



# Made in *annual report 2009* Europe





## Foreword

*For the European extractive industry the year 2009 was the year of the "Raw Materials Initiative" – 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 struggle for natural resources has triggered not only the EU's Communication on the access to raw materials, but has led to a whole raft of initiatives and discussions at all levels, EU Member States, EU, OECD and UN.*

*At EU level two working groups were established, one on "Defining critical raw materials" with the aim to determine which resources are critical for the EU economy and one on "Exchanging best practices on land use planning, permitting and geological knowledge sharing".*

*In 2009 Euromines and its members were closely co-operating with Czech and Swedish Presidencies and significantly contributed to the organisation of conferences which had one main goal: to further support the Raw Materials Initiative. Following the Prague event "Mineral resources for Europe", addressing the question of demand and supply of minerals for the European Union, two more events were organised under the Swedish Presidency. The main focus of the first event organised by the Luleå University of Technology and the Luleå county was on education and R&D in the sector, while for the second conference organised by the Swedish government in Linköping the topic was the eco-efficient economy.*

*The Spanish Presidency will continue to support the raw materials issue and the "European Minerals Conference" is planned for June 2010 in Madrid.*

*Many real technological breakthroughs are necessary to achieve the EU Raw Materials 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.*

*The extractive 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 also 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.*

*And finally it is the European policy maker that needs to address the needs of the European economy for sustainable raw materials from whatever source, primary or secondary production, EU or non-EU sources, but not only through free trade, but through a fair level playing field, not only for the downstream industry, but also for the primary producers.*

Thomas Drnek  
President



*European Association of Mining Industries,  
Metal Ores & Industrial Minerals*

*12, Avenue de Broqueville  
B-1150 Brussels  
Belgium*

*[www.euromines.org](http://www.euromines.org)  
Tel.: +32 2 775 63 31  
Fax: +32 2 775 63 03*

# Contents

<b>Foreword</b>	<b>1</b>
<b>1. Innovation as the cornerstone of the EU economy</b>	<b>4</b>
1.1 How important are raw materials for our future?	4
1.2 High import dependency – or more sustainable self-sufficiency	5
<b>2. European Flagship Projects and their raw materials demands</b>	<b>7</b>
2.1 Galileo – an opportunity for European enterprises	7
2.2 Airbus A380, Highly fuel efficient and environmentally friendly	10
2.3 Batteries for the electric cars of tomorrow	12
2.4 Photovoltaics – converting sunlight into energy	15
<b>3. Raw materials for the European economy – the strive for Sustainability through R&amp;D</b>	<b>18</b>
3.1. Subsea Mining	19
3.2 Intelligent Deep Mine - Eco-innovative and intelligent exploration and extraction	19
3.3 Optimising extraction and processing of resources throughout their life-cycle	20
3.4 Saving Water Resources (WIAMI)	21
<b>4. Sustainable supply of raw materials for Europe</b>	<b>22</b>
4.1 Working with the Presidencies	22
4.2 Preparing inputs for the final communication	26
<b>5. Materials Stewardship from cradle to grave</b>	<b>28</b>
5.1 Metals and Minerals as safe substances	28
5.2 Metals and Minerals extraction as a safe operation	29
5.3 Addressing safety issues at the workplace	30
5.4 Eco-efficiency – waste management	33
5.5 Eco-efficiency – water consumption	34
5.6 Eco-efficiency – energy consumption and climate change	35

# Innovation as the cornerstone of the EU economy



"As a matter of principle, innovation is the cornerstone of the European economic strategy. The whole strategy is based on the idea that we have to compete in the globalised economy; that we cannot compete on cheap labour, low environmental or social standards. The only way we can compete and succeed is if we are better. Quality matters, technology matters. How do we achieve that? Quality and technology, through innovation. Therefore innovation is really the key for Europe's economic future. That is embedded in the Lisbon Strategy, the European Strategy for Growth and Jobs."

European Commission Vice-President **Günter Verheugen**,  
Vice-President of the European Commission  
and Commissioner for Enterprise and Industry from 2004 – 09

## 1.1 How important are raw materials for our future?

The following table demonstrates the importance of raw materials for sustainable technological and economic development. Our economic future and wealth depends on using old and new materials as efficiently as possible.

Challenge	Solutions	Raw materials (application)
Future Energy supply	Fuel cells	Platinum, Palladium Rare Earth Elements (Scandium, Yttrium and Lanthanides) Cobalt
	Hybrid cars	Samarium (permanent magnets) Rare Earth Elements: Neodymium (high performance magnets) Silver (advanced electromotor generators) Platinum, Palladium (catalysts)
	Alternative energies	Silicon, Gallium (solar cells) Silver (solar cells, energy collection/transmission) Gold, Silver (high performance mirrors)
		Energy storage
Energy conservation	Advanced cooling technologies	REE
	New illuminants	REE, Indium, Gallium: LEDs, LCDs, OLED
	Energy saving tyres	Various industrial minerals
	Super alloys (high efficiency jet turbines)	Rhenium
Environmental protection	Emissions prevention	Platinum, Palladium
	Emissions purification	Silver, REE
High precision machines	Nanotechnology	Silver, REE
IT limitations	Miniaturisation	Tantalum, Ruthenium (MicroLab solutions)
	New IT solutions	Indium (processors) Tungsten (high performance steel hardware)
	RFID (hand-held consumer electronics)	Indium, REE, Silver

Source: COM(2008) 699 – The Raw Materials Initiative – Meeting our critical needs for growth and jobs in Europe;  
DG-ENTR selection based on data provided by RWTH Aachen, 2008; BRGM, 2008 and USGS (2008).

## 1.2 High import dependency – or more sustainable self-sufficiency

A wide range of raw materials are essential inputs to European industry, yet in many cases down-stream enterprises are wholly dependent on foreign countries to obtain their supplies.

In particular for **metallic minerals**, despite the presence of an active metal mining industry in the EU, there is a significant import dependency for most metallic minerals, as its domestic production is currently limited to about 3% of world production<sup>1</sup>.

Certain European countries are major mine producers of particular metals, such as Turkey producing chromium (8.1% of the world total in 2008), Norway titanium (7.1%) and Poland silver (5.4%), however the majority of European countries depend largely on imports from other continents. Between 2007 and 2008, the overall mine production for metals produced in the EU32 generally decreased slightly, although the situation was mixed. Mine production of tungsten increased by nearly 13% and chromium increased by nearly 12%. However, the mine production of zinc decreased by nearly 5%, mined copper and iron ore by just over 4% each<sup>2</sup>. Table 1 illustrates EU 32 metal mine production in the world percentage.

Comparing to the domestic usage, the EU uses 11% of global iron-ore production<sup>3</sup>, simultaneously the EU produces more than 10% of the world's refined Al, Cu, Pb & Zn production<sup>4</sup>. Industry as well as academia claim that this is occurring despite the continued presence of significant mineral potential within the EU.

Table 1: EU32\* mine production of selected metals as world percentages.

Metal	% world	EU32 countries within >1% of world output in 2008
Chromium	10.7	Turkey (8.1%), Finland
Silver	8.5	Poland (5.4%), Sweden, Turkey
Zinc	7.7	Ireland (3.4%), Sweden, Poland
Lead	7.5	Poland (2.1%), Sweden, Ireland
Titanium	7.1	Norway (7.1%)
Copper	5.1	Poland (2.8%)
Tungsten	3.7	Austria (2.0%), Portugal
Nickel	3.0	Greece (1.2%)
Mercury	3.0	Finland (3.0%)
Aluminium (bauxite)	1.8	Greece (1.0%)
Iron	1.4	Sweden (1.1%)
Gold	1.2	-
Manganese	0.3	-

Source: European Mineral Statistics, 2004 – 2008, British Geological Survey. 2010.

<sup>1</sup>DG Enterprise and Industry calculations based on data from British Geological Survey (2008) and Bureau de recherches géologiques et minières (BRGM; 2008)

<sup>2</sup>European Mineral Statistics, 2004 – 2008, British Geological Survey. 2010

<sup>3</sup>Sweden's "Metals and Minerals" booklet

<sup>4</sup>World Bureau of Metal Statistics. July 2008



European Union also produces a wide range of **industrial minerals**, and for mineral types such as feldspar, kaolin, magnesite, perlite and salt, the EU is either the largest or second largest producer in the world. In the cases of several minerals, production is dominated by one country and the majority is still dependent on imports for all but a few of these minerals<sup>5</sup>. The proportion of selected minerals produced by Europe is given in Table 2.

Table 2: **EU32\* production of selected industrial minerals as world percentages.**

<b>Industrial mineral</b>	<b>% of world</b>	<b>EU32 countries within &gt;2% of world output in 2008</b>
Feldspar	62.1	Turkey (26%), Italy, France, Spain, Poland, Czech Republic
Kaolin	28.2	Germany (13%), UK, Czech Republic
Bentonite	25.1	Greece (9.8%), Turkey, Germany
Magnesite	22.6	Turkey (8.9%), Slovakia, Austria
Gypsum	21.6	Spain (10.7%)
Salt	20.0	Germany (5.4%), Netherlands, France, UK
Talc	17.4	Finland (6.9%), France, Austria
Potash	12.5	Germany (9.9%)
Mica	8.4	France (5.3%), Finland
Fluorspar	3.8	Spain (2.4%)

Source: European Mineral Statistics, 2004-2008, British Geological Survey. 2010.

