European Technology Platform

on

Sustainable Mineral Resources

Strategic Research Agenda
Revision 3

Version March 2009

Table 1. **Members of the High Level Group of the European Technology Platform for Sustainable Mineral Resources**

Companies:	**Associations**:	**Academia**:
– BHP Billiton – Boliden – KGHM – K + S AG – LKAB – Meed – Outokumpu Technology – Rio Tinto – S & B Industrial Minerals – SGL Carbon – SMZ Jelsava – Technip – Tecnicas Reunidas – Umicore – Kompania Węglowa SA **Geological surveys:** – BRGM (France) – GTK (Finland) - Geological Survey (Poland)	– EneRG, the European Network for Research in Geo-energy – EuroGeoSurveys, the Association of the European Geological Surveys (29 members) – EUROGIF, the European Oil and Gas Innovation Forum (15 members) – Euromines, the European Association of Mining Industries (18 associations + 20 companies) – MINFO, the Swedish Mineral Processing Research Organisation (14 members) – MIRO, Mineral Industry Research Organisation (32 members) – MITU, the Swedish Mineral Industry Research Organization (4 members) – Polish Non-Ferrous Metal Platform – UEPG, the European Union Association of Aggregate Producers (19 national Federations of producers)	– RWTH University of Aachen, Germany – TNO – University of Technology Lulea, Sweden – Institute of Mechanized Construction and Rock Mining, Poland – Institute of Non-Ferrous Metals – University of Leoben, Austria – University of Kosice, Slovakia

Foreword.

Welcome to the 3rd revision of the Strategic Research Agenda (SRA) of the European Technology Platform on Sustainable Mineral Resources (ETP SMR). This document marks next step on the way to achieve our overall objectives and vision, to modernise one of the fundamental pillars of the European economy and society: the European extracting and processing sector of energy and non-energy minerals. We maintained the vision and the general strategy on how to reach our objectives. However, we adapted our research intentions to the changed conditions on the European level after the launch of the 7th Research Framework Programme (FP7).

The updated version of our SRA relies mostly on the EU Raw Material Policy presented in *Commission Communicate of the EC (Brussels, 4.11.2008, COM(2008) 699 final) and was* announced in November 2008. It gives us opportunity to support the 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

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. Defining and establishing 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.

Since the beginning of 2006 we have discussed the Strategic Research Priorities with the European Commission in the drafting process of the first call of FP 7. We were successful in getting our Strategic Research Priorities into the 2008 Nanosciences, Nanotechnologies, Materials and New Production Technologies work programme and got the approval of ProMine project. Now we are going to be successful in getting our Strategic Research Priorities into the 2010-2013.

This document should not only demonstrate the way and how we intend to achieve our objectives and fulfil our vision. It is also to show how the minerals industry is going to contribute to the future needs of EU economy. And it will be accompanied by a second important document: The Updated Implementation Plan (IP). Both complementary documents of our ETP SMR clearly show the great effort the industry sector is willing to make in order to fulfil the objectives and the vision.

. . . . . .
Henryk Karas
Chairman High Level Group of ETP-SMR

Executive Summary

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.

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.

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".

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

	Level of response		
	EC	**Member States**	**Industry**
1.Define critical raw materials	**X**	**X**	**X**
2. Launch of EU strategic raw materials diplomacy with major industrialised and resource rich countries	**X**	**X**	
3. Include provisions on access to and sustainable management of raw materials in all bilateral and multilateral trade agreements and regulatory dialogues as appropriate	**X**	**X**	
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	**X**	**X**	**X**
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	**X**	**X**	
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 and –developing guidelines that provide clarity on how to reconcile extraction activities in or near Natura 2000 areas with environmental protection	**X**	**X**	
7.Encourage better networking between national geological surveys with the aim of increasing the EU's knowledge base		**X**	
8. Promote skills and focused research on innovative exploration and extraction technologies, recycling, materials substitution and resource efficiency	**X**	**X**	**X**
9. Increase resource efficiency and foster substitution of raw materials	**X**	**X**	**X**
10 Promote recycling and facilitate the use of secondary raw materials in the EU	**X**	**X**	**X**

Table 2. 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 (a definition of what we understand by short-, medium- and long-term is given in chapter 5.3). 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 should show the way the mineral industry has to proceed in forthcoming decades if it is to serve European society in the way necessary

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1. Introduction

The EU minerals industry[1], having undergone massive restructuring over the last decades, is not only a supplier of inputs vital to the EU economy; it is also a significant exporter of world-class expertise and technologies and manufactured goods. The steady supply of mineral resources to the EU economy remains a vital and irreplaceable input to the EU economy and to the well-being of its citizens. However, the importance of the extractive industries is not well realised by most European decision makers and for the time being still poorly integrated in most EU policies.

The European Technology Platform on Sustainable Mineral Resources (ETP SMR) has been initiated after the end of the recently concluded European project NESMI[2]. This project started to overcome the historical fragmentation of the minerals industry sector with little previous effort to collaborate. The network reconfirmed the presence of strong competencies in many research areas and technology fields, but also identified the future threats and the opportunities for significant improvements.

Further to NESMI the ETP SMR was built upon the conclusions of ENMR, the European Network of Mining Regions[3], which drafted a "Roadmap for European Mining Regions" based on detailed analysis of the strengths and weaknesses of the various mining regions in Europe. The roadmap outlines recommendations to EU stakeholders and policy makers related to European mining regions.

The ETP SMR unites stakeholders from industry, the research community, public authorities, the financial community, regulators, consumers and civil society around the major technological challenges of the sector. The platform also will ensure the necessary "critical mass" for future RTD activities. The Strategic Research Agenda outlines these major technological challenges from today's point of view (March 2009) and shows the way to proceed. However, the Strategic Research Agenda will be a living document, which is matter of revision according to possible upcoming new developments.

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1 The term "Minerals" used in the context of the European Technology Platform designates all subsurface resources, with the exception of groundwater, resulting from geological processes. It comprises metallic and industrial minerals, construction minerals, fossil fuels and geothermal energy resources.

2 NESMI: Network on European Sustainable Minerals Industries
A European Thematic Network where a total of 43 partners and about 70 so-called associated members (partners not receiving any funding) worked together for 3 years from April 1st, 2002 until March 31st, 2005. Their main objective was to concentrate forces in the European mining and processing fields in order to make a significant step forward towards sustainable raw material supply in Europe. The network was funded by the European Commission under the 5th Framework Programme for Research and Development in the Thematic Programme GROWTH (Competitive and sustainable growth).

3 ENMR: European Network of Mining Regions
The network comprised of 19 partners and 8 associated partners. The partners mainly represented official representatives of European mining regions. The network aimed to form a European Partnership of regional authorities including representatives of the regional and local actors (such as industry, trade unions, NGO's and educational and research institutions). One major objective was to create permanent working structures based on existing institutions. The main output was a Roadmap for European Mining Regions outlining recommendations to various European Union stakeholders and policy makers with respect to European mining regions, past, present and future.

Regarding the Lisbon Strategy[4], the results of the Gothenburg summit[5] and latest Raw Material Initiative, the ETP SMR will contribute to the implementation of these results by establishing and implementing a research programme for Pan-European collaborative research aiming at sustainable mineral resources supply to the downstream European industries. All the documents provided the European policy reference framework for the ETP SMR Our Platform also takes into account the decoupling of economic growth from the adverse environmental impacts and unsustainable resource use that have historically accompanied industrial development.

The European minerals industry provides vital inputs to Europe's economy and social well-being. In their great diversity, minerals and their derived products are necessary for almost every aspect of life. Housing, transport, energy supply, health, information and communication technologies, space technologies, for instance, would either be inexistent or suffer much without steady mineral supplies to the EU economy.

Minerals are highly diverse, providing the economy with an extremely wide range of physical and/or chemical functions as well as a world of derived products. Construction minerals, including sand and gravel, represent the largest single material flow through the EU economy. According to Eurostat[6], in 2002 they represented 40% of the direct material inputs into the EU economy while mineral fuels (oil, gas, coal, lignite, peat and uranium) represented another 25%.

The number of European centres of excellence in the minerals industry sector has shrunk in the past 20 years, due to a consolidation reflecting the strong decrease in mining activities in the industry of the old Member States, especially in the coal and metallic mining segments of the industry. However, Europe still has a considerable number of extractive operations, and its research facilities, engineering companies and equipment suppliers are still at the forefront of technology as well as world-leaders in technology supplies.

Europe still has significant resources, and whatever the progress to be made in re-use, recycling and use of substitutes, primary materials will continue to be in high demand. The "Mineral Planning Policies and Supply Practices in Europe" report commissioned by the European Commission Enterprise Directorate General shows that annual per capita consumption of construction minerals (aggregates) in the new Member States of the EU will most likely increase from the present level as their economic activities grow.[7] New exploration methods are needed to identify more metallic and other deposits worth exploiting, knowing that the metallic ore deposits for the future will be largely concealed deposits that do not outcrop on the surface. For industrial minerals and construction materials surface deposits can still be discovered.

It seems essential for Europe to not become too much dependent on import of raw materials. Table 1 shows the development of some example commodities world market prices from 2002 until 2007. The figures clearly indicate the economic risks of import dependency. Therefore the sector needs improvements in many ways for sustainable and competitive raw material supply.

