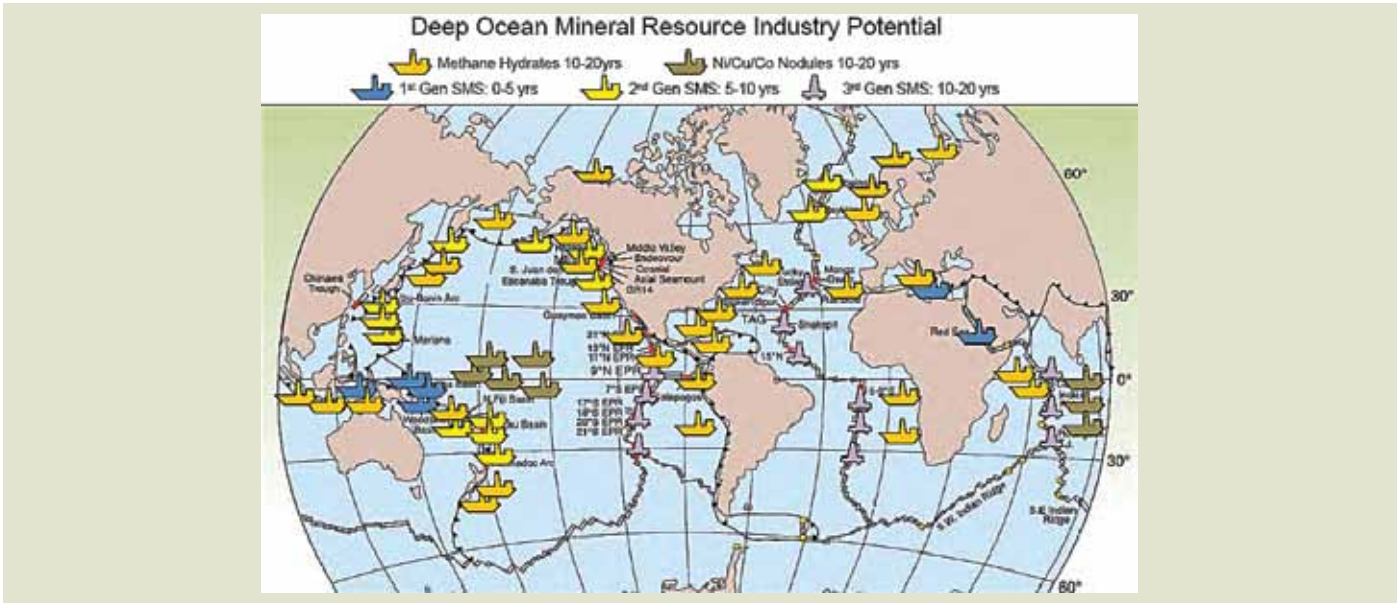
The Seafloor resource potential is enormous.Oceans cover 70% of the Earth's surface; hence till today the mineral and energy development covered only 30% of the earth's surface.

The exploitation of raw materials located in deep offshore has become an attractive option to contribute to the solution of the complex worldwide equation linking security of supply, sustainable development and industrial competitiveness. New technologies have to be developed to reach the future extraction areas of new materials. The challenge is not only technical but also economic (cost-effective equipments and competitiveness) and environmental (reduce footprint and respect the environmental regulations).

The first **SUBSEA** mining projects are in the development phase; several more are in the pipeline. Various commodities already in development by:
- Japan (for manganese crusts) in their respective Economic Exclusive Zones (EEZ),
- South Korea (for polymetallic nodules and Seafloor Massive Sulphides) in Tonga,
- India (for manganese crusts and Seafloor Massive Sulphides) in the Indian Ocean (UN waters),
- Brazil (for phosphates) possibly in Namibia and NZ,
- Russia and China (for Seafloor Massive Sulphides) in the Atlantic Ocean (UN waters).