\*In this table 'Europe' is defined as the 27 EU Member States (as of February 2008), the EU associates Norway and Switzerland and the EU candidate countries Croatia, Macedonia and Turkey; this group of 32 countries is for convenience referred to as 'EU32'.

<sup>5</sup>Source: European Mineral Statistics, 2004-2008, British Geological Survey. 2010.



## 2. European Flagship Projects and their raw materials demands

The following four European flagship projects represent just a few examples of how the European industry can compete with the rest of the world through innovations, technology and of course new materials. None of these projects would be possible to realize without minerals and metals.

### 2.1 Galileo – an opportunity for European enterprises

Galileo, the EU's strategic global navigation satellite system (GNSS), will be Europe's own global navigation satellite system, providing a highly accurate, guaranteed global positioning service under civilian control. It will be inter-operable with GPS and GLONASS, the two other global satellite navigation systems.

Galileo, is set to be operational in 2014. This is good news for European enterprises, as Galileo's advanced technological features will make it a valuable tool for nearly all economic sectors. It is also good news for European citizens who will enjoy more accurate positioning technologies and greater safety in the air, on land and at sea.

The European satellite navigation market is tangible proof that the best way to deal with a recession is to be bold and reach for the stars. While many sectors of the European and global economy have stagnated or even shrunk, the GNSS market – which includes such things as the navigation devices in vehicles – has grown at a healthy rate.

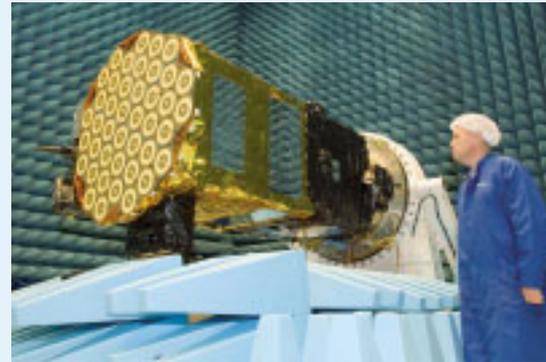
Between 2009 and 2013, GNSS markets are expected to grow at impressive compound annual growth rates of around 24%. This builds on years of sustained growth which saw GNSS-based products and services generate around EUR 20 billion in direct revenues in Europe in 2007.

The longer-term future also looks promising. A market study carried out by the GSA, the EU's GNSS agency, predicts that the global GNSS civilian market will amount to some EUR 235 billion by 2025.

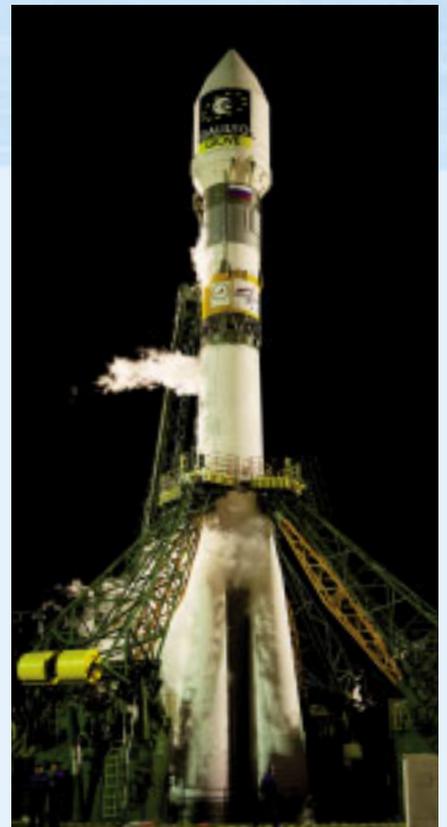
In fact, the GNSS market provides a wealth of opportunities for upstream and downstream European enterprises and public services in a variety of sectors, including space technologies, software, hardware, social services to all kinds of citizens, real time information to people on the move, road transportation, public transport management, aviation, agriculture, energy, the protection of the environment, civil engineering, security, and much more.

The Galileo story began over a decade ago, at the end of the 1990s, when the EU decided to set up its own GNSS infrastructure for civil and commercial use. Named after the famous Italian astronomer Galileo Galilei, the ambitious system is a great achievement in space engineering. With a fully deployed configuration of 30 satellites in medium Earth orbit, it will provide unprecedented positioning precision and accuracy down to a few metres.

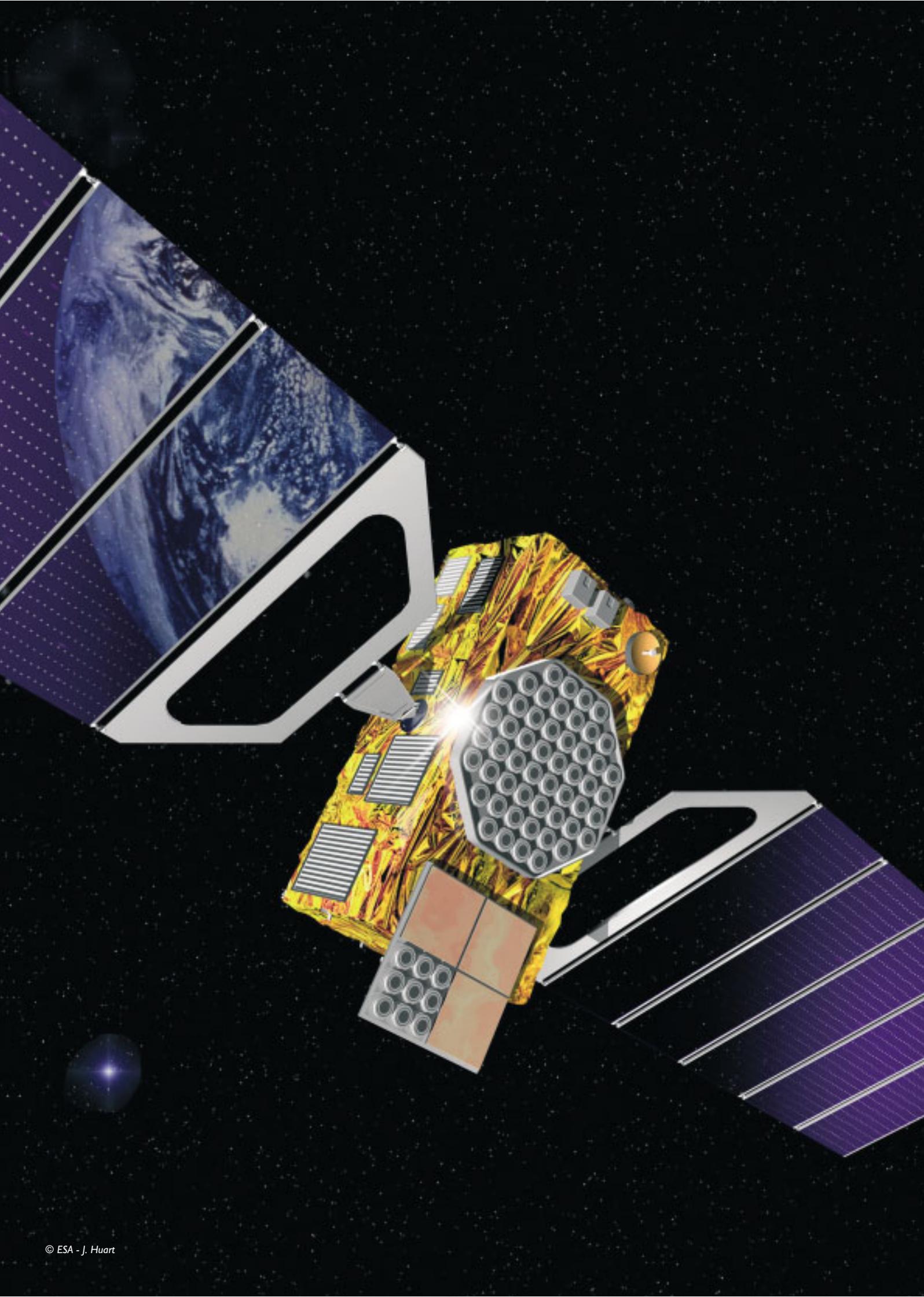
In addition to its high precision, the Galileo constellation will improve the availability of positioning services in cities where tall buildings can obstruct signals from satellites that are low on the horizon. Galileo's navigation signals will also be more available than GPS at high latitudes, such as in Scandinavia.



photos © ESA



photos © ESA - S. Corvaja 2008



As for Galileo itself, the satellite navigation system has reached the most advanced stages of development. Two experimental satellites were successfully launched in 2005 and 2008. In addition, in November 2009, the Kourou ground station was inaugurated. This marks an important milestone in the in-orbit validation phase of the Galileo programme.