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4 Communication from the Commission, COM(2000) 6

5 Communication from the Commission, COM (2001) 264

6 EUROSTAT - 2002. Material Use in the European Union 1980-2000: Indicators and analysis. Theme 2., Economy and finance; Luxemburg

7 Mineral Panning Policies and Supply Practices in Europe. Department of Mining and Tunnelling University of Leoben Austria. November 2004. Commissioned by the European Commission Enterprise Directorate General under Contract n° ETD/FIF 2003 0781

Commodity	Unit	Price						Ratio 2007/2004
		1.1. 2002	1.1. 2003	1.1. 2004	1.1. 2005	1.1. 2006	1.1. 2007	
Oil brent	$/barrel	19,90	28,70	30,17	40,37	60,39	58,64	**194 %**
Natural gas	$/MMBtu	2,55	4,79	6,19	5,76	6,34	7,91	**128 %**
Copper	$/ton	1462	1536	2321	3280	6201	5225	**225 %**
Nickel	$/ton	5680	7100	16650	15205	13380	37900	**228 %**
Steel	$/ton	504	422	740	1056	1725	1575	**213 %**
Zinc	$/ton	768	750	1008	1270	4259	3045	**302 %**
Gold	$/ozt	276	343	417	427	640	668	**160 %**
Silver	$/ozt	4,52	4,67	5,97	6,39	13,01	13,93	**233 %**
Platinum	$/ozt	477	598	814	861	1135	1199	**147 %**

Table 3: Comparison of world market commodity prices

Many types of resources are not present in Europe. They have to imported without any doubt. However, Europe still owns significant resources of many types of resources. New exploration technologies will allow for more new deposits to be discovered. New processing technologies will further allow for old deposits and wastes from extraction to be reprocessed to recover valuable products. One of the main challenges will be to develop technologies for economic exploitation of those deposits, which will become smaller and smaller and located deeper and deeper.

The extractive industry in Europe has undergone considerable change in order to remain competitive with its non-European competitors. It has undertaken major investments and changes of technology. Inside EU also the extractive industry has improved competitiveness to face e.g. a European single market for construction mineral based on new European Standardisation. The long history of mining and the complex geological conditions in Europe have resulted in a leading position for European mining equipment suppliers, who operate flexibly on the world-wide market with acknowledged quality products in the form of knowledge and equipment; often produced by small and medium sized enterprises (SMEs). The EU has built an enviable reputation for its technology, its technologists and the application of new techniques. As a result, it still holds more than half of the huge world market for equipment and technology.

While needing to continuously enhance its competitiveness, the European minerals industry is committed to sustainable development ethics. Jointly with the Commission, its non-energy extractive segment developed periodically updated Sustainable Development Indicators. The report on "*EU non-energy extractive industry sustainable development indicators 2001-2003*"[8]was published in 2006. It includes the most factual description of the relevant industry segment. A first attempt to provide an assessment of the environmental footprint of EU's raw materials was produced by EUROSTAT (op. cit.) and MOLL et al.[9] and reviewed by the

[8] Available for download here: http://europa.eu.int/comm/enterprise/steel/non-energy-extractive-industry/final_report_2001_2003.pdf

[9] Moll S. et al. - 2003 - Zero Study: Resource Use in European Countries - An estimate of materials and waste streams in the Community., including imports and exports using the instrument of material flow analysis - European Topic Centre for Waste and Materials Flow - European Environmental Agency -Copenhagen, Denmark

stakeholder group on resources supply to the EU economy that was set-up by the European Commission in preparation of the *"Thematic Strategy on the Sustainable Use of Natural Resources"*[10].

In the context of competitiveness aspects of sustainable development the DG Enterprise and Industry of the European Commission launched the so-called High Level Group (HLG) on Competitiveness, Energy and the Environment. The work in this group and the related ad-hoc working groups aim at fostering closer coordination between policy and legislative initiatives and the development of an integrated approach, contributing to creating a more stable and predictable regulatory framework, and exploring ways to unleash the growth potential of basic and intermediate product industries by further integrating competitiveness, energy and environmental policies.

The mandate of the HLG is to offer advice to policy makers, to ensure an integrated approach within these three areas and to develop closer coordination between policy and legislative initiatives. Unlike some other groups which only present their findings towards the end of their mandate, this one issues recommendations after each of its meetings. The issues with which it deals are carefully chosen to reflect their topicality in the overall EU decision-making process. In this way, its input can be fed directly into wider political discussions, leading to possible action at European or national level.

The ad-hoc working group 10 of the HLG dealt with "Natural Resources, Secondary Raw Materials and Waste". It just finished its discussions and published its related recommendations. The group stated that the implementation of best practices, innovation and R&D are major factors in improving the resource efficiency of the EU economy[11].

Based on the work of different related working groups the HLG published on 11 June 2007 its 4th report on "*Ensuring Future Sustainability and Competitiveness of European Enterprises in a Carbon and Resource Constrained World*"[12]. The report delivered policy recommendations on sustainable use of natural resources and called, among other things, for simplifying and streamlining access to domestic raw materials and improving the EU's resources efficiency through the better use of resources embedded in waste.

Access to raw materials was on the agenda of the G8 Summit on 6-8 June 2007. On that occasion a Declaration on *"Growth and Responsibility in the World Economy"*[13] containing a chapter on *"Responsibility for Raw Materials: Transparency and Sustainable Growth"* was adopted, which addresses the key priorities for a sustainable and transparent approach to this question. In addition the Competitiveness Council meeting on 21 May 2007[14] has called the European Commission to develop a "coherent political approach to raw materials supplies for industry" and "to identify appropriate measures for cost-effective, reliable and environmentally friendly access to and exploitation of natural resources, secondary raw materials and recyclable waste, especially concerning third-country markets".

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10 Christmann P. - 2004 – Towards a Thematic Strategy on the Sustainable Use of Natural Resources – Report of Working Group 1: Supply of resources" - European Commission, DG Environment – only available as electronic download from: http://europa.eu.int/comm/environment/natres/pdf/final_report_wg1.pdf

11 Working Group 10 of the DG Enterprise High Level Group on Competitiveness, Energy and the Environment, Recommendations on "Natural Resources, Secondary Materials and Waste", to HLG 4th Report, May, 4th 2007

12 Available for download here: http://ec.europa.eu/enterprise/environment/hlg/hlg_en.htm

13 Available for download here: http://www.g-8.de/Webs/G8/EN/G8Summit/SummitDocuments/summit-documents.html

14 Press release no 9671/07 of the Council of the European Union, 2801st Council Meeting

Further to that the European Commission DG Enterprise and Industry launched a staff working paper on the "*Analysis of the Competitiveness of the Non-Energy Extractive Industry in the EU"*[15]**.** The paper stated that the present situation of the non-energy extractive industry in the EU calls for an integrated approach through which relevant EU policies and instruments work in concert with the aim of ensuring availability of essential raw materials, and sustainability in their extraction and use.

The HLG also called on the EU and Member States to support the development of a raw materials policy. The result of that is the Communication from the Commission to the EUROPEAN Parliament and the Council titled "The raw materials initiative — meeting our critical needs for growth and jobs in Europe {SEC(2008) 2741}". Many recommendations of Communicate are in line with the objectives and the work programme of the ETP SMR being elaborated since 2005.

After introducing RM Initiative the problem of sustainable raw material supply is now one of the main topics on the political agenda. The Strategic Research Agenda of the ETP SMR shows ways and means to contribute to problems solving from the point of view of the European minerals industry, mainly involved in providing domestic mineral-based raw materials. It was compiled by a European panel of stakeholders and endorsed by the High Level Group of the ETP SMR, which itself advises the European Commission.

The SRA of the ETP "Sustainable Mineral Resources" is designed to:

- act as a realistic and inspirational guide to defining a comprehensive action programme that will mobilise stakeholders and ensure that European competences are at the forefront of science & technology worldwide;
- help stimulate investment in research;
- provide guidance for policy options.

The economic downstream impact of the mining and minerals sector in Europe is huge and it is as strategic as energy supply. Therefore it is essential to continue the research activities towards a sustainable mineral resources supply. The ETP SMR will be the group to safeguard sustainable development within the European mineral industry.

1.1. The Vision

The European Technology Platform on Sustainable Mineral Resources will provide a focal point for the industry's research efforts and strengthen the competitiveness of this sector by a major increase in cost efficiency and resource efficiency. Through integrating all stakeholders across the raw-material supply chain a critical mass will be established to implement successful R&D with cross-sectoral application potential. The consumption of raw materials in Europe was always high in the past and can likely to grow due to increased market demand, particularly in the new member states.

[15] Commission Staff Working Document no SEC(2007) 771, available for download here: http://ec.europa.eu/enterprise/steel/index_en.htm

The visions of the ETP "Sustainable Mineral Resources":

- Reshape a 'traditional' industry from resource-driven to a knowledge-driven industry;
- foster new and better jobs, particularly at SME level and in the New Member States;
- supply and secure the mineral resources needed by the EU economy with minimised related environmental footprint (decoupling);
- strengthen world leadership and competitiveness in minerals sector technology;
- add value for customers and the society.