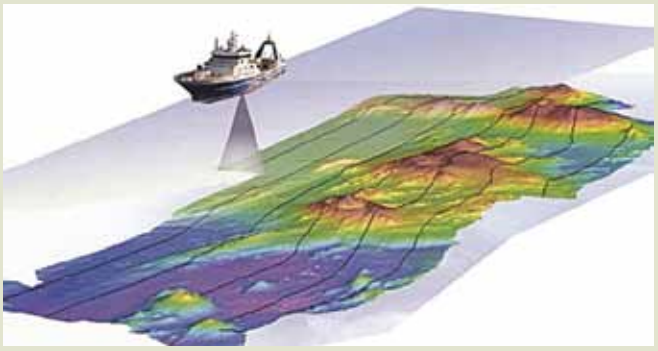
Private companies involved so far are Nautilus Minerals and Neptune Minerals (for Seafloor Massive Sulphides) in Papua New Guinea and New Zealand, De Beers Marine (for diamonds) in Namibia, Bonaparte and Gecko Mining (for phosphates) in Namibia. The world's first seafloor copper-gold project, Solwara 1, is under development in Papua New Guinea. Utilising technologies from the offshore oil and gas, dredging and mining industries; project will mark the launch of this new deep water seafloor resource production industry.

However Europe has been involved only on a very limited scale although it has the technology and could be involved to a much higher degree. European deepsea mining technologies today are available from IFREMER (France); Technip (France); IHC Merwede (Netherlands), and SMD (UK).



The EU has access to its European Economic Exclusive Zone (EEZ) which is the largest EEZ worldwide. French EEZ is the first contributor with a total surface of 11millions km2. Seafloor Massive Sulphides (SMS) resources have been identified in Wallis & Futuna (France), Sicily (Italy) or Azores (Portugal). The SMS deposits are polymetallic and contain high concentrations of copper (5 – 15 %), zinc (5 – 50 %) and lead (3 – 23 %) in addition to gold (2 – 20 g/t) and silver (20 – 1,200 g/t). Polymetallic sulphide deposits size can reach 100 Mt and they lie in water depths typically ranging from 1,200 m to 2,500 m.

SMS deposits are formed where rising hot hydrothermal fluids mix with cold sea water on the sea floor. At present, approximately 150 sites of active or recently active hydrothermal fluid venting on the sea floor have been discovered worldwide. Volcanic hosted massive sulphide (VHMS) deposits form a major part of the world's reserves of copper, lead and zinc, as well as being producers of gold and silver.



In this context, it has been proposed to implement a program in conducting marine geophysical and geological surveys in the overseas using research vessels to explore Potential marine mineral resources. By analyzing the mineralogical and geochemical characteristics of sediments, sub-bottom profiles, coring samples and sedimentary structures, it shall be assessed the sedimentary model of seabed-level deposits of heavy minerals and by the way the attractively of sea-floor mineral resources.

The targeted market is linked to their economical values guaranteed by the development of cost-effective technologies. An innovation of this kind requires an experimental phase during the process leading to industrialization. Experimentation begins as soon as a project definition analysis demonstrating the technical and economic interest of the planned project has been conducted. The Pilot Production System will operate at a ¼ scale to the full field development system. The Pilot Production System will act as a subsea mining demonstrator, proving the effectiveness of the proposed recovery technologies and will further enable to test seabed based rock cutting tools.

The SUBSEA mining project will:

Promote a Sustainability of mining projects

- Seafloor extraction will not require the social dislocation and the resulting impact on culture or disturbance of traditional lands.
- Production will be limited to a floating ship with little additional land-based infrastructure.
- The ore generally occurs directly on the seafloor and will not require large pre-strips or overburden removal.

Access mineral and energy resources

- Survey data already exist and confirm deep-sea mining potential (in France in particular).
- Will contribute to the advancement of global seafloor resource development.
- Will promote more effective use of available resources within Europe EEZ.
- Will achieve Europe self-sufficiency in major strategic metal and energy supplies and help the control the development of marine mineral and energy resources.

Scientific Excellence

- Ensure better knowledge, assessment in the exploitation of mineral resources.
- Improve knowledge of ocean floors, biodiversity, marine ecosystems mechanisms and means to protect and restore the marine environment.