The text is based on the article from *Enterprise & Industry* magazine, 16 Feb 2010, ([http://ec.europa.eu/enterprise/e\\_i/index\\_en.htm](http://ec.europa.eu/enterprise/e_i/index_en.htm)), © European Union, 2008 – 2010

## Galileo – selected raw materials used

### Indium

Production of indium tin oxide (ITO) continues to be the leading end use of indium and accounted for most global indium consumption. ITO thin-film coatings are primarily used for electrically conductive purposes in a variety of flat-panel devices most commonly liquid crystal displays (LCDs). Other end uses include solders and alloys, compounds, electrical components and semiconductors, and research (USGS, 2009).

### Lithium

Lithium is a very light metallic element. It is mainly used as lithium compounds that act as fluxes in the ceramic and glass industries, and in lubricants. The metal is an important alloying agent in primary aluminium. Lithium is increasingly being used in rechargeable batteries (European Mineral Statistics 2003-2007, BGS).

Lithium use in batteries expanded significantly in recent years because rechargeable lithium batteries were being used increasingly in portable electronic devices and electrical tools (USGS, 2009).

In Europe (32 countries) Portugal and Spain are the only countries producing lithium minerals (European Mineral Statistics 2004-2008, BGS).

### Niobium

Niobium is a soft and ductile metallic element that is used mainly in special steels and superalloys (European Mineral Statistics 2003-2007, BGS).

Niobium was consumed mostly in the form of ferroniobium by the steel industry and as niobium alloys and metal by the aerospace industry (USGS, 2009).

There is no production in Europe (32 countries), Europe is entirely import dependent (European Mineral Statistics 2003-2007, BGS).

### Silicon

Most ferrosilicon is consumed in the ferrous foundry and steel industries. The main consumers of silicon metal are producers of aluminum and aluminum alloys and the chemical industry. The semiconductor and solar industries, which manufacture chips for computers and photovoltaic cells from high-purity silicon, respectively, accounts for only a small percentage of silicon demand (USGS, 2010).

Ferrosilicon accounts for about four-fifths of world silicon production (gross-weight basis). The leading countries, in descending order of production, for ferrosilicon production were China, Russia, the United States, South Africa, and Norway, and for silicon metal production were China, Brazil, Norway, and France. China was by far the leading producer of both ferrosilicon and silicon metal in 2009 (USGS, 2010).



photo © ESA/CNES/ARIANESPACE - Photo Optique Video CSG, P. Baudon, 2009



photo © ESA - P. Müller



photo © Airbus

## 2.2 Airbus A380, Highly fuel efficient and environmentally friendly

*Airbus' 21st century flagship has made its name as the world's largest, greenest passenger aircraft, and has captured the imagination of air passengers everywhere. With the lowest cost per seat and the lowest emissions per passenger of any large aircraft, the A380 provides a competitive edge.*

*The A380 embodies 30 years of Airbus experience in applying intelligent innovation to its new products. The result is an airliner at the top of the scale in terms of efficiency, profitability and operational effectiveness.*

*By incorporating the latest advances in structures and materials, the A380 offers a direct operating cost per passenger that is 15 per cent lower than the competing large airliner. Reliability and maintainability will be further increased through the use of new technologies such as an enhanced onboard central maintenance system and variable frequency generators (which simplify the large aircraft's electrical generation network).*

*New-generation engines, combined with an advanced wing and landing gear design, have made the A380 significantly quieter than the next largest airliner – enabling the very large aircraft to meet strict local regulations at airports around the world.*

***Fuel-burn: Despite its ability to carry 35 per cent more passengers than its competitor, the A380 burns 12 per cent less fuel per seat – reducing operating costs and minimising its effects on the environment at the same time through fewer emissions. The A380 burns fuel per passenger at a rate comparable to that of an economical family car.***

With its three decks for cargo, the A380F freighter version is able to carry 50 per cent more freight than its closest rival – and to fly a full 1,400nm further. Yet with its advanced technology and use of weight-saving composites – 25 per cent of its structure is made from composite materials – the A380F also burns 18 per cent less fuel per tonne than its rival.

## Aircrafts – selected raw materials used

### Aluminium (Bauxite)

Bauxite is the only source of aluminium that is currently mined and is produced by deep chemical weathering of rocks. The chief use of bauxite is as a raw material for the production of alumina (aluminium oxide), the majority of which is converted to aluminium metal by electrolysis. Approximately 10% of bauxite is non-metallurgical grade and most of this is calcined for use in the abrasive or refractory markets (European Mineral Statistics 2004 – 2008, BGS).

European production is limited, representing only 1.8% of the total world production in 2008 (Greece, Turkey, France, Hungary), leaving a very strong dependence on imports from countries outside Europe (European Mineral Statistics 2004 – 2008, BGS).

### Copper

Copper is very important metal and is used in the electrical, electronics, transportation and construction industries (European Mineral Statistics 2004 – 2008, BGS).

The main areas of application for copper are in the construction, electro-technology and electronics sectors. Together these sectors account for more than two thirds of copper demand. In contrast, the use of copper in the mechanical engineering and vehicle and transport technology sectors shows a clear quantitative decline (BMW 2007).

The EU32 countries contributed 5% to the world mined copper total and 15% to world refined copper production. Poland was the largest mine producer in Europe and second largest refined metal producer, after Germany where refined copper production is based on imported materials (European Mineral Statistics 2004 – 2008, BGS).

### Iron Ore (Steel)

98% of iron ore are used for the manufacture of iron and steel. The remaining 2% are used, for example, for dyes and chemicals. Worldwide, over 40% of steel production is used for construction. No data is available on worldwide iron ore demand. However, since practically all iron ore production is consumed in steel manufacture, which is well documented, the development of steel consumption can serve as a point of reference for the development of iron ore consumption (BMW, 2007).

EU 32 iron ore production was only 1.4% of the world total in 2008 and has increased by only 6% since 2004. Sweden is the largest EU32 producer (76% of EU32 production) (European Mineral Statistics 2004 – 2008, BGS).

### Titanium minerals

The titanium minerals ilmenite and rutile are the main source of titanium, a low density, strong and corrosion resistant metal that is important in aerospace industry. However, the chief use (94%) of titanium minerals is in the form of titanium dioxide, a white pigment used in paint, plastics, rubber and paper (European Mineral Statistics 2004 – 2008, BGS). Europe (32 countries) production is restricted to Norway, which produced about 7% of world total in 2008 (European Mineral Statistics 2004 – 2008, BGS).





photo © <http://electricnick.com/2009/08>

### 2.3 Batteries for the electric cars of tomorrow

*The fact is that the lithium-ion batteries (Li-ion) of the best laptops allow them to be run for an hour and a half before needing to be recharged for two hours or more. And a laptop is a stationary application while a car is designed to be mobile! In other words, today's batteries are inadequate for automotive applications.*

*Much work remains to make lithium batteries capable of powering urban cars at reasonable prices. As Daimler AG spokesman Matthias Brock is keen to point out, "the question of cost is paramount and the battery is an important part of the price of the car. To be competitive, we must reduce the price of batteries, but this will take another few years."*

*"The materials used until now for the cathode prevent large-scale battery production", says Saiful Islam of the University of Bath (UK), a member of the Alistore European Network of Excellence. One research objective is to design cathodes capable of storing more energy by increasing their lithium content using new materials.*

*In a Li-ion battery, when both electrodes are connected to the circuit, chemical energy is released. The lithium ions flow from the cathode to the anode when the battery is charging, and from the anode to the cathode during discharge. While the anode is made of graphite, the cathode is mainly composed either of a layer of metallic oxide such as lithium cobalt oxide, or a polyanions-based material such as lithium iron phosphate or spinels of magnesium oxide and lithium. Of these materials, lithium cobalt oxide is the most common. However, as Saiful Islam points out, "cobalt raises issues of price and toxicity".*

*To replace the cobalt oxide and allow large scale development of batteries for automotive applications, scientists have focused their research on oxides based on iron, nickel or manganese as well as on lithium iron phosphate (LiFePO<sub>4</sub>) cathodes. The latter show a greater resistance to heat and to high-intensity electrical current.*

Even more avant-garde research is seeking to get rid of the cobalt cathode altogether with a lithium-air battery in which lithium enters into the electrode and reacts with oxygen to form lithium oxide. Results suggest that this approach makes it possible to store more energy than with traditional lithium-ion batteries.

The current research looks promising, and although it will take another decade before competing with the advantages of modern internal combustion engine technology, electric vehicle technology is well established on the EU agenda. In March 2009 the European Commission earmarked a billion euros for the development of green cars as part of the Green Cars Initiative, which is an integral part of its economic recovery plan. A portion of these funds has been earmarked for research into high-density batteries, electric motors, intelligent electricity distribution networks and vehicle recharging systems.

The text is based on the article from Research.eu magazine, N° 61 - July 2009, (<http://ec.europa.eu/research/research-eu>), © European Union, 2009



photo © <http://electricnick.com/2009/08>

	World production 2006	use of fuel cells in vehicles	demand forecast for 2030
Platinum	221	+/-0	344
Copper	15,100,000	+/0	258,000

	World production 2006	use of fuel cells in 2006	demand forecast for 2030
Scandium	1.3	n.a.	0.5 - 3.0
Y	7008	n.a.	2.0 - 12
Zr	1180	n.a.	80 - 480

## Batteries – selected raw materials used

### Platinum

The platinum group metals (PGMs) are platinum, palladium, rhodium, ruthenium, osmium and iridium. Of these, platinum and palladium are the most commercially significant (European Mineral Statistics 2004 – 2008, BGS).