2. The European Mineral Industry in the Global Context

The Communicate {COM(2008) 699} highlights that: "the EU is self-sufficient in *construction minerals*, in particular aggregates, and is a major world producer of gypsum and natural stone. The availability of aggregates from regional and local sources is essential for economic development, in view of logistical constraints and transport costs. The EU is also the world's largest or second largest producer of certain *industrial minerals*, though it remains a net importer of most of them. However, the EU is highly dependent on imports of *metallic minerals*, as its domestic production is limited to about 8% of world production."

European Technology Platform on Sustainable Mineral Resources has integrated also the energy extractive industry. Consequently the ETP SMR is covering the following groups of mineral resources:

- Metallic minerals
- Industrial minerals
- Aggregates and Ornamental Stone
- Oil and gas
- Coal

About 250 EU companies are engaged in metals extraction, including three major multinationals ranking in the top five largest mining corporations in the world. The capitalisation amounts to more than 96 billion € with about 415000 people directly employed. However, while the EU consumes about 25% to 30% of the world's metal production, EU metal extraction accounts for a mere 8% of world production. A better balance between production and consumption on the one hand and security of supplies considerations on the other will, due to the demand within the EU, call for an increase in extraction within the EU.

Metals are traded on the international market which means that European producers are in direct competition with many lower cost producers. In order to maintain European EHS standards and remain competitive, European producers have to continuously cut costs through modernisation and innovation. If the mining, metals and minerals sector were not to remain in Europe the research competences as well as downstream industry will relocate, too, leaving Europe totally deprived of further possibilities of action. Economic, social and – at the end -

environmental consequences would be dramatic. At the same time the European metals industry has been one of the major technology providers in smelting technology around the world, aluminium and copper are just two examples. This technology know-how needs to be continuously developed further to maintain this European asset that provides considerable exports.

The European industrial minerals sector is present in all of the EU Member States. and includes the world's leading international production companies. It offers direct employment to some 100,000 people. With some 810 mines and quarries and 830 plants, Europe is a major producer of some industrial minerals, for example, feldspar, gypsum, magnesite, bentonite and kaolin, for which over a quarter of global production was recorded within the EU 27 and candidate countries.

The industrial minerals sector produces an annual volume of some 145 million tonnes, contributing a value of around 13 billion € to Europe's GDP. If downstream industries such as glass, foundries, ceramics, paper, paint, plastic, etc. are included, these figures are several orders of magnitude greater. In contrast to aggregates, the geological distribution of specific industrial minerals is more localised. This means there is much international trade in these minerals. Despite significant production of some minerals, the available data suggests that the EU is a net importer of all industrial minerals, even those for which the EU is a major global producer.

The importance of construction minerals has increased significantly over the years. The European Aggregates Industry is the main supplier of materials to all types of infrastructure works within the European Union. Construction of roads, railways, airfields, buildings, sewage systems and other civil engineering works depend on large amounts of locally and regionally extracted and processed aggregates. More than 3 billion tonnes of sand, gravel and crushed stone (with a value of more than 35 billions €) are produced annually to meet the demands of the European building and construction industries.

Ornamental Stone often referred to as Dimension Stone is the most visible part in our daily life. Stone buildings, flooring, high rises with granite facades up to tombstones show the daily presence of stone. Around 60,000 small and medium sized businesses in the EU work with ornamental stone in all aspects. The work force of more than 500,000 people engaged in and around ornamental stone is impressive and highly specialised. The total turnover reaches the amount of 24 billon €.

Energy is the next major enabler for EU sustainable development. According to the International Energy Agency Outlook 2004[16], worldwide energy consumption will increase by almost 60% by 2030. Fossil energies, which represent today 88% of the worldwide energy consumption, will remain at the same global level in 2030.

Oil and gas are forecasted to represent about 60% of the EU energy consumption in 2030. In 2000, 1.9 million people were estimated to be directly and indirectly working for the oil and gas industry in the EU/EEA, of which 200,000 in exploration and production, 750,000 in services and supply, and 950,000 in refining & marketing.

Total oil production in Europe amounted to more than 300 million tonnes in 2002, which represents a share of more than 40% of the total oil consumption, while total gas production amounted to more than 200 million tonnes in 2002, which is equivalent to a share of more than 60% of the total European gas consumption. However, production in the North Sea is declining or expected to decline (UK, Netherlands, Denmark) over the next 10 years, or to be

[16] International Energy Agency; World Energy Outlook 2004, 550 pages, ISBN 92-64-10817-3 (2004)

maintained at current level (gas in Norway). Production in other European areas is either also expected to decline or not expected to rise considerably.

Coal is a major energy source for the enlarged EU. Behind China and the US Europe is the world's third largest coal consumer. Together with other energies it forms a secure and well-balanced partnership for the EU's power generating structure and its role has clearly increased with the enlargement. Coking coal is essential for steel production in the blast furnace. Dramatic price increases and shortage in coking coal in 2004 / 2005 have drastically proven the dependence of the European steel industry from overseas imports. Present coal production and imports totals about 370 million tonnes, lignite production amounted to some 600 million tonnes.

Altogether some 32 % of the power generated in EU27 is based on coal and lignite. But this is not coal's only field of application as also the steel and base material industries are highly dependent on coal. The coal mining industries safeguard more than 350,000 direct jobs in the EU. The production value of generating power from coal in the enlarged EU amounts to almost 30 billion €. The production facilities of the coal power generating industries are capital-intensive operations that promise huge investments in the employment sector. The labour market therefore has an enormous significance as a value added factor that extends far beyond the actual mining regions.

2.2. Metallic Minerals

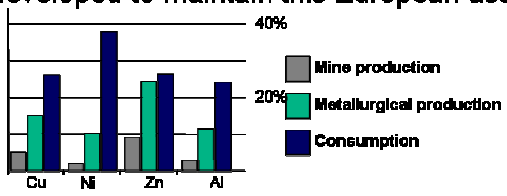
ETP SMR Fact Sheet

Metallic Minerals

EU Production	80 million tons of metal produced
	50 metal mines in operation
EU Employment	415,000 jobs
EU Value	33 b€

About 250 EU companies engaged in metals extraction, including three in the top five largest mining corporations in the world. The total turnover is more than 96 b€.

The European metals industry has been one of the major technology providers in metallurgy around the world. This technology know-how needs to be continuously developed to maintain this European asset that provides considerable exports.



In the EU27 metal extraction accounts for ~5% of world production, metallurgy produces 10-20% of the world production, while consumption is 25-30% of the world's consumption.

European producers are in direct competition with many lower cost producers. If the metals sector and research competencies will leave Europe, economic, social and environmental consequences could be dramatic.

Metal mining include a wide range of ores which - following processing - provide metals. A variety of metal ores are extracted within the EU.

The EU is a major producer of some metals such as iron, copper, zinc, gold, mercury, silver, lead, zinc and chromium, but is nevertheless dependent on imports of many of these metals and entirely dependant on the import of many others like antimony, cobalt or molybdenum. Imports are in the form of concentrates for metal refinery within Europe, or as metal half-products.

The European metals sector is a fundamental, strategic pillar of the downstream fabricating, service and consumer industry in Europe. Metals have become such an integral part of our every day life that many of us no longer recognise them. Metals and their compounds play a major role in the pharmaceutical industry as they do in nutrition, housing, transport, communication and in the household.

2.3. Industrial Minerals

The industrial minerals sector provides a wide range of minerals which can be loosely classified as 'physical' minerals (e.g. calcium carbonates, borates, diatomite, kaolin, plastic clays, bentonite, feldspar, silica, and talc) or 'chemical' minerals (e.g. salt, potash, sulphur). The sector also produces important raw materials for the chemicals and fertiliser manufacturing industries, as well as for ceramics, glass, paper, paints and plastics.

ETP SMR Fact Sheet

Industrial Minerals

EU Production 145 million tons of minerals extracted

EU Employment 100,000 jobs (direct employment)

EU Value 13 b€

The European industrial minerals sector is present in all of the EU Member States, with 810 mines and quarries and 830 plants.

Mainly composed of SMEs, but also includes the world's leading international production companies.

Europe is a major producer of some industrial minerals, for example, feldspar, gypsum, magnesite, bentonite and kaolin, for which over a quarter of global production was recorded within the EU27 and candidate countries.

In contrast to aggregates, the geological distribution of specific industrial minerals is more localised. This means there is much international trade in these minerals. Despite significant production of some minerals, the available data suggests that the EU is a net importer of all industrial minerals, even those for which the EU is a major global producer.

2.4. Aggregates and Ornamental Stones

The European aggregate production and consumption is about 3,000 million tonnes - the largest macroregional market in the world. The **European Aggregates Industry** is the main supplier of materials to all types of infrastructure works within the European Union including aggregates for concrete and asphalt pavements. Construction of roads, railways, airfields, buildings, sewage systems and other civil engineering works depend on large amounts of locally and regionally extracted and processed aggregates. There are currently about 25,000 production sites all over Europe with about 250,000 employees in total. Most of aggregate producers in Europe are small and medium sized companies, SME.

Aggregates can be produced from natural sources, basically from quarries and gravel pits and in some countries from sea dredge as well as from "Secondary Raw Materials", such as demolition waste, recycled concrete and material recovered during road repairs. Recycled materials may replace aggregates from natural sources in as much as 5% of the total amount of aggregates needed in the construction sector.