Technology Development and Know-how

European nations will be involved in projects that will expand the boundaries of technologies while helping companies use new ideas effectively. This project will encourage the potential for creativity and innovation and strengthen the position of European nations as leading deep-sea mining nations.

will be exciting for existing and next generations of scientists or engineers to be involved with the development of an opportunity that brings back memories of the classic Jules Verne novel Twenty Thousand Leagues Under the Sea that fascinated our parents and grandparents but at the same time captures our better resources capabilities and attention. The team of engineers and business development professionals that are working on this project know that by working closely we can turn the challenge of exploring and processing of minerals from the depths of the ocean into seas of opportunity" for Europe.

From the mountains in the Andes to the depths of the Pacific Ocean, the world of mineral exploration, discovery and production continues to evolve, and Technip Mining & Metals is excited to be an important part of it.

The Intelligent Deep Mine – Eco-innovative and intelligent exploration and extraction

A major research effort has to be put into developing the extractive operation of the future. This large section of the research programme will address a series of issues in an integrative fashion trying to develop each of the components to achieve a major step forward in extracting the vital resources in a much more sustainable manner.

- Increase access to sustainable resources in Europe.
- Making more with less: decoupling, material efficiency.
- Decrease EU dependency on resource imports.
- Contributing solutions to climate change issues.
- Strengthen leadership of European technology providers.
- Increase safety of production and products.
- Job creation in Europe.

Following the EU RMI this project is applicable to all energetic and non-energetic raw materials and addresses the eco-innovative access to resources for Europe and addresses the relative decoupling of resource consumption from economic growth.

Step 1 "Exploration" addresses the first step of identifying the resource through **Remote exploration technologies** including satellite and airborne geo-exploration targeting "blind ore" deposits below 1000 m (new instruments, new methods) for Underground & Surface geo-exploration.

It will limiting European import dependency, increase supply from domestic resources and provide worldwide leadership by:

- New resources,
- Extension of existing resources,
- Less environmental impacts, less interference with society,
- Extension of existing operations with continued economic growth,
- Developing new potential for regional development,
- More job creation,
- Land use with long-term sustainability.

Step 2 "Resource Characterisation" addresses the second step of identifying the resource through:

- In-situ on-line resource diagnosis for continuous extraction/recovery,
- New Drilling technology (MWD, real-time interpretation, drilling probes, etc.),
- Fully integrated intelligent mining processes,
- Geo-metallurgy,
- Sensor development (e.g. ore "sniffers") for grade control, rock mechanics,
- Integrated and automated data processing and analysis for 3D mine planning use.

It will increase the resources availability and improve the following processing by valorisation of existing site specific resources which will provide the basis for the safe intelligent, automated mine and improve the resource efficiency. If successful it will provide substantial new leadership in methodology and technology.

Step 3 "Resource Extraction" comprises 3 major work items related to different conditions aiming at completely new mining concepts:

- Safe deep resource extraction,
- Eco-efficient in-situ extraction,
- Novel technology for selective extraction.

Work item "Safe deep resource extraction" is the first section of the third step and addresses an issue of European, but also global dimension: the safe and very deep resource extraction. This is a pre-requisite for the extractive business of the future addressing increasing increasingly rising issues of accessibility of the resources and the pressure on reduced environmental footprint by extractive operations through:

1. Safe deep resource extraction (+ 1500 m);
2. Rock mechanics and ground support for static and dynamic loading at +1500 m; extreme rock stress and temperature conditions;
3. Automation to reduce human underground exposure.

Work item "Eco-efficient in-situ extraction" is the second section of the third step and addresses the need to extract resources in-situ by bio-/chemical solution technologies in order to provide novel methods for extraction with minimal environmental foot-print and increased resource base by providing viable method for resources so far not possible to extract. This follows on from the previous project "Bio-Mine".

It will explore more opportunities for eco-efficient in-situ mining in Europe and small scale mining of low grade ores. It will look at "Invisible" extraction including near-to-face processing, limit European import dependency and could establish Europe as technology provider for the world in this area.

Finally, work item "Novel technology for selective extraction" is the third section of the third step and addressed small-scale mechanical excavation and backfill systems by developing mobile mineral processing plants with closed process systems.