Platinum metals are used primarily in the jewellery and automobile industries. In the automobile industry, platinum and palladium are used in the manufacture of catalytic converters. Further catalytic applications are found in the chemical industry. In the petrochemical industry, heavy fractions of crude oil are converted into light fractions with the help of platinum catalysers. Platinum is heavier and more stable than gold, and is used for jewellery settings or for the manufacture of precision watches. Due to their resistance to corrosion, platinum and platinum alloys are used in the electronic industry for electrodes, sensors, contacts, resistors and computer construction parts. In the chemical and glass industry, platinum is the preferred material for the manufacture of laboratory devices and plant components such as vats and nozzles for the manufacture of glass and fibreglass. Due to its biocompatibility, platinum is used in medical and dental technology, e.g. in cardiac pacemakers. Like gold, platinum is seen as a long-term investment and, for this reason, it has played an important role in the investment field until recently (RWTH Aachen University, Institute of Engineering, 2008).

There is no PGM production in Europe (32 countries), thus Europe is entirely import dependent (European Mineral Statistics 2004 – 2008, BGS).

## Rare Earths

High-technology and environmental applications of the rare earth elements (REE) have grown dramatically in diversity and importance over the past four decades. As many of these applications are highly specific, in that substitutes for the REE are inferior or unknown, the REE have acquired a level of technological significance much greater than expected from their relative obscurity. Although actually more abundant than many familiar industrial metals, the REE have much less tendency to become concentrated in exploitable ore deposits. Consequently, most of the world's supply comes from only a few sources.

Rare earths minerals, which occur chiefly in the minerals bastnaesite and monazite, are group of 15 metallic elements of which cerium, lanthanum and neodymium are the most commonly used. Rare earths are widely used in automotive catalysts, as metallurgical additives and in glass and ceramics (European Mineral Statistics 2004 – 2008, BGS).

## Rare Earths – Scandium, Yttrium

Scandium is used in Scandium-aluminium alloys which reduced the coarsity which facilitates the rolling and welding of the material. It all increases the stability of the material. Scandium is used in Magnesium-Scandium alloys.

Scandium is used as laser material and is used in the fuel cell technology.

Yttrium is used as an additive for steel and improves is mechanical, electrical and magnetic qualities.

Yttrium-aluminium granules (YAl5O12) are synthetic crystals that are used for laser technology.

Yttrium is a component of Yttrium-Barium-Copper-oxides which are used in high-temperature superconductors.

There is no European (32 countries) production at this point in time, thus Europe is entirely import dependent (European Mineral Statistics 2004 – 2008, BGS), but there is potential in Europe.

## Zirconium

Zirconium due to its very high melting temperature and chemical stability, it is used as a refractory in furnace and ladle linings, foundry sands and ceramic manufacture. Zirconium metal manufacture is a very small part of total output (European Mineral Statistics 2004 – 2008, BGS).

There is no Zirconium production in Europe (32 countries), thus Europe is entirely import dependent.



photo © Fraunhofer-Gesellschaft



## 2.4 Photovoltaics – converting sunlight into energy

*In spite of their significant role, conventional silicon-based single junction photovoltaic (PV) cells have a major drawback: although they are sufficient to power wrist watches and desktop calculators, they are not efficient in converting the broad range of photon energy in the solar spectrum. Conventional industrial silicon PV cells convert only a fraction of the solar light spectrum, around 17%, while the record for a laboratory cell is 25%.*

*Research is therefore focusing on the development of multi-junction photovoltaic cells, which achieve higher efficiency. They are able to capture more sunlight energy for conversion into electricity, in part due to their composition of different materials, including gallium arsenide, gallium indium phosphide and germanium. The multi-junction structure is in principle a stack of single-junction cells but, because it makes use of several semiconductor energy band gaps, different segments of the solar spectrum can be converted by each junction at a higher efficiency. Fraunhofer ISE has been developing metamorphic multi-junction photovoltaic cells for a decade using III-V semiconductor compounds, which are semiconductors especially suitable for converting sunlight into energy.*

*The starting point of any photovoltaic cell is a semiconductor material with a P-N junction(1). This, however, is just the foundation. The basis for achieving high conversion efficiency is stacking cells of various materials on top of one another, with each material having its own P-N junction. In the case of Fraunhofer ISE's record-breaking cells, the stacked materials are comprised of gallium indium phosphide as a top material, then gallium indium arsenide, and finally germanium as the third material. According to Andreas Bett, head of the solar cells and technology department at Fraunhofer ISE, although the premise of increasing efficiency by stacking cells is old, the key now is to use the right technology with high-quality materials.*



All semiconductors are made within a crystal. Inside this crystalline structure are layers of atoms with a specific distance between them, constituting what is known as the lattice constant. In this context, germanium is the bottom layer of the cake.

Traditionally, if another material is grown on top of germanium, it needs to be done in the same lattice constant and have lattice-matched material. This achieves high crystal quality, which poses fewer solar conversion problems. If the lattice constant differs even slightly, though, it will not "fit," resulting in failures, called dislocations. These dislocations reduce solar cell efficiency significantly.

Herein lies the trick for record-breaking efficiency: Fraunhofer ISE has developed a specific, photovoltaic non-active layer – known as a buffer layer – in which all the dislocations in the crystals are confined. On top of the buffer layer is the material with a new lattice constant, which is relatively free of faults in the resulting crystals. In other words, all the defects are localised in an electrically inactive region of the solar cell, and the active regions remain relatively dislocation-free.

Metamorphic crystal growth also uses a larger scope of III-V semiconductors in multi-junction PV cells. To achieve high efficiency, the solar spectrum is divided into three equally sized regions by appropriate light-absorbing materials. The metamorphic Ga<sub>0.35</sub>In<sub>0.65</sub>P and Ga<sub>0.83</sub>In<sub>0.17</sub>As/Ge material combination, the solar cell structure, is perfectly current-matched in the solar spectrum (all three sub-cells of the triple-junction solar cell generate the same volume of current). In addition to metamorphic growth, this is essential to achieving high efficiency.

The text is based on the article from Research.eu magazine, N°60 - June 2009, (<http://ec.europa.eu/research/research-eu>), © European Union, 2009

### Photovoltaic cells – raw materials used

Semi-conductor solar cells consist – apart from the protective outer glass panels – of tin oxide electrodes between which there are layers of nano-porous titanium oxide as the pigment carrier, zirconium dioxide as electrolyte, and platinum as catalyst.

The titanium oxide itself is covered by a layer of light absorbing metal-organic pigment substance which is based on ruthenium.

Individual elements of the fuel cell are separated and sealed by glass solders and are electrically connected with each other by silver bridges.

**The market for photovoltaic applications has developed dynamically. In 2007 the worldwide solar energy market increased by 40%. From 2010 to 2020 this market is expected to increase by 19 % per annum, from 2020 to 2030 a further increase by 14 % per annum is expected.**

### Global demand for the semi-conductor solar cells in t

Raw material	World production	Demand 2006	Demand forecast for 2030
Platinum	221	0	0.8
Ruthenium	29	0	1.0
Silver	20200	0	14.8
Silicon	302000	0	76.0
Titanium	20100	0	108.0

## Thin-layered photovoltaic technology

Thin-layered photovoltaic technology is the lamination of solid substances in the micro and nano-sizes down to mono-molecular layers that have different physical characteristics than their massive form (strength, optical characteristics, electrical conductivity, etc.) The thin-layering as a surface treatment technology has become one of the key technologies.

### Gallium

About 65% of the gallium consumed is used in integrated circuits (ICs). They are used in defense applications, high-performance computers and telecommunications.

Optoelectronic devices, which include laser diodes, light-emitting diodes (LEDs), photo-detectors, and solar cells, represented 29% of gallium demand. Optoelectronic devices are used in areas such as aerospace, consumer goods, industrial equipment, medical equipment, and telecommunications.

The remaining 6% is used in research and development, specialty alloys, and other applications (USGS 2009).

There is no Gallium production in Europe (32 countries), thus Europe is entirely import dependent.

### Germanium

The major end uses for germanium, worldwide, are estimated to be fibre-optic systems, 30%; infrared optics, 25%; polymerization catalysts, 25%; electronics and solar electric applications, 15%; and other (phosphors, metallurgy, and chemotherapy), 5%. In the USA, these end uses varied and were estimated to be infrared optics, 50%; fiber-optic systems, 30%; electronics and solar electric applications, 15%; and other (phosphors, metallurgy, and chemotherapy), 5% (USGS, 2010).

In conclusion, Fraunhofer expects that the global demand of germanium only in one field of application will octuplicate until 2030. This is nearly the doubled amount of worldwide refinery production in 2008.

There is no Germanium production in Europe (32 countries), thus Europe is entirely import dependent.

### Silver

Silver has the highest electrical and thermal conductivity of all metals. It is widely used in electronics although the most important uses are in photography (silver nitrate) and making mirrors.