The particular problem with construction minerals is that they are required in large quantities in the economically more active regions and close to growth centres. Most of the aggregates are produced locally with the exception of a few mega-quarries next to the sea which can deliver development centres reachable by bulk carriers. The relatively low value of construction minerals places constraints on the distance over which they are transported. Short transport distances are the most effective means of keeping the cost of transport and the environmental impact of mineral supply low. This particularity may create a conflict with other land uses.

The **Ornamental Stone** sector provides ready made raw material for the construction industry. From marbles and granites used for interior and exterior flooring and cladding up to kitchen tops, fireplaces and slates for roofing, a huge variety of stones is used in this industry with structural and decoration purposes. They significantly contribute to the improvement of life quality, reflecting prosperity and the history and culture of the people. Other important uses include sculptures, ancient buildings and monuments restoration and even some high-tech applications on measurement and stabilisation apparatus.

This sector represents a worldwide increasing market. Within the European Union around 60,000 small and medium sized businesses work with ornamental stone in all aspects. This comprises a work force of more than 500,000 people engaged in and around ornamental stone industry with strong economical and social impacts at regional levels. Main issues affecting the economy of the **European Ornamental Stones** sector are the steadily decreasing share of this market in favour of Asian countries and Brazil, and the high marketing competitiveness by the ceramic sector products.

2.5. Oil and Gas

ETP SMR Fact Sheet

Oil and Gas

EU Production	300 million tons of oil produced (in 2002) 200 million tons of gas produced (in 2002)
EU Employment	1,900,000 jobs (in 2000)
EU Value	50 b$ (annual turn-over EU service and supply industry) 25 b$ (annual investment in Europe) 10 b$ (annual export value)

Forecasted to represent about 60% of the EU energy consumption in 2030.

The service and supply industry has a worldwide turnover of 115 billion $

Total oil production in Europe represents a share of more than 40% of the total oil consumption, while total gas production is equivalent to a share of more than 60% of the total European gas consumption.

Production in the North Sea is declining or expected to decline (UK, Netherlands, Denmark) over the next 10 years, or to be maintained at current level (gas in Norway). Production in other European areas is either also expected to decline or not expected to rise considerably.

Value-added products made from crude oil or natural gas are important for the chemical industry and for transport.

The oil and gas sector is composed of two main types of actors:

- The oil and gas companies, referred to as “the operators”, which have a full understanding of exploration issues, support the full burden of extraction risks and manage the fields during their whole life

- The supply, service and construction industries provide technologies required by exploration and exploitation operations and bring their field operations' know-how

Oil and gas operators/producers increasingly outsource their R&D to the Oil and Gas service and supply industry. Today, the latter contributes to more than one third of the world's total R&D budget (and this trend is increasing steadily) although their financial capabilities do not compare with those of the operators.

Annual investment in Europe by oil and gas producing companies is estimated to be some 25 billion €, directly benefiting many EU/EEA suppliers and contractors. The export value of oil and gas related supplies and services is more than 10 billion € annually. The oil and gas service and supply industry has a worldwide turnover of 115 billion $ (50 billion $ in Europe, and annually invests 2 billion $ in research and development at European level, while 6 billion $ are being invested worldwide.

In 2000, 1.9 million people were estimated to be directly and indirectly working for the oil and gas industry in the EU / EEA, of which 200,000 in exploration and production, 750,000 in services and supply, and 950,000 in refining and marketing.

The "easy oil" extracted until today will definitely decline, at a rate that approximately defines the famous Peak Oil with significant differences existing from one area to the other. "Difficult hydrocarbons" – these resources may represent more important reserves than those produced since the first well was drilled in 1850 - will mainly come from three sources.

- **Existing reservoirs**, today oil-producing reservoirs have a recovery rate of 30-35% on average. It means that two thirds of hydrocarbons remain in the ground! Better recovery rates are obtained with gas but similar improvements have to be performed too. Innovative technologies are needed to better sweep the reservoirs (Enhanced Oil Recovery techniques).
- **Accessing new reserves**: Offshore ultra deep reservoirs (>2,000m of water depth) and deep buried reservoirs (between 5,000m to 10,000m depth). Ultra deep offshore reservoirs need new materials to alleviate platform structure, new technologies to guarantee flow assurance, new sub sea robotics, a better understanding of well bore stability, sealing techniques, fit for purpose completions, high temperature high pressure sensors, imaging deep reservoir structure, etc. All of this is making innovation a necessary step.
- **Non-conventional hydrocarbons**: Non conventional-hydrocarbons (heavy oils, tar sands, tight gas reservoirs and coal bed methane may be hydrates, too) could be defined as current known reserves which have been locally exploited for a long time but never globally industrialised due to economical factors.

2.6. Coal

The geopolitical events of 2003 – 2009 highlight the fragility of the world's energy supply and security system. They once more pose concerns over energy supply disruptions and price volatility. Coal can make a crucial contribution to energy security in EC. Therefore the positive effect of coal use in relation to security of supply, price and added value must also be taken into account in the political decision-making process. The energy mix must be maintained as a strategy of risk management and as a sustainable option.

ETP SMR Fact Sheet

Coal

EU Production	370 million tons of coal (produced and imported) 550 million tons of lignite
EU Employment	350,000 jobs (coal mining industry)
EU Value	30 b€

Coal is a major energy source for the enlarged EU.

Behind China and the US Europe is the world's third largest coal consumer.

Coking coal is essential for steel production in the blast furnace. Dramatic price increases and shortage in coking coal in 2004 / 2005 have drastically proven the dependence of the European steel industry from overseas imports.

Some 32 % of the power generated in EU25 is based on coal and lignite.

The production facilities of the coal power generating industries are capital-intensive operations that promise huge investments in the employment sector. The labour market therefore has an enormous significance as a value added factor that extends far beyond the actual mining regions.

Coal-industry suppliers are mainly medium-sized companies.

Considering the discussed shortage of easy accessible oil reservoirs coal can be expected to regain importance in the replacement of oil derived products. The European coal industry believes that the three energy sustainability objectives – security of supply, competitiveness and environmental compatibility – must be pursued with equal intensity. Europe's energy sector is going to face considerable challenges to ensure security of energy supplies and invest in the necessary replacement power plants and new plants, and in transmission and distribution systems. Conventional power generation on the basis of nuclear energy and, to an even greater extent, on the basis of hard coal and lignite, using Clean Coal Technologies, will continue to form the backbone of Europe's sustainable electricity supply. The risks for energy supply in the EU have increased significantly in recent years.

Other essential elements of future security of supply are broad-based mixes of energy sources and technologies. A wide energy mix comprising in particular domestic energy sources, i.e. hard coal and lignite, will limit the present high level of import-dependency in the EU27, which amounts to some 50% in the case of fossil energy sources.

3. Turning the Vision into Action

The official recognition of the ETP SMR in 2008 and Raw Material Initiative announced in Brussels at the end of 2008 created good conditions which are necessary to make the vision reality. The mineral industry, in the past known as being fragmented, has joined forces to work on the common problems of the sector in order to achieve the ambitious goals. The participation of key industrial companies, research institutes, associations and other stakeholders in the process of establishing the platform secured the critical mass necessary for the future work.

In order to further increase the participation in the work as well as to inform the community about achievements and intentions, the High Level Group since 2006 decided to organise open stakeholder forums. These forums which were organised regularly and mobilised additional resources for the work foreseen.

One further condition for a success of any Technology Platform is the support of the EU Member States. Therefore the ETP SMR plans to establish national mirror groups for improved communication on national levels.

3.1. Development of Strategic Research Priorities

The strategic research priorities of the European Technology Platform on Sustainable Mineral Resources have been identified from the activities of RMI. They describe the research actions necessary for fulfilling the vision and the objectives of the new EU policy. Grouping of research topics according to technological fields and research areas lead to the strategic research priorities. Those can be understood as technological areas of strategic importance for the ETP SMR on its way to reach the objectives and fulfil the vision. The Strategic Research Priorities should relate directly to particular activities announced in RMI – see table 1 page .

3.1.1. Defining and building up European Critical Raw Materials Base.

The above-mentioned EU Communicate states that "the EU is highly dependent on imports of *"high-tech" metals* such as cobalt, platinum, rare earths, and titanium. Though often needed only in tiny quantities these metals are increasingly essential to the development of technologically sophisticated products in view of the growing number of their functionalities", and „The EU will not master the shift towards sustainable production and environmental-friendly products without such high tech metals. These metals play a critical role in the development of innovative "environmental technologies" for boosting energy efficiency and reducing greenhouse gas emissions. There are three main reasons why some of these materials, such as platinum and indium, are particularly critical: first, they have a significant economic importance for key sectors, second, the EU is faced with a high supply risks, associated with e.g. very high import dependence and a high level of concentration in particular countries, and third, there is currently a lack of substitutes. The EU already experienced a supply crisis in 2000, when the boom in mobile phones has led to a sudden demand for tantalum. Such events can be expected to occur more frequently due to the multiple uses of these materials, and temporary supply bottlenecks can no longer be excluded".

Focus Area: "Critical Raw Materials for Europe " which would cover following activities:

- Secure Europe's future supply of critical raw materials feedstock for EU existing high-tech industries to reduce dependence on imports
- Define the natural and man-made critical raw materials base for the EU and to document the strengths and weaknesses of European critical raw materials according to EU mineral policy
- Document the location of the known and potential EU critical minerals occurrences and quantify their economic value as reserves (proven) or resources (inferred)
- Securing the future supply of critical raw materials for Europe through exploration within and outside of European Union
- Develop innovative and sustainable production technologies to extract critical raw materials from natural resources and from CRM concentration in existing technology process in the EU extractive industry.