This will minimise the environmental footprint and increase the resource base, but also will increase SMEs in the sector which could provide a substantial contribution to the development of eco-efficient mining in the developing world.

Resource efficiency

Optimising extraction and processing of resources throughout their life-cycle

But the solution to access to resource also needs to be addressed by improved efficiency throughout the life cycle of the mineral resource beginning at the extraction and processing.

One the hand it is necessary to continue the developing of new processing technologies for the **better extraction and utilisation** of minerals and **metals, on the other hand it is important to continue developing** new **recovery** technologies for secondary and waste materials, thus reducing the loss of these resources for the economy and the sustainability of our societies.
Part of the optimization will also be achieved by improvement of technological parameters using innovative construction of machines and equipment.

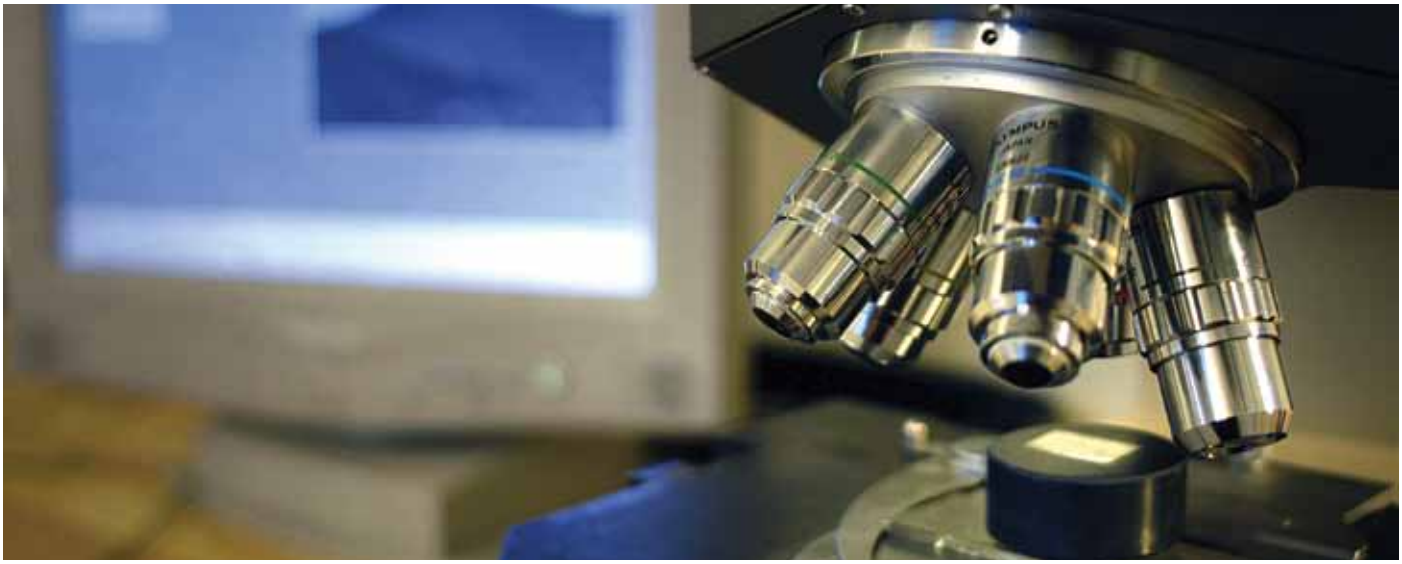
Main R&D targets are:

- Novel technologies for **minerals and metals processing**: mineral particle engineering, heat management, replacement of energy intensive pyrometallurgical technologies with less intensive methods, new technologies in hydrometallurgy, optimal chemical, physical and high temperature processes for industrial minerals, produc tion of precious metals.
- New technological processes for **treatment of polymetallic materials**, by implementation of new methods for recovery of currently not recovered metals, as well as new technologies to improve efficiency of already recovered by-product metals.
- Innovative methods for **making value of waste** by development of sustainable recycling system of metallurgical wastes and effluents to increase production of basic metals by launching technologies for processing of low-quality raw materials, tailings, waste.
- Complete utilization of resources from secondary materials and scrap treatment from non-ferrous metals industry by development of combined highly-efficient technologies for metals recovery from scraps and multi-metallic and multi-material waste.
- Process control through intelligent IT based systems.