Silver is more common than the other precious metals, although still much rarer than base and ferrous metals. It is rarely mined on its own right, and is chiefly produced as a by-product of lead, tin or copper mining.

In 2008 Poland was the largest producer in Europe, 58% of European production and 5% of world production (European Mineral Statistics 2004 – 2008, BGS).

### Titanium minerals

The titanium minerals ilmenite and rutile are the main source of titanium, a low density, strong and corrosion resistant metal that is important in aerospace industry. However, the chief use (94%) of titanium minerals is in the form of titanium dioxide, a white pigment used in paint, plastics, rubber and paper (European Mineral Statistics 2004 – 2008, BGS). Europe (32 countries) production is restricted to Norway, which produced about 7% of world total in 2008 (European Mineral Statistics 2004 – 2008, BGS).



### 3. Raw materials for the European economy – the strive for Sustainability through R&D



The minerals industry, comprising producers and users of industrial minerals and metals, aggregates and ornamental or dimensional stone, oil, gas and derivatives 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.

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 potential liabilities should be turned into assets for the future.

The European extractive industry wants to fulfil expectations of the European society in the move towards acceptable environmental impact and a sustainable use of resources.

*Innovation in the extractive sector in order to meet the high expectations for a sustainable raw materials supply in the future is likely to be a key element. A European Technology Platform on Sustainable Mineral Resources (ETP SMR) is providing a strategic research agenda and together with many European and international partners has already and will continue to launch major research projects into the future of mineral exploration, extraction, processing and new materials from mineral resources.*



**EUROPEAN TECHNOLOGY PLATFORM  
ON SUSTAINABLE MINERAL RESOURCES**

**"The EU needs a strong innovative drive to equip itself with the means needed to secure our future competitiveness and address the major societal challenges of this century,"** Commission Vice-President and Enterprise and Industry Commissioner Günter Verheugen said. **"Mastering nanotechnology, micro- and nanoelectronics, biotechnology, new materials and photonics means being at the cutting edge – to the benefit of citizens."**

After its official recognition the ETP SMR has restructured itself and has revised its Strategic Research Agenda. In light of the Raw Materials Initiative the ETP SMR considers itself as part of the solution for the access to more resources and the better use efficiency. Having already been awarded funding for two major projects in 2008/2009 for the coming calls the ETP SMR prepared a series of calls addressing key issues of technology innovation needed in the sector which range from exploration to recycling.

It is hoped that 2011 – 2013 a series of calls will be launched for the sector which would guarantee additional public funding for major research in the sector.



## ETP SMR Projects

### 3.1. Subsea Mining

The Seafloor resource potential is enormous. Oceans cover 70% of the Earth's surface; hence till today the mineral and energy development covered only 30% of the earth's surface. The exploitation of raw materials located in deep offshore has become an attractive option to contribute to the solution of the complex worldwide equation linking security of supply, sustainable development and industrial competitiveness. New technologies have to be developed to reach the future extraction areas of new materials. The challenge is not only technical but also economic (cost-effective equipments and competitiveness) and environmental (reduce footprint and respect the environmental regulations).



### 3.2 Intelligent Deep Mine - Eco-innovative and intelligent exploration and extraction

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



#### The Mine of the Future – Eco-innovative and intelligent exploration and extraction

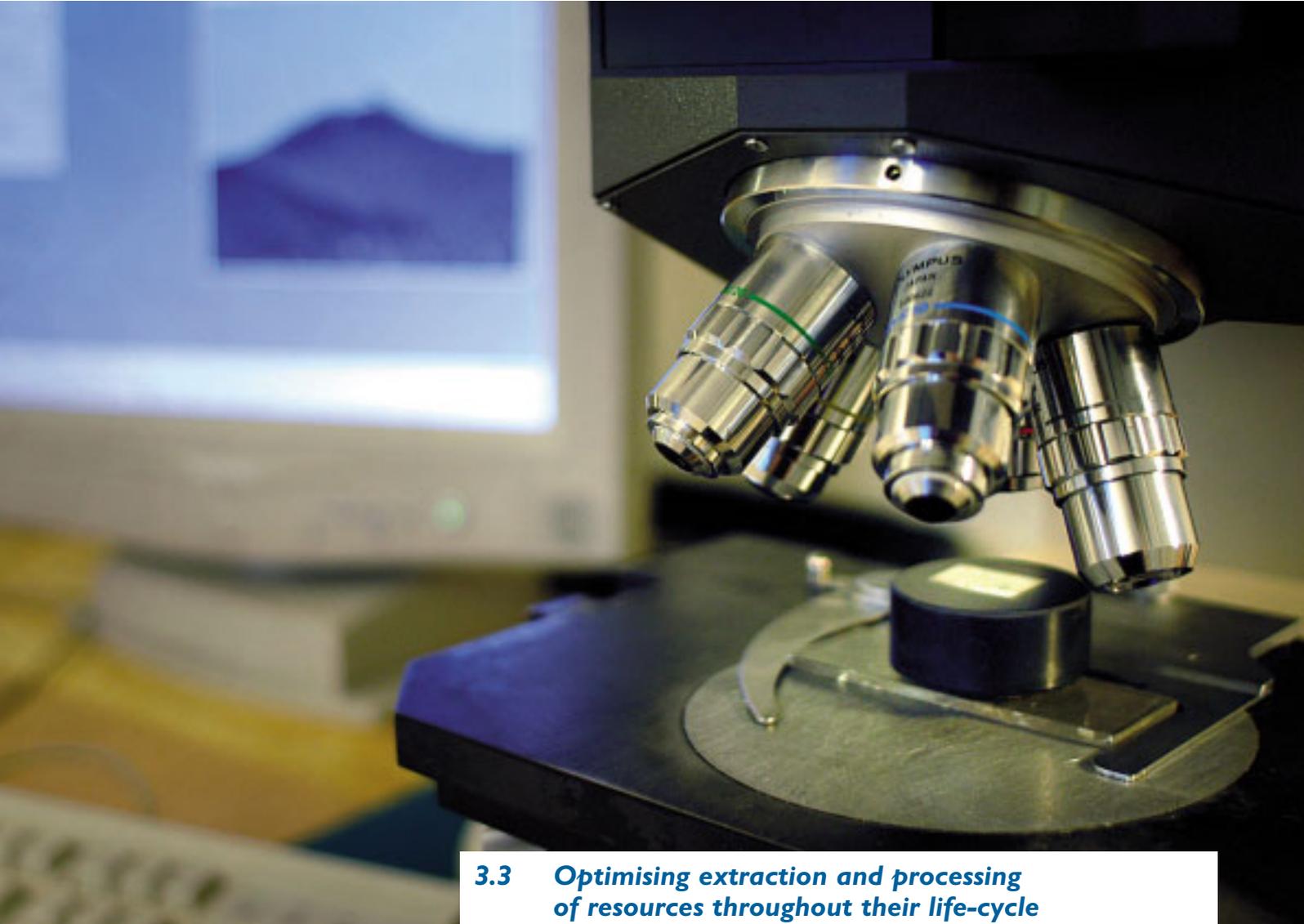
**WP 1 - Exploration**  
**WP 2 - Resource characterisation**

**WP 3**  
Safe Deep  
Resource Extraction

**WP 4**  
Eco-efficient  
in-situ extraction

**WP 5**  
Novel technology  
for selective extraction



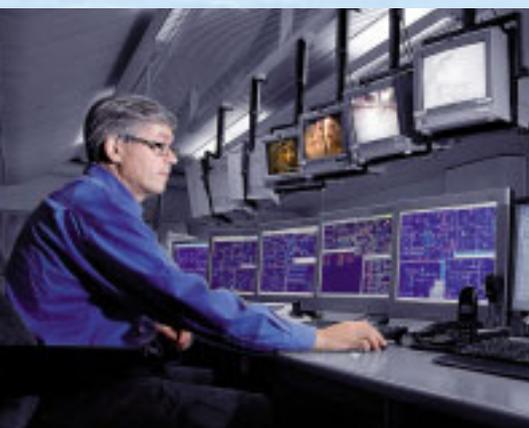


### 3.3 *Optimising extraction and processing of resources throughout their life-cycle*

*On one hand it is necessary to continue the developing of new processing technologies for the **better extraction and utilisation** of minerals and metals, on the other hand it is important to continue developing new **recovery** technologies for secondary and waste materials, thus reducing the loss of these resources from the economy and the sustainability of our societies.*

- *Novel technologies for minerals and metals processing*
- *New technological processes for treatment of polymetallic materials*
- *Innovative methods for making value of waste*
- *Complete utilization of resources from secondary materials and scrap treatment from non-ferrous metals industry by development of combined highly-efficient technologies for metals recovery from scraps and multi-metallic and multi-material waste.*
- *Process control through intelligent IT based systems.*

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



### 3.4 Saving Water Resources (WIAMI)

As any scientists will confirm today water is and will be our most precious resource.

Therefore water management and protection will become an even more important part of managing land for communities and industries related to it.

The EU in the past years has passed major water management and protection legislation (Water Framework Directive, Groundwater Directive).