The present situation in CRM supply in Europe explains the table 4 below, where position of EU in many metals and elements is very low or non-existent when looking at the position of Europe on the list from rare earth elements to rhenium.

Metal	First	%	Second	%	Third	%	Cum. %
Rare Earth concentrates	China	95	USA	2	India	2	99
Niobium-Columbium	Brazil	90	Canada	9	Australia	1	100
Antimony	China	87	Bolivia	3	South Africa	3	93
Tungsten	China	84	Canada	4	**EU**	**4**	92
Gallium	China	83	Japan	17	-		100
Germanium	China	79	USA	14	Russia	7	100
Rhodium	South Africa	79	Russia	11	USA	6	96
Platinum	South Africa	77	Russia	11	Canada	4	92
Lithium	Chile	60	China	15	Australia	10	85
Indium*	China	60	Korea	9	Japan	9	78
Tantalum **	Australia	60	Brazil	18	Mozambique	5	83
Mercury	China	57	Kyrgyzstan	29	Chile	4	90
Tellurium	Peru	52	Japan	31	Canada	17	100
Selenium*	Japan	48	Canada	20	**EU**	**19**	87
Palladium	Russia	45	South Africa	39	USA	7	91
Vanadium	South Africa	45	China	38	Russia	12	95
Titanium	Australia	42	South Africa	18	Canada	12	72
Rhenium**	Chile	42	USA	17	Kazakhstan	17	76
Chromium	South Africa	41	Kazakhstan	27	India	8	76
Bismuth	China	41	Mexico	21	Peru	18	80
Tin	China	40	Indonesia	28	Peru	14	82
Cobalt	Congo D.R.	36	Australia	11	Canada	11	58
Copper	Chile	36	USA	8	Peru	7	51
Lead	China	35	Australia	19	USA	13	67
Molybdenum	USA	34	China	23	Chile	22	79
Bauxite	Australia	34	Brazil	12	China	11	57
Zinc	China	28	Australia	13	Peru	11	52
Iron ore	Brazil	22	Australia	21	China	15	58
Cadmium	China	22	Korea	16	Japan	11	49
Manganese	China	21	Gabon	20	Australia	16	57
Nickel	Russia	19	Canada	16	Australia	13	48
Silver	Peru	17	Mexico	14	China	13	44
Gold	South Africa	12	China	11	Australia	11	34

Data source: World Mining Data (2008), * = World refinery Production (USGS, 2008) ** = USGS (2008)

Table 4: Top three producing mining regions for selected metallic minerals (2006).

The goal of the ETP SMR activity is establishing the programme which would help to secure future supply of critical raw materials for European economy based on European and out of Europe resources and by implementing innovative extraction technologies. This programme with the help EU and EU-members states can be treated as a strategic one for Europe.

3.1.2. Promote skills and focused research on innovative exploration, extraction technologies, recycling and materials substitution.

Focus Area : "Innovative Exploration "

The overall challenge of the work is securing the future supply of raw materials for Europe through innovative exploration.

Regarding the main problems the sector currently faces and the conditions to be regarded in Europe the following general goals will be achieved:

- Secure Europe's future supply of key raw mineral feedstock for its existing and new downstream industries to reduce dependence on imports
- Define the natural and man-made mineral endowment for the EU:
  - To document the strengths and weaknesses of European mineral resource data base, and to improve it according to EU RMI mineral policy
  - document the location of the known and potential EU mineral occurrences and quantify their economic value as reserves (proven) or resources (inferred)
  - use and share the information to manage their sustainable use, avoiding conflicts in land use
- Fill resource gaps by:
  - provide a platform for exploring and extracting new mineral resources within and outside of European Union

To achieve these goals a lot of R&D efforts have to be made in various technological fields in the area of new exploration technologies based on results of FP 7 ProMine project achievements. The research areas covering new exploration technologies are:

- Pan-EU predictive resource assessment
- 4-D mineral belt models
- Pan-EU GIS/GAD data management and visualisation systems for mineral endowment
- New exploration tools

Focus area: "Extraction and resource processing technologies".

The EC communicate underlines the second pillar of RMI policy which will foster sustainable supply of raw materials from European resources. See the citation from the document : "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".**

New technologies that will reshape the industry, developed from knowledge-based systems, allowing efficient production of products tailored to the demands of the customer and society. This focus area includes energy efficient processing methods to reduce energy consumption for product production.

- Full Resource Utilisation
- Energy optimised fragmentation and extraction
- Towards fully automated extraction
- Sustainable and competitive extraction systems towards zero impact
- Optimising land use

These address the resource processing and metallurgy segment of the metals and minerals industry and will focus on research and development needed to respond to the trends and challenges to support overall improvement in the competitiveness and sustainability of the industry. The most urgent and promising areas that should be addressed include improvement in energy efficiency through the implementation of improved technology, sustainability of minerals and metals production and a reduction in the environmental footprint through initiatives that facilitate improved practices and performance across all sectors of the industry. Sharing of non-competitive knowledge amongst industries will help to distribute "best practices" for operation and maintenance, thus creating added value on a global basis.

The research work will focus on the following goals:

- Move Towards Zero Impact processing - initiatives that facilitate improved practices and performance across all sectors of the industry, promoting efficient and responsible use of natural resources and reducing the footprint (decoupling)
- Reduce energy consumption
- Develop sustainable economic processing, production and products ensuring the benefits are positive and useful to the community
- Knowledge building and transformation on a global basis to provide advanced technologies for the natural resources industry.

3.1.3. Increase resource efficiency and foster substitution of raw materials,

The EU Strategy on the Sustainable Use of Natural Resources outlined a long term strategy aimed at decoupling between resource use and economic growth. In a recent Action Plan the Commission aims to give further impetus to **resource efficiency** and eco-innovative production processes to encourage optimal resource use and recycling.

Main challenges and overall aims

In mature industries, like several sectors of the mineral industry, R&D has been going on for a long time, creating a knowledgebase for the development of improved or new products and materials to foster substitution of raw materials. Such pre-competitive research will benefit from cross-sectorial collaborations within this platform but also from a cross-disciplinary research approach.

This focus area deals with competitive products and materials on the global arena and identified the following targets:

- The European mineral industry must meet the increased global competition for mineral products by developing new or improved products with better functional properties to substitute other raw materials.
- There is a big need in thinking multidisciplinary and using appendages for new materials and products with new applications. This needs a close cooperation with other Technology Platforms who will be the end-users of these materials and products.

3.1.4 Promote recycling and facilitate the use of secondary raw materials in the EU.

The third pillar of the EC Communicate on RMI underlines the need to support recycling, substitution and the increased use of renewable raw materials. That should be promoted in view of easing the critical dependence of the EU on primary raw materials, reduce import dependency, and improve the environmental balance, as well as meeting industrial needs for raw materials.

Apart from primary raw materials, the EU relies heavily on *secondary raw materials*. The use of recycled scrap has increased significantly in recent decades and now represents 40% to 60% of input to EU metal production. However, access to scrap is becoming more difficult in Europe; over the past 8 years, EU imports of non-ferrous and precious metal scrap have dropped nearly 40%, while exports are up more than 125%, resulting in shortages and price rises. A similar trend can be observed for exports of ferrous scrap.

Focus Area : "The Use of Secondary Raw Materials",

The increased use of **secondary raw materials** contributes also to the security of supply and energy efficiency. However, today, many end-of-life products do not enter into sound recycling channels, resulting in an irremediable loss of valuable secondary raw materials. Innovative systems for re-use, re-cycle and emission reduction/prevention will have a direct benefit on sustainable production and lessen environmental impact.

The sustainability of processing technologies and their impact may be improved by integrated systems design, incorporating principals of life cycle assessment in process option selection, use of materials and waste handling/management. Improved monitoring methods and greater knowledge of environmental impacts, coupled with integrated process design, will improve efficiency and minimise impact of processing from resource to product.

Focus Area : "Promote Recycling",

Strategies to enhance recycling and reuse are important to address social and economic development in a context of restricted access to resources and high import dependency. The advantage of recycling is that it contributes to energy efficiency, particularly in the case of metals where production on the basis of secondary raw materials (scrap) is significantly more energy efficient compared to primary raw material.

However, today, many end-of-life products do not enter into sound recycling channels, resulting in an irremediable loss of valuable secondary raw materials. The **recycling of secondary raw materials** will be facilitated by the full implementation and enforcement of relevant recycling legislation as well as by the new provisions in the Waste
Framework Directive on when waste ceases to be waste. The Directive will also require Member States to meet collection targets for the re-use and recycling of metals, paper, glass and non-hazardous construction and demolition waste. The **advantage of recycling** is that **it contributes strongly to energy efficiency**, particularly in the case of metals where production on the basis of secondary raw materials (scrap) is up to significantly more energy efficient compared to primary raw material. **As an example, secondary smelting of aluminium using scrap consumes only 5% of the electricity used compared to primary smelting.**

To boost the reuse or **recycling** of products and materials at a significant economy of scale within the EU, a fair and transparent market is essential, based on agreed minimum standards, certification schemes where appropriate, within proportionate legal framework conditions.