The expected impact of such new processing technologies would address in particular three major European policy concerns:

Resource availability for the European economy

- Higher efficiency of ore enrichment and metallurgical processes will result in increased metal recovery for existing ore bodies and will decrease the processing losses up to 5% from currently extracted material. After application of innovative technologies recycling of the material which is now considered waste, e.g. flotation tailings, will increase the recovery efficiently of up to 50% of usable metals.
- Much more comprehensive and efficient management of all the available resources by increase in the process efficiency will increase in the European ore reserves of currently not extracted mineralizations and will recover usable metals in a form of commercial semi-products.
- To make the slag suitable for a reuse for example in construction, and by that minimise the amount of material to dispose of significantly.
- Recovery and separation of halogens and sulfate from process waste water.



Energy efficiency
The aim is through intensification of processes and implementation of new equipment to reduce the energy consumption for obtaining the metals and minerals. Reuse of heat and more synergistic processing will also help to reduce energy consumption.
A reduction of energy consumption of 5-10 % is targeted.

Environmental Sustainability
The development of new technologies will permit to address resource extraction and processing in a new way and will allow to:

- Define conditions for using technologies taking under consideration limitations resulting from local geographical and environmental conditions, implementation of possible protective and improving activities,
- Separate out the main sources of pollution and determine the most suitable for actions of the highest environmental and economical effectiveness.
- Limit specific substance related (bioactive, including carcinogenic) emissions and improve utilisation of hazardous waste.
  provide a multi-criteria analysis covering the development of tools to evaluate technological impact on the environment taking into also reduction in maintenance and repair costs, and considering extractive/metallurgy industry specificities.
- Treatment of internal or external waste water streams/sludges in order to improve metal recovery and reduce hazardous emission.

European Technological Leadership
New processing technologies for extraction, processing and recycling will built on the existing excellence of European technology provides and will continue to provide a substantial contribution to the future leadership of European technology and will guarantee growth and exports in this industrial sector.

Saving Water Resources (WIAMI)

As any scientists will confirm today water is and will be our most precious resource.
Therefore water management and protection will become an even more important part of managing land for communities and industries related to it.
The EU in the past years has passed major water management and protection legislation (Water Framework Directive, Groundwater Directive).

Good water management is a critical element for the extractive activities because it has major impact in many ways:

- **technically** because it is the only fluid which serves as a solids carrier, a cooling agents and a medium for selective recovery of metals for example;
- **economically** because it equals costs when having to make it available at the beginning of any operation, during the operation, and in terms of management a long time after the operation has been ceased;
- **environmentally** and socially because the extractive operations have it is a large impact on water table and quality which can be long-term and it can affect very large areas.

Hence water management still requires considerable efforts in R&D:

- to minimize the uptake;
- to improve the efficiency of liquid/solids separation and chemical treatments;
- to solve the issues met from exploration to tailings ponds;
- to reduce the risks of uncontrollable impact and the cost of water use.

The ETP SMR's project **WIAMI** is addressing all of these issues.

Water being a geological component of most ore bodies managerial issues will be addressed by looking at monitoring, modelling, and simulation of water from the ore body to the tailings dam, in particular with regard to

- nitrogen effluents from the mining industry, and
- metal dissemination.

Decision Support Tools for assisting in the management of water will be developed to provide the interface with other relevant activities, such as irrigation, geothermal power generation, agriculture, and waste water treatment.