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

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

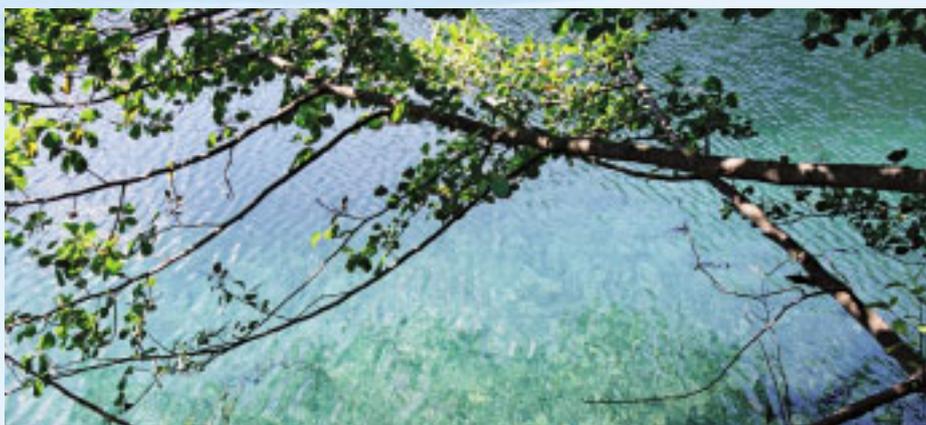
The ETP SMR's project WIAMI is addressing all of these issues.

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

#### **ETP SMR – the outreach for cooperation with other partners**

In response to a call under FP7 the ETP SMR has handed in a proposal for a supporting coordination action in order to strengthen the activities of the ETP SMR in particular with regard to cooperation with other ETPs. The aim of such future cooperation is to increase the number of projects and to prepare an ERA-NET for mineral resources research and a stronger position under FP8.

In order to enhance its research efforts the industry and the ETP SMR are actively looking for cooperation with other research bodies and institutions in order to widen the scope and the collaboration with other ETPs such as the Water Platform and the JRC in Ispra to create new partnerships.



## 4. Sustainable supply of raw materials for Europe



### The political commitment

*The challenges of ensuring a sustainable supply of non-energy raw materials for the EU economy are multiple, complex, and interrelated. These challenges are likely to persist, or even increase. There is a need for a decisive European response in order to ensure European competitiveness<sup>6</sup>.*

*In 2009, the issue of raw materials was given high-level political attention and will be addressed in an integrated EU strategy that ties together various EU policies and promotes further cooperation between the Member States. The successive Czech, the Swedish and the Spanish Presidencies of the European Union have put the Raw Materials issue high up on their agenda, as will the Spanish, Belgian, Hungarian and Polish presidencies.*



**EU2009.CZ**

### 4.1 Working with the Presidencies Conferences organized in response to the RMI

#### 4.1.1 Czech Presidency addressing the question of demand and supply of minerals for EU

*With the support of the Ministry of Industry and Trade of the Czech Republic, Euromines and Těžební unie (the Czech Mining Association), organised an outstanding conference "Mineral Resources for Europe" with high level participation from downstream-industries as well as European and worldwide mineral suppliers. The conference took place on 28 and 29 April 2009 in the capital of the Czech Republic – Prague.*

*In total more than 200 participants attended this event: Representatives of the Ministry of Industry and Trade of the Czech Republic, Ministry of Environment of the Czech Republic, Czech Mining Authority and the European Commission attended this event as key speakers.*

<sup>6</sup>COM(2008) 699 The Raw Materials Initiative – Meeting our critical needs for growth and jobs in Europe



*This conference was the first event organised in response to the European Union Communication "The raw materials initiative – meeting our critical needs for growth and jobs in Europe" initiated by Vice-President of the European Commission Günter Verheugen and officially published in November 2008. **The aim of the conference was to address the question of demand and supply of minerals for the European Union with the intention of providing additional input for the analysis of the "strategic" short, medium and long-term needs of mineral resources for Europe's industry and economy.***

*Among the conference conclusion the following issues were highlighted:*

- *Mining has played and continues to play a crucial role in the development of industrial and economic activities in Europe as well as in other parts of the world.*
- *Minerals and metals represent one of the basic material options for industrial production processes and every day products.*
- *Minerals and Metals have always been an integral part of our every day life.*
- *Disregarding the current financial crisis, the strong and growing markets for aggregates, metals and minerals and their downstream products in Europe will remain.*
- *Many EU products and technologies are world-leading and serve many world markets; In order to produce these downstream products reliable and competitive energy is required.*



#### 4.1.2 Education, R&D and the Eco-efficient Economy on the agenda of the Swedish Presidency

Also in the second half of 2009 Euromines and ETP SMR significantly contributed to the organisation of conferences which had one main goal: to further support the Raw Materials Initiative. The first conference **"Sustainable Mineral Resources within EU: European higher education and research on metallic and mineral raw materials"** was organised in Sweden in Luleå, 12 – 14 October 2009, by Luleå University of Technology, County Administrative Board of Norrbotten, Swedish Mining Research – MITU/Bergforsk and the European Technology Platform on Sustainable Mineral Resources (ETP SMR). This conference was an official Swedish EU presidency conference and the only one fully devoted to raw materials research and education.

The second conference, again official conference of the Swedish Presidency, **"Eco-efficient Economy – Towards Innovative and Sustainable Competitiveness"** took place in Linköping, Sweden, 2 – 3 November, 2009. This High-level Conference offered a unique opportunity to discuss and demonstrate how policy, new business models, energy and resource efficiency and eco-innovation can drive sustainable European competitiveness and stimulate the creation of jobs and businesses



#### 4.1.3 Spanish Presidency providing further support for the RMI

In June 2010 another conference will be organized to further support the Raw Materials Initiative. The "European Minerals Conference Madrid 2010" is organised by the extractive industry representatives both at European and at Spanish level and is included in the official conference programme of the EU Spanish Presidency with the support of the Spanish Ministry for Industry, Tourism and Commerce.

This event will be another great opportunity to discuss and to share views, between the European Commission, Member States, other administrations, extractive industry CEOs and other stakeholders – looking at the expected development of the Communication and its benefits for the EU economy and the industry, especially focusing on the access to resources from the industrial, land planning and environment point of view.

Representatives of the Spanish Ministry for Industry, Tourism and Commerce and of the European Commission will participate to this conference as the key speakers. Other relevant speakers will be the Members of the European Parliament, Member States representatives, extractive industry high level representatives, both at European and Spanish level. "Madrid Raw Materials Declaration 2010" will be the final document of this Conference.

#### European Minerals Conference Madrid 2010

**The EU Raw Materials Initiative:  
Sustainable access to resources in Europe**

16, 17 and 18 June 2010, Madrid (Spain)



### **Luleå Declaration: Promoting the Raw Materials Initiative**

- *A future society without minerals and metals is unthinkable.*
- *The global growth of population and of the world economy demands a strong emphasis on securing future mineral supply.*
- *There is a great potential for sustainable supply of raw materials from EU resources, but we need access to land, an improved knowledge base and R&D to improve methods for exploration, extraction and recycling.*
- *European companies are highly competitive and (high-tech) technology providers for the world. It is important that the mineral sector is recognized in the EU land access planning and in the EU R&D programs for maintaining this leadership. The development of a pan-European "Europe beneath our feet" knowledge base on the geology and mineral resources needs to be supported jointly by the European Commission and the Member States.*
- *The future mineral supply is a grand challenge for society at large. The extractive industry, academia and geological surveys are committed to contribute to sustainable mineral supply and meeting future challenges by excellent R&D. Improved transparency and simplifications are necessary in the mechanisms and administrative procedures governing EU-funded research.*
- *A sustainable supply of minerals and metals needs to be eco-efficient. This can be achieved by improved resource and energy efficiency and by increased use of secondary raw materials.*





## 4.2 Preparing inputs for the final communication 2 expert working groups

### **Defining "criticality" of raw materials supply**

As a first step the created expert working group of criticality defined and analysed the "criticality" of raw materials for the EU economy, that is their importance for the EU's GDP and the supply risk related to each raw material.

The Fraunhofer Institute was appointed as consultant to screen the chosen 39 minerals against these criteria. Each of the raw materials will be treated in a separate analysis allowing for quantitative and qualitative assessments.

The question of environmental risks related to resource use will be treated separately.

### **Defining best practices in land-planning, authorisation and permitting**

The second expert working group conducted a European wide survey amongst industry and Member States to identify best practices in land-planning. Land use planning generally aims to optimise land resource use for the benefit of society, both now and into the future. In order to achieve this, good land use planning practice demands a rigorous decision-making framework that is informed by adequate knowledge and stakeholder consultation. Land Use Consultants plc was appointed as a consultant to synthesize and compile existing good practices amongst the Member States.

Both working groups are expected to table their reports in April/May 2010 with the aim to present these reports on the occasion of the Madrid conference on raw materials under the Spanish presidency in June 2010.