The common goal concerning reuse and recycling within the ETP SMR is to make certain that Europe in 2030 has a recycling industry as a natural part of its mining, mineral and metallurgical industry.

4. Research Areas

Research areas are general fields of research needs common to at least most of the parties involved in the European Technology Platform on Sustainable Mineral Resources. The research areas form the basis for the formation of individual actions comprising of those working steps necessary to bring the whole sector a significant step forward. The results of the actions will be real breakthroughs necessary to fulfil the vision of the sector.

The research areas are related to the value chain of mineral products. It reaches from exploration to the final product ready for use in the downstream industry. As each of the areas represents a part of this chain they are linked to each other. Dependencies between different areas are obvious. Therefore actions to be formed will be based on integrating approaches with the overall aim to fulfil the vision.

They are listed and generally described subsequently:

- The scope of exploration is to secure the long term supply of minerals to Europe, by new exploration technologies and by building a 4D knowledge base of Europe's mineral resources.
- Different extraction and processing methods are depending on the type of mineral resource and the desired products, and therefore require different main RTD. Common points are process and extraction efficiency, the significant reduction of energy consumption and developments toward zero environmental impact.
- The common goal concerning reuse and recycling is to ensure that Europe also in 2030 has a recycling industry as a natural integrated part of its mineral industry.
- The future demands new application areas for mineral products, the design of new mineral products, and the creation of new mineral product functionality, through an enhanced product and customer understanding.
- Well-functioning interaction between industry and society is crucial for a sustainable industry. It is necessary to enhance a positive attitude of the society towards minerals consumption and activities of the mineral industry and its technological development.

4.1. Rationale for Identification of Actions

Actions may consist of targeted research, integrated research, specialist networks, stakeholder networks, specific events, and much more. They must be clearly linked to the overall challenges of the ETP SMR. The orientation of the objectives of actions at the overall aims ensures a target-oriented approach even in the action details. In order to achieve the goals and fulfil the vision based on, work will be done on the following research areas:

- Information network for mineral and metallurgical industry, Original Equipment Manufacturers (OEM) and politicians (while implementing the Thematic Strategy on Waste within the sector)
- Industrial network on waste prevention and recycling aiming at turning wastes into products
- Prevention of waste by innovative processing
- Feedstock recycling

- Maintaining secure supplies of raw materials while safeguarding the environment through resources management conformable to Sustainable Development ethics
- Substantially improving the extractive industry's energy efficiency and thereby reducing the emission of green house gases
- Developing and designing new products for new applications that can be recycled and reused (no waste, increased recovery)
- Ensure the closeness of process chains e.g. for manufacturing of advanced materials and products starting with the raw material and adapted conversion processes
- Keeping close connections and cooperation to Technology Platforms, like Steel, Sustainable Chemistry, Advanced Engineering Materials, Waterborne, and Zero Emission which are handling these materials, products and technologies in following-up processes.
- Providing a sufficiently skilled workforce by attracting young talents to the sector

Actions must aim at real technological breakthroughs. These breakthroughs are essential for fulfilling the vision. From today's point of view the technologies needed to reach the final targets are not present and even no way conceivable.

4.2. Cooperation with other Technology Platforms

Almost every economic sector in Europe and also elsewhere in the world needs products from the minerals industry. In order to serve all these sectors with the best possible cooperation, the European Technology Platform on Sustainable Mineral Resources looks for establishing connections with quite a number of the other Technology Platform already established in Europe as shown in following figure 3.

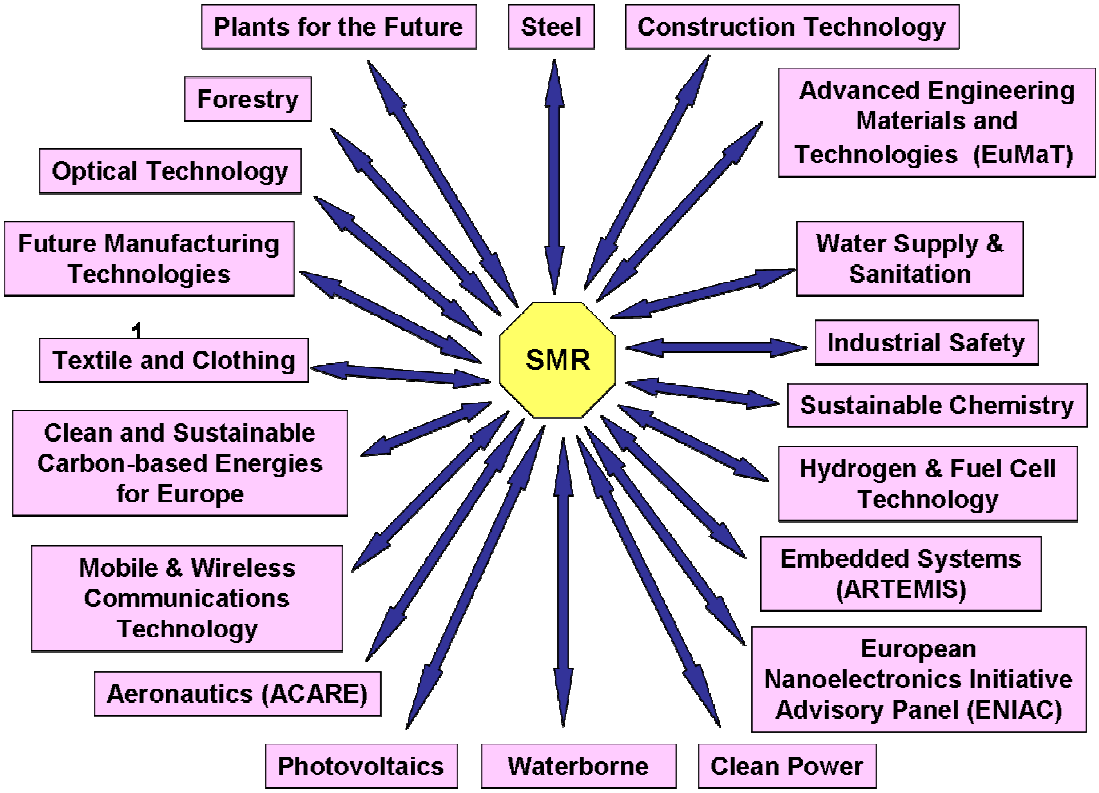


Figure 1: Relation of ETP SMR with other ETPs

The cooperation is essential for both sides. The ETP SMR needs input from the customers in order to be able to serve their needs. The downstream industry benefits from the cooperation in being able to ask for specific requirements related to the mineral product they need for their production processes.

4.3. Benefits

The investment in research in the mineral industry sector will have positive impact on the European society as well as on those numerous European industries heavily demanding products from the minerals sector for further use.

The benefit for the mineral industry will mainly be strong competitiveness on a global market for mineral products. A competitive European mineral industry as a consequence will guarantee significant employment in Europe and social welfare. Especially in regions where mineral industries are located the positive economic impact will be significant.

Additional added value for Europe will be produced in contributing to the implementation of the Lisbon Strategy and the expectations of Raw Materials Initiative. Sustainability in producing mineral products with less environmental footprint, decoupling of production from consumption and production technologies producing no (hazardous) waste are only a few but essential points which additionally will be achieved.

4.4. Conditions for Success

The perception of the mineral industry in the European society needs improvement, which also is true for other industrial sectors. The society has to learn that there is no progress in society and economics without the products produced within the mineral industry and other sectors like manufacturing, chemistry etc. Those products are needed to produce a lot of the current and future high-tech products supposed to guarantee the welfare of the European society also in the future.

In the recent past the mineral industry has transformed to meet the directives by the EU and these changes has affected the daily operation and provided benefits to the long term objectives of the society. It is important that work continues for producing wealth and at the same time reducing the environmental footprint. Such work should be conducted in close co-operation with the industry so that the benefits are ripped without unnecessarily threatening the sustainable world competitiveness of the industry.

5. Implementation Strategy

The European Technology Platform on Sustainable Mineral Resources will develop a detailed strategy on the implementation of the research agenda and its intended results. This implementation strategy will cover all topics necessary to be successful in turning our vision to reality. It will be laid down and described in detail in the Implementation Plan as a separate document of the ETP SMR. The following paragraphs show a first outline of the steps needed. The strategy should answer the basic questions: Where are we now? Where do we want to be in 2030 and what do we need to do to move effectively from today to 2030?

5.1. Managing Implementation

The first step to undertake is to set up a suitable management for the implementation of the research strategy. The ETP SMR currently comprises of a High Level Group and an associated Executive Committee responsible for the day to day work, Focus Areas and a Stakeholders Forum.

High Level Group

The High Level Group (HLG) forms the top level decision making group. The HLG represents the vast majority of the EU minerals industry and of its supporting organisations. It comprises of high-level stakeholders (i.e. companies, institutes or associations) prepared and willing to also financially contribute to the implementation process of the ETP SMR. In March 2009 the HLG comprised of 15 industrial companies including most of the top ranked global players in mining business, 10 associations representing several hundreds of especially small and medium-sized enterprises (SME), 7 research organisations and three individual geological surveys. It is the basic intention to make the HLG as representative for the mineral industry as possible. It will meet at least twice a year.