Technologically the aim will be to reduce water use and recycling. Therefore the following elements are crucial:

- Identification and validation of technologies of mineral processing using less water or low-quality water;
- Cleaning with innovative technologies like combining flotation and membrane microfiltration, hybrid electrocoagulation membrane process, electrodialysis with bipolar membranes;
- Mine water desalination;
- Internal solid/water separation to re-circulate poorer quality water and reduce discharge;
- Minimisation of the cost and the complexity of technologies for the treatment of effluents;
- Optimisation of use of cooling water of metallurgical plant;
- Hydrometallurgy for selectively extracting metals from minerals and for cleaning effluents from processing complex ores and low-grade primary and secondary resources;
- Chemical and biochemical abatement treatments on the dissolution of metals in mine tailings;
- Removal/recovery of sulphate, metals, and acidity from mine drainage and effluents of mineral processing plants;
- Development of new chemical processes combined with biochemical processes for mine water treatment and purification;
- Novel applications for metals recovery and water purification applied to acid mine drainage based on membrane separation, ion exchange and solvent extraction (e.g. conventional SX, liquid membranes techniques, etc.).

Involving industrial operators from the waste water treatments, agriculture, paper industry, energy production and networking with land use and other water initiatives the extractive industry will contribute to environmental and human health on a regional and local level as well as global level by providing new solutions.

Closing the Loop for Precious and Special Metals used in Consumer Products – Opportunities and Challenges

Special and precious metals play a key role in modern industrial technologies as they are of specific importance for clean technologies and other high tech equipment. Important application areas are information technology (IT), consumer electronics, or car-catalysts, as well as emerging technologies such as photovoltaics, fuel cells and batteries for hybrid cars. Driving forces for the booming use of these “technology metals” are their extraordinary and sometimes exclusive properties, which make many of these metals essential components in a broad range of applications.

Due to their only recent use in mass applications 80% or more of the cumulative mine production in the entire history of mankind for platinum group metals, gallium, indium or rare earth elements for example took only place in the last 30 years. Building up a more sustainable society with the help of technology depends to a large extent on sufficient access to technology metals. It is therefore necessary to establish effective recycling systems to “close the loop” and preserve limited metal resources, but moreover also to fully harvest the environmental benefits of state-of-the-art recycling compared to mining (CO_2 impact, land & water use etc.). This puts a big challenge on appropriate management of the end-of-life (EoL) phase of (metals in) products. Most consumer products are characterized by an “open cycle” structure with multiple owners along the lifecycle, (EoL) products flowing around the world, highly intransparent material streams, and complex collection and recycling chains.

It is crucial to address these issues from a holistic perspective and elaborate the system interdependencies and potential ways of improvement. In many cases effective recycling technologies exist but that the majority of consumer products do not enter in such recycling chains. Hence, significant efforts are still required to achieve the ultimate goal of a “recycling society” and to fully utilize our “urban mines”. Key requirements in this context are:

- High tech products need high tech recycling. Economies of scale are essential for high metal recovery yields at high environmental standards and reasonable costs.
- Efficient recycling comprises various subsequent steps that need to be well adapted to each other, interface management is crucial. Value of precious metals allows by-product recovery of special metals.
- Recyclability of a product is not enough, it needs to happen at end-of-life. → improve collection of relevant consumer goods and prevent doubtful exports of such EoL-products to developing countries without an appropriate recycling infrastructure.
- New business models required, e.g. leasing products/ components/metals or selling functionality/services instead of selling products. Set up early recycling incentives for new products (PV, flat screens, EV/HEV batteries, fuel cells etc.)
- Push interdisciplinary approaches addressing complexities in a holistic way: material science + metallurgy + mineral processing + social science + sales/marketing.
- Efficient recycling & responsible mining are needed to meet future metals demand.

4. Conclusions

The European Technology Platform on Sustainable Mineral Resources (ETP SMR) established in 2005 and officially recognised in September 2008 unites many stakeholders from mining industry, the research community, regulators, consumers and civil society around the major technological challenges to the sector, in order to jointly act towards a common vision.
It is going also to contribute to achieving the goals of the Revised Lisbon Strategy and the intentions of the Gothenburg Strategy on Sustainable Development. The identified needs for Pan-European collaborative research aim at a sustainable supply of mineral resources to the downstream European industries, also taking into account the decoupling of economic growth from adverse environmental impacts.

EUROPEAN TECHNOLOGY PLATFORM
ON SUSTAINABLE MINERAL RESOURCES