### **Compatibility of extractive operations and nature protection**

*There is a need to work effectively with governments and local communities to improve environmental performance and to raise the bar on good practices across the industry. To this end, Euromines worked closely with the ICMM & IUCN to publish good practice guidance on mining and biodiversity in 2006.*

*However, there is still much room for improvement across the sector and one of the elements to be delivered under the Raw Materials Initiative is a guidance note on compatibility of Natura 2000 and the extractive industry. DG Environment has been working through 2009 to complete its consultation with various stakeholders on the subject.*

*The Euromines Resource-Access Committee brought its experience from development of the ICMM guidance and continued to highlight throughout the process the need for scientifically sound and equitable decision-making processes that better integrate biodiversity conservation and mining into land-use management within the Member States. This might involve the "protection" of areas of geological potential in the way that areas of archaeological potential are currently considered – so that "rescue" exploration work can be carried out before any sites are sterilised. It should also incorporate the use of biodiversity offsets as mitigation measures under the EU Habitats Directive. It was previously agreed that the future Guidance on Development of Non-Energy Extractive Activities in Accordance with the Natura 2000 Provisions would leave this particular issue open to further dialogue and interpretation work, which the Resource-Access Committee will be committed to in future. This guidance note will now be available in 2010.*



# 5. Materials Stewardship from cradle to grave

# REACH

## 5.1 Metals and Minerals as safe substances

Chemicals Management

### 5.1.1 REACH – preparing for the 2010 deadline

2009 was the launch year for many activities in the context of REACH. Although ores and concentrates were excluded from the scope of registration under this regulation, there was still a range of substances that needed to be screened and some of them needed to get ready for the registration process.

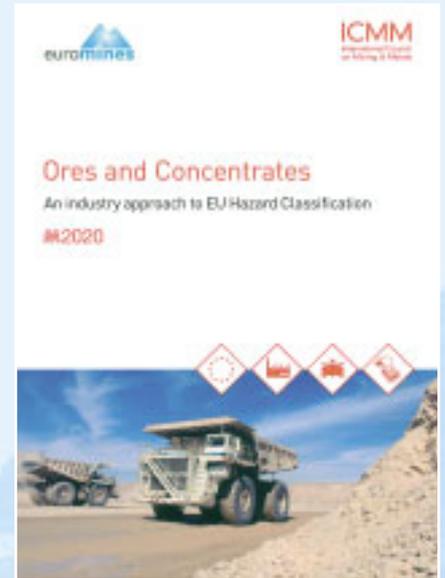
Numerous consortia initiated SIEF meetings with all the other pre-registrants and developed their substance IDs, testing strategies, etc.

Whilst all this was ongoing, the Euromines Environment Committee was involved in preparing input for a raft of influential decisions which continued to be made throughout the year in Brussels and Helsinki. This was mainly being done through the REACH Alliance, which has direct representation in a number of important fora where the European Commission, the European Chemicals Agency and Member States continue to discuss outstanding issues around the interpretation of the REACH Regulation.

In addition, the Euromines Secretariat provided advice on many related questions from EU and non-EU companies that were trying to cope with the complexity of the regulations and its requirements.



photo © Micolte Gaëtan, European Chemicals Agency



### 5.1.2 EU Hazard Classification and labelling (CLP)

*In 2009 Euromines was supporting the implementation of materials stewardship principles within European mining companies. Materials Stewardship is the responsible provision of materials and supervision of material flows towards the creation of maximum societal value and minimum impact on man and the environment. It is about understanding the nature of the material; developing relationships with those who can assist in minimising risks; and taking the necessary actions to ensure that risks are adequately controlled.*

*Euromines members have been working for the last three years towards an internal review of current practices and a significant milestone was reached at the end of 2009, with a joint electronic publication with ICMM on "Ores and Concentrates: An industry approach to EU Hazard Classification".*

*During 2008/09, a number of other studies were done with the aim of developing guidance for members on how to enhance relationships with those who can assist in minimising risks associated with the transport of ores & concentrates; and taking the necessary actions to ensure that risks are adequately controlled throughout their respective life-cycles. Euromines will continue its collaboration with the ICMM to have this documentation published.*

## 5.2 Metals and Minerals extraction as a safe operation

*Addressing safety issues in and around the installations*

### 5.2.1 Review of the Seveso Directive

*The EU Seveso II Directive which is aiming at preventing major severe industrial accidents is in the process of being adapted to be consistent with the new CLP Regulation. Meanwhile a consultant to the Commission has recommended that the scope of the Directive needs to be extended in the longer term. The inclusion of new substances could be the aim of the Commission.*

*A second study on the effectiveness of Directive and its implantation in the Member States will be finalised and published in the near future and a new Communication is expected to be published during 2010. Since some of the extractive industry's installations come under this directive Euromines will be following this potential revisions carefully.*



## 5.2.2 Explosives Directive and Action Plan

In 2009 the EU continued its work on enhancing the security of explosives which is a measure to address safety issues and terrorism and aims at reducing the access to explosives and facilitate the traceability of these.

The Action Plan is based on prevention, detection and response measures on explosive precursors, the supply chain and traceability.

One key element of the Directive is the labelling of detonators which should have unique coding for traceability. Commission and Member States hope that with such unique codes the security of explosives would be much improved. Euromines, a stakeholder in the debate, took the opportunity to discuss the issue of a unique labelling of explosives with FEEM (Federation of European Explosives Manufacturers).

## 5.2.3 Guidance Note on the FEEM European Explosives Code

The Federation of Explosive Manufacturers developed a Guidance document with a method to achieve a harmonised system for the purpose of implementing the European Commission's Directive 2008/43/EC. The system being recommended is not binding, but the adoption and adherence to it shall minimise logistical problems throughout civil explosives supply chains in Europe. It is also available for others to adopt should such a system be seen as beneficial. This guidance note is a great step forward in order to harmonise in the use of explosives and detonators in the European Union and does address some of the concerns that the industry had with regard to the potential costs.

## 5.3 Addressing safety issues at the workplace

### 5.3.1 Status report on OEL discussions

The industry continues to be involved in the discussions on the methodology of OEL setting as well as on particular OELs, such as NO<sub>2</sub> and NO. In 2008 ICMM published its Guidance on OEL setting as a contribution to the debate in many countries around the world on how to establish best occupational exposure limit values.

In the EU the third list of occupational exposure limit (OEL) values for a range of substances has been adopted on the 19th of December 2009 by the European Commission and went into force on the 8th of January 2010. It will amend Directive 98/24/EC on the protection of workers from chemical agents at work. The Member States have to transpose the Directive into national law by the 18th of December 2011. The European Commission is assisted – when making the list – by the Scientific Committee for Occupational Exposure Limits to Chemical Agents (SCOEL).

In the meantime in the continuous effort to improve the workplaces – the industry attends to systematically to reduce its emissions at the workplace.



### 5.3.2 NEPSI agreement

The European Social Dialogue "Agreement on Workers' Health Protection through the Good Handling and Use of Crystalline Silica and Products Containing" was signed in April 2006 by the representatives at European level of the Employees and Employers of 14 industry sectors. In June 2009, the Expanded Clay industry sector signed the Agreement, which now represents 15 industrial sectors.

The signatories (16 Trade Associations and 2 Union Federations) agreed that quantitative information on the application of the Agreement within each of the sectors they represented would be collected for the first time in 2008 and every two years from then on. The next report will have to be prepared in 2010. The information will be collected at site level and consolidated into EU signatory sector report, to form the basis for a NEPSI Summary report addressed to the European Commission. 2009 was a year in which many national federations held promotional activities and seminars with regard to the Good practice guidance. This is reflected in the preliminary response rate at the beginning of 2010 which shows a considerable increase (more than 50%) in covered sites amongst the Euromines members

The total number of employees covered through the reporting on these sites has more than doubled in the 2010 reporting. These efforts will continue in 2010.





### 5.3.3 Addressing accident prevention

Since 2008 the European Sectoral Social Dialogue on the Extractive Industry is engaged in a proactive project which is aimed at recognising trends in accidents, causes and promoting relevant guidelines and best practices and disseminating related guidance, mainly addressing two groups of workers, identified as most vulnerable: Young (inexperienced) workers and Contractors.

Key conclusions were that there are a number of issues around the definitions used, the availability of statistics, cultural habits and finally the company culture.

Overall it could be stated that whilst there were actually very few issues with regard to the young/inexperienced workers, there were a few with regard to the contractors.

Guidance on best practice was developed and will be published in 2010 by the Social Dialogue Committee.

The outcome of the discussion can be summarised as follows:

- H&S must be a priority for the management;
- the workers must be properly trained in H&S issues;
- H&S training must be adapted to each division/task;
- A good H&S document is a document which is understood by all workers of the company; it must be concise, short and clear;
- Risk assessment must be an issue for all employees and not only for the management;
- Each accident requires a revision of the risk assessment which should be open to all workers;
- A risk assessment should be elaborated together with workers and supervisors, workers must feel involved.

Accident prevention has a high priority in companies throughout Europe and the latest mine accidents in Turkey and Slovakia have triggered new discussions also with the SWP Extractive industry in Luxembourg which will be addressing some of the issues around methane explosions in their new work programme in 2010.