The HLG will finally decide on proposals to be submitted for funding and on changes of the Strategic Research Agenda and the vision if appropriate. It will also launch calls for proposals for dedicated research work if necessary.

Steering Committee

The Steering Committee (SC) is the operational arm of the HLG. It consists of one representative from each branch of the extractive industry (metals, industrial minerals, aggregates, stone, coal, graphite, oil & gas, geological surveys). The SC is responsible for the implementation of decisions of the HLG and for collecting items to be discussed and proposals to be decided in the HLG. It will also keep track of the progress of the research work and make assessments of the results with regard to the overall vision. The SC will prepare calls for proposals for dedicated research work as consequence of the assessment of research results.

Priority Areas

The Focus Areas (FA) are responsible for developing and reviewing the contents of the key areas of the RTD efforts identified in the Strategic Research Agenda and based on RM Initiative. They are also responsible for implementing the technical action plans once they have been adopted by the HLG. The Focus Area Leaders, who will be appointed by the High Level Group, are in charge of organising and co-ordinating the work within one focus area and are responsible for reporting back to the HLG via the Steering Committee about the work programme, funding situation, company involvement, results, reporting and deliverables.

Stakeholders Forum

The Stakeholder Forum (SF) consists of all interested parties of the sectors involved and associated parties that are expressing an interest in the work of the ETP (industry, EU and national public authorities, research communities, civil society, operators, users and consumers). It will meet as appropriate (e.g. annually) and will provide the major network for the ETP. It is responsible for providing additional input into the discussions and review of the vision and the Strategic Research Agenda. The broad representation would also enable the functioning of a mirroring group.

Mirror Group (to be established)

The platform also interfaces with a Mirror Group, consisting of representatives of Member States that allows coordination of ETP SMR activities with national research programmes, initiatives and projects.

The members will be appointed by the national governments or through each Permanent Representation to the European Union. The Mirror Group will ensure the increased coordination of mineral resources research activities in Member States with those of the SMR

Platform. To this end a maximum of three observers from three different countries in the Mirror Group will be invited to attend the High Level Group meetings.

The Member States Mirror Group facilitates the interface with national programmes and reflects regional interests. The roles and tasks are co-operation/co-ordination with national regulatory initiatives, co-operation/co-ordination with national R&D initiatives and provide opinion and advice to the HLG when setting goals and targets, inputs are expected in relation with Strategic Research Agenda, implementation of the planned actions, networking activities and integration and dissemination of knowledge and technologies.

5.2. Resources

One main topic of work of the High Level Group and the Steering Committee will be introducing new updated SRA to DG Enterprises and Industry and DG Research. Therefore the vision and work of the ETP SMR will become successful if if we become reliable partner of both DG's to help them implement the EU strategy in mineral policy.

5.2.1 Human Resources

There are many kinds of resources, which might be appropriate in particular actions. First of all enough human resources are necessary to carry out all the work necessary to fulfil the Strategic Research Agenda and the vision. Although the research capacities in the sector had shrunk in the past decades, there are still significant human resources left. The sector still has an excellent and highly sophisticated research community, which will in collaboration with the industry be able to carry out all necessary work.

Owing to RMI action the minerals sector does currently have a good standing in Europe. There are parts of Europe, where the minerals industries got support in their attempts to meet the challenges of globalisation and improve or at least only remain their competitiveness. However, there are even more parts in Europe, where the minerals industries have to struggle hard in order to only do its job.

The education related to the sector therefore is also affected to a large extent by this attitude of non-regarding. Since the eighties of the last century a number of educational courses in the fields of mining and minerals engineering have disappeared – most likely without any chance to re-appear again. We have at least to secure the current level of education potential in Europe in order to not run into danger of lack of well educated staff if we want achieve success in implement RMI policy.

5.2.2 Financial Resources

The research necessary to achieve the objectives of the Strategic Research Agenda requires substantial budget. The stakeholders, especially the industry, are committed to contribute to the extent necessary. However, the intention of the ETP SMR is of course also to raise significant public funding for the research activities both on European and national level where possible. Activities, which are not matter to public funding, will be financed by own money of the participating industry and loans.

In principle, there are two main sources for public funding of research: The European level mainly comprising of the European Framework Programmes for Research and national funding sources dedicated to the sector.

Apart from the European funding sources, which are the main target of pan-European applications, the national funding sources play a significant role of financing research for the minerals sector. National funding sources may finance research work on local level and

mainly dedicated to organisations in the particular country. But they also may serve as co-financing source for pan-European projects. Some of the currently available national funding sources are described subsequently.

Unfortunately, only limited national funding sources are available in the different Member Sates of the European Union. Only Sweden and Poland and to some extent France offer possibilities for the minerals industry to apply for support for sector oriented research. This is mainly due that minerals are not high priority all over Europe until now. However, this view might change due to the political developments in the context of sustainable raw material supply for Europe.

Additional resources may be raised by cross-sector collaboration. This type of collaboration may result in spin-offs and spin-ins beneficial for each sector. From the point of view of the mineral industry the collaboration with other industry branches and the resulting spin-in effects are welcome and will probably reduce the amount of financial resources necessary.

5.3. Timing and Milestones

The timing of the activities within the European Technology Platform on Sustainable Mineral Resources follow the time horizons identified for the research areas and research topics as well as the firstly formulated strategic research priorities. There are short-, medium- and long-term activities planned and foreseen.

Short-term activities are foreseen to be completed until about 2013. The medium-term work aims at a time frame until about 2020 after a successful completion of the short-term actions. Finally, the long-term activities are those running until about 2030 and are designed as final steps to meet the overall goals and the vision of the ETP SMR.

As a consequence the first important milestone will at about 2013 and will assess the results and the success of the short-term actions. The success of these activities is the condition for the continuation of the work within the ETP SMR and the launch of follow-up projects. Future milestones cannot be planned seriously today. The will be set consecutively in the course of the work.

5.4. Possible Future Initiatives

Depending on the progress and the results of the activities intended for the future in the ETP SMR several additional activities may be considered then. These are mainly the so-called Public Private Partnerships and the Joint Technology Initiatives.

Both activities are mainly looking for the financing of the commercialisation of the research results. The initiatives are able to raise the money needed to implement a certain technology and may be appropriate measures for certain industry sectors, where high investment is needed.

This might also be the case for some technologies to be developed within the course of the ETP SMR. However, it seems to be appropriate to not initiate such activities now. The ETP SMR will carefully regard the progress of the work and decide upon further steps on the basis of the research results.

6. Annex: List of Research Topics

The topics form the basis for the formation of individual actions aiming at putting the sector a significant step forward towards fulfilling the vision together with new EU RMI policy. The identified research topics are related to the strategic research priorities and can be found in the annex (chapter 6) to this document. The table also shows an indication of the timing the topics are aiming at (short-, medium- or long-term actions).

The following references are made in the table below:

Reference to ETP SMR Strategic Research Priorities based on activities of the Raw Materials Initiative.

The figure in the 3rd column of the table refers to The Raw Materials Initiative (COM(2008) 699) not enclosed in this document. The Raw Materials Initiative issues (abbreviated in the following table as RMI) are numbered from 1 to 10 as follows:

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 and

   - 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

Reference to FP7 specific programmes in Cooperation theme.

The figure in the following table indicates a theme in the Cooperation programme as follows:

1. Health
2. Food, Agriculture and Fisheries, Biotechnology
3. Information and Communication Technologies
4. Nanosciences, Nanotechnologies, Materials and New Production Technologies
5. Energy
6. Environment (including Climate Change)
7. Transport (including Aeronautics)
8. Socio-economic Sciences and the Humanities
9. Space
10. Security

The indication in the column “Time horizon” has following meanings:

S = short-, M = medium-, L = long-term actions

Research area	Research topics	Referring to			Time horizon
		RMI		FP7	
Pan-EU predictive resource assessment	Pan-EU assessments for metallic minerals, energy resources, industrial minerals, aggregates, and dimension stones, incl. mineral sustainability modelling and life cycle analysis	7		4, 5	S
	Survey and evaluation of high-tech metals as economically valuable by-products in mineral deposits	7		4, 8	M
	Evaluation of mineral resources of the Legal Continental Platform	7		8	M
Pan-EU geological data management and systems for mineral endowment analyses	Pan-EU Assessment and land use planning on mineral resources in the context of integrated natural resources management	6		4, 6, 8	M
	Develop computer systems which will use the data and information bases to model and visualise the key spatial, geological, geophysical, geochemical and financial parameters of mineral occurrences on common EU platforms	7		3, 4	M/L
	Use the GIS models interactively to measure the likely environmental and societal impacts of mineral extraction throughout the entire LC from discovery to closure, as well as financial and legislative limitations, to avoid conflicts in land use	6		3, 4, 6	M/L
Development of new exploration technologies	Develop technologies to detect and map new mineral occurrences with non-destructive exploration, sampling and sensing techniques, e.g.: MWD - Measuring while drilling, 3D-seismics in crystalline rocks, hyperspectral and 3D models	8		3, 4	S/M
	Develop technologies and equipment in the oil and gas sector to explore for HP/HT (High Pressure/High Temperature) reservoirs and deep/ultra deep water fields	8		4	S/M
Full Resource Utilisation	New investigation methods and new mine planning tools for improved utilisation of resources and minimum environmental impact	9		4, 6	S/M
	Frontier technologies for improved recovery of minerals and oil & gas	9		4	M/L
Energy optimised fragmentation and extraction	Optimal fragmentation and controlled blasting for different sectors	8		4	S/M
	Future fragmentation & excavation methods (e.g.. mechanical cutting, high-pressure water, microwaves etc.)	8		4, 5	M/L
	Alternative hauling- and transportation methods	8		4, 7	M/L
	New and more efficient power supply for production equipment	8		4, 5	M/L
Towards fully automated					
	Computer - based optimisation & simulation models and on-line control methods for extraction, crushing and screening	8		3, 4, 5	S/M