## 5.4 Eco-efficiency – waste management

### **Mine Waste Directive and standards for waste characterisation**

The Mine Waste Directive calls for European standards for waste characterisation, which are now being prepared by the European Centre for Norms (CEN) as mandated by the European Commission.

Over the past four years (at least), the Euromines Environment Committee has been an active contributor to the process, which has so far included two international workshops on acid generation behaviour; a comprehensive review of existing standards; the development of draft guidelines for overall understanding of mine-waste characterisation processes; the preparation of typical mine waste sampling scenarios; and publication of a preliminary European Norm (prEN15875) on Static testing for determination of acid potential and neutralization potential of sulfidic mine waste. Additionally, methods for monitoring cyanide emissions from processing plants are being formalised into a CEN Technical Specification. Final drafts for most of these should be delivered in 2010.

### **Safe storage of metallic mercury**

Towards the end of 2009, Euromines contributed to a formal stakeholder consultation on storage options for waste metallic mercury. Export of mercury, cinnabar ore, mercury (I) chloride and mercury (II) oxide is banned by Regulation (EC) No. 1102/2008 as of 15 March 2011. As of that date, "mercury gained" from the non-ferrous metals sector must be stored according to rules that will be developed following the consultation. The European Commission will now form a Technical Adaptation Committee to agree storage standards before the end of 2010. Their initial studies have suggested that disposal of liquid mercury in salt-mines is the most cost-effective immediate solution.



## Review of the European Waste List

The European Commission wishes to strengthen the link between chemicals and hazardous waste classification, which may mean that hazardous waste code H15 will apply to a greater number of extractive wastes (e.g., those that produce a leachate which can itself be classified "H14 – eco-toxic"). Euromines will contribute to the review of the list over the following months.

## 5.5 Eco-efficiency – water consumption

In 2009, most Member States had presented their draft River Basin Management Plans in compliance with the Water Framework Directive (WFD). Contamination of surface water bodies by point sources of pollution is reported to be the second most important water management issue across the EU (and mines are the least quoted point source), so consultation of our industry in deciding the measures to be taken will be important.

The Euromines Environment Committee continued to support implementation of the WFD, by contributing to the review of draft guidance on sediment and biota monitoring and on the identification of allowable mixing zones in surface water bodies.

Meanwhile, the Euromines Resource-Access Committee has been following debates around competition for access to land & water; the role of land-use planning and the role of partnership with local communities. For example, Euromines contributed to a scoping exercise funded by the International Council of Mining & Metals to identify priority water issues and current strategies and tools for addressing those issues. The result was that an ICMM task force will internationally pilot a water accounting framework that has been developed by the Minerals Council of Australia and which should be particularly useful in the context of measures taken by EU Member States to implement their River Basin Management Plans according to their best estimates of the volume, prices and costs associated with water services.



## 5.6 Eco-efficiency – energy consumption and climate change

2009 was a very important year with regard to the EU's efforts to combat climate change. A series of legislative initiatives were being discussed and – apart from the negotiations in Copenhagen - this included the EU's ETS directive and the proposal of revising the EU's Energy taxation directive.

### 5.6.1 Emission Trading Scheme: Carbon Leakage and Benchmark methodologies

Whilst committed to combating climate change 2009 was the year in which all industrial sectors had to convince the European Commission and Member States that the impact of the adopted ETS directive would have detrimental impact on the industrial sectors in Europe in comparison to their international competition which did not have to comply with equivalent measures in place.

The various sectors in Euromines encountered a number of problems with the Commission's approach, be it due to the low number of installations still existent in Europe, or due to the fact that the potential costs for ETS allowances that will have to be bought in 2013 will seriously jeopardize the competitiveness of the European operations in comparison to their international competitors.

The discussions therefore have to be continued in 2010 before the Member States will adopt the final rules for all the sectors and the allocations amongst them.

### 5.6.2 Establishing a new ETS for NO<sub>x</sub> and SO<sub>2</sub>

The industry is very concerned that following the adoption of an ETS system for CO<sub>2</sub> the Commission is considering introducing a system on emission trading for NO<sub>x</sub> and SO<sub>2</sub>. Industry has been opposing this strongly since it would place an additional burden which cannot easily be digested under the current economic climate and in light of the fact that continues efforts have been made to implement VAT.

Euromines opposed this proposal since it will impact mainly on those sectors which already have to suffer from the ETS on CO<sub>2</sub>.

### 5.6.3 Revision of the EU Directive on Energy Taxation (ETD)

Already from the very beginning the ETD caused many critical voices across the industry sectors and led to a huge opposition against another additional burden, which will weaken the industry all over Europe. In the second half of 2009 an unofficial draft of the revision of the ETD by the European Commission circulated indicating the commission's intention to change the taxation from a unit based to a CO<sub>2</sub>-related taxation. This would favour in Europe those installations that can rely on hydropower, nuclear or alternative energy sources.

Since this would be a proposal on taxation it would require unanimity in the Council of Ministers and it remains to be seen whether the Member States can agree to such a switch of the taxation.



## Euromines Members 2009

### ■ Fachverband Bergwerke und Stahl

**Mr Roman Stiftner**  
Wiedner Hauptstraße 63  
AT-1045 Wien  
**Austria**  
Tel.: 00 43 590 900 33 10  
Fax: 00 43 590 900 33 78  
web: <http://www.bergbaustahl.at>  
e-mail: [roman.stiftner@wko.at](mailto:roman.stiftner@wko.at)

### ■ Bulgarian Mining Chamber

**Mr Latchezar Tsotsorkov**  
205, Al. Stambolijski Boulevard  
Office 30  
BG-1309 Sofia  
**Bulgaria**  
Tel.: 00 359 28 22 93 72  
00 359 22 29 37 3  
Fax: 00 359 28 22 93 73  
00 359 29 20 18 57  
web: <http://www.bmc-bg.org>  
e-mail: [bmc@mb.bia-bg.com](mailto:bmc@mb.bia-bg.com)

### ■ Těžební unie / Mining Union

**Ms Milena Šandová**  
Slavičkova 827/1a  
CZ-638 00 Brno  
**Czech Republic**  
Tel.: 00 420 545 193 411  
Fax: 00 420 545 211 014  
web: <http://www.tezebni-unie.cz>  
e-mail: [unie@tezebni-unie.cz](mailto:unie@tezebni-unie.cz)

### ■ FinnMin

**Mr Olavi Paatsola**  
Runkopolku 4  
SF-71800 Siilinjärvi  
**Finland**  
Tel.: 00 358 174 624 784  
Fax: 00 358 174 624 784  
web: <http://www.teknologiateollisuus.fi>  
e-mail: [olavi.paatsola@dnainternet.net](mailto:olavi.paatsola@dnainternet.net)

### ■ Verband der Kali- und Salzindustrie e.V.

**Mr Hartmut Behnsen**  
Reinhardtstrasse 18a  
DE-10117 Berlin  
**Germany**  
Tel.: 00 49 30 847 10 69 10  
Fax: 00 49 30 847 10 69 21  
web: <http://www.vks-kalisalz.de>  
e-mail: [hartmut.behnsen@vks-kalisalz.de](mailto:hartmut.behnsen@vks-kalisalz.de)

### ■ Vereinigung Rohstoffe und Bergbau

**Dr Norbert Schächter**  
Am Schillertheater 4  
DE-10625 Berlin  
**Germany**  
Tel.: 00 49 30 31 51 82 41  
Fax: 00 49 30 31 51 82 52  
web: <http://www.v-r-b.de>  
e-mail: [n.schaechter@wv-bergbau.de](mailto:n.schaechter@wv-bergbau.de)

### ■ Greek Mining Enterprises Association

**Mr Christos Kavalopoulos**  
10, Vassileos Georgiou B & Rigilis Street,  
GR - 106 74 Athens  
**Greece**  
Tel.: 00 30 210 363 83 18  
Fax: 00 30 210 363 40 19  
web: <http://www.sme.gr>  
e-mail: [sme@hol.gr](mailto:sme@hol.gr)

### ■ Hungarian Mining Association

**Dr Akós Zoltay**  
Margit Circle 85  
H-1024 Budapest  
**Hungary**  
Tel.: 00 36 133 678 01  
Fax: 00 36 133 678 01  
e-mail: [akos.zoltay@t-online.hu](mailto:akos.zoltay@t-online.hu)

### ■ Irish Mining Exploration Group

**Mr Robert O'Shea**  
Confederation House  
84/86 Lower Baggot Street  
EL-Dublin 2  
**Ireland**  
Tel.: 00 353 1 605 1526  
Fax: 00 353 1 638 1526  
web: <http://www.ibec.ie>  
e-mail: [robert.oshea@ibec.ie](mailto:robert.oshea@ibec.ie)

### ■ Norsk Bergindustri Norwegian Mining and Quarrying Industries

**Ms Elisabeth Gammelsæter**  
Næringslivets Hus, Middelthunsgt 27  
Postboks/P.O. Box 7072 Majorstuen,  
N-0306 Oslo  
**Norway**  
Tel.: 00 47 23 08 88 40  
web: <http://www.norskbergindustri.no>  
e-mail: [eg@norskbergindustri.no](mailto:eg@norskbergindustri.no)

### ■ Związek Pracodawców