Research area	Research topics	Referring to RMI	Referring to FP7	Time horizon
extraction	Development of wear parts and prognostics for predictive maintenance	8	4	S/M
	Improvement of robotics for underground and surface operations	8	3, 4	M/L
	Development of monitoring-, control-, positioning- and communication systems	8	3, 4	S/M
	Further development of mine modelling	8	4	S/M
Sustainable and competitive extraction systems towards zero impact	Development of drilling and blasting techniques for minimising of noise, dust, emissions and vibrations	8	4, 6	S/M
	More efficient in-situ extraction and near-face beneficiation	8	4, 5	M/L
	In-situ (solution) mining of metal ores for energy saving and less excavation	8	4, 5	M/L
	Optimisation of the aggregate production chain: drilling/blasting – loading/haulage – crushing/screening for improvement of production and energy efficiency of operations	8	4	S/M
	Crushed rock aggregate replacing natural sand and gravel for protection of ground water resources and better land use	9	4, 6	S/M
	New restoration methods for surface mining sites – use of stripped soil, waste and fines	6	4, 6	S/M
	Coal mine of 21st century: In-situ producer of energy, fuels and chemicals	8	4	L
Optimising land use	Turn mining sites into social and environmental assets	6	4, 6, 8	M/L
	Develop post-mining areas landscape value building (recreation resorts)	6	4, 6	S/M/L
	Maximise biodiversity in post mining areas	6	4, 6	S/M
	Develop natural alternative to reclamation techniques	6	4, 6	S/M
	Transform quarries into natural habitats	6	6	S/M
Turning liabilities into assets for the future	Develop use of waste water as a unique source of raw material and water	10	4, 6	M/L
	Valorise mine wastes in new applications	10	4, 6	M/L
	Valorise mine wastes as secondary sources of materials and products	10	4, 6	S/M/L
	Develop use of underground exploitations for geothermal energy production	8	4, 5, 6	M/L
	Enhance heat production from underground by induced geothermy combined with site preparation for CO2 storage	8	4, 5, 6	M/L
Towards total resource utilisation: New strategies and technologies for transformation	Use of new machinery in the quarry business.	8	4	M
	Chemical treatment of stone.	8	4	M
	Development of optimal chemical, physical and high temperature processes for the industrial minerals treatment with respect to physiochemical properties of the raw and secondary materials.	9	4	L
	Process Simulation & Optimisation Modelling – improve process efficiency, reduce risk of scale-up to commercial scale and improve product recovery.	9	4	S

Research area	Research topics	Referring to RMI	Referring to FP7	Time horizon
	New technological processes for treatment of polymetallic materials and slags with recovery of usable metals.	9	4	M
	New technologies for recovery of accompanying metals for better utilisation of natural resources.	9	4	M
	Direct treatment systems; In-situ mining, Improved "green" hydrometallurgy, Processes for metal recovery	8	4	M
	Holistic processing strategies: from extraction to product to minimise waste and maximise efficiency, optimisation for end product use.	9	4	M
	Sub-sea mining using derived equipments from Oil and Gas deep water production technology	8	4	S
	Optimisation of metallurgical processes to improve efficiency and reduce waste	9	4, 6	L
	Development of ion-exchange and membrane techniques in non-ferrous metals hydrometallurgy.	8	4	M
	Development of chemical analyses methods for lowering costs of quality controls in metallurgical processes and for continuous control of the processes.	8	4	S
	New processing Technologies for physical separation of minerals – Improved physical methods for minerals concentration (enrichment of non-ferrous ores, froth flotation, new techniques for fine & ultra-fine particles)	8	4	M
	New technologies for production of precious metals.	8	4	M
	Development of chloride metallurgy.	8	4	S/M
	The development and validation of new industrial models and strategies covering all aspects of product and process life-cycle;	9 + 10	4, 8	M
	Improved energy utilisation in electrometallurgy processing.	9	4	M
Energy efficient fragmentation technologies	Equipment design to improve energy transfer and efficiency of fragmentation	9	4	S/M
	Control of grain size and shape, optimisation for downstream processing	9	4	M
Internal processing systems for re-use and recycle	New solutions in combustion engineering and heat recovery.	9	4, 5	M
	Feed stock recycling (plastics, waste wood, chemicals, CRT/LCD glass). Use of recyclables as fluxes, reductants or process chemicals	10	4, 6	M
	Improved methods for heat recovery and re-use	10	4, 5	M
	Stabilisation of hazardous substances in waste materials	10	4	M
	Improved method for water recovery, re-use and recycle	10	4, 6	S
	Reduce the consumption of critical resources and consumables in whole chain production	9 + 10	4, 5, 6	M
	Methods to improve disposal of solids waste	10	4, 6	M
	New technologies for lead production with generation of ecological waste slags.	8	4	M

Research area	Research topics	Referring to RMI	Referring to FP7	Time horizon
Environmental footprint reduction using new processing systems, techniques (life cycle assessment), monitoring methods and materials	New processes for treatment of low quality scraps and waste.	8	4	M
	Clean technologies for raw materials treatment and product production, reducing environmental footprint or process emissions.	8	4, 6	L
	New methods for separation of arsenic and other toxic elements from production lines of non-ferrous metals smelters.	8	4	M
	Protecting ground and surface water quality. Treatment of acid mine drainage, recovery of contained metals, etc	8	4, 6	M
	Improved methods for disposal and use of minerals tailings	9	4	M
	Innovative use of alternative energy sources for processing of raw materials and metals recovery	8	4, 5	M
	New chemical/biochemical processes for recovery or sequestering of pollutants from contaminated land	8	4, 6	M
Knowledge building networks	Bioprocessing and microbial functions – improving performance and understanding (linked to BioMine)	8	4	M
Industrial network on waste prevention and recycling aiming at turning wastes into products	Recycling data source (collectors, recyclers, energy, metallurgy, mineral, mines, equipment)	10	4, 8	S
	Mining and quarrying environmental and waste GIS-database development	7	4	L
Prevention of waste by innovative processing	Combined technologies for processing of waste and scrap (incl. WEEE, ELV, batteries, CDW, catalysts, slags, sludges, dusts etc.)	10	4	L
	New technological processes (hydro, bio, pyro-beneficiation) for treatment of complex waste (incl. dust, tailings, residues,)	10	4	L
Feedstock recycling	Waste to chemicals, e.g. Salts	10	4	M
	Pb-glass phase-out (glass type substitution)	9	4	S/L
Footprint free production	New products from waste (road construction, cement, concrete, foam glass etc)	10	4, 6	M
	Slag processing and new slag products (incl. characterisation, new products)	10	4	S/M
	Fast acceptance routes for waste based products (permitting, tests, characterisation, etc)	10	4	S/M
	Low grade heat recovery (incl. new processes,)	10	4, 5	L
	Processing for Safe use or disposal of problematic waste (incl. Hg, As, Cd, gypsum, tailings etc, vitrification, inertisation etc)	10	4, 6	L
Finding new application areas for mineral products and	Particle engineering: Modification of micro-size mineral particles for new application areas like catalysts, absorbents, pigments, surface modification, water treatment	9	4	M

Research area	Research topics	Referring to RMI	Referring to FP7	Time horizon
designing the mineral products for tomorrow	Development and industrialisation of an alternative coke making process enabling a greater amount of non-coking coal in the coal bed, which means an extension of the lifetime of the raw material supply and reducing the environmental influence.	9	4	L
	Transferring the coke-making by-product tar into valuable end products like poly-granular carbon and graphite, carbon fibres and carbon mesophase for engineering and energy applications	9	4	M
	Development of the European carbon fibre production for new industrial applications	9	4	M
	Research and development of aggregates for future concrete to substitute natural sand and gravel for long-term ground water protection.	9	4	M
	Research and development of aggregates for future asphalt pavement to assure high level safety roads	9	4	M
Environmental Stewardship	Dam construction and impoundment technology for waste disposal and top soil erosion.	8	4, 6	M
	Nature Protection and impact on the ecosystem	6	6	M
	Remediation strategies for sulphide bearing mining waste	8	4, 6	S/M
Health & Safety	Increased automation, especially at high risk workplaces	8	4	L
	Transfer of robotics technologies into the mining and minerals processing field	8	4	L
	Close cooperation with ESA (space industry) and vehicle manufacturers in order to identify technologies for transfer into our sector	8	4	L
	Improved personal protection equipment including wireless communication	8	3, 4	M/L
	Virtual reality simulations for improved education and training initiatives	8	3, 4	M
	Standardisation in safety procedures and safety management.	5+8	4	S
Education	Follow-up European Mineral Programmes	8	8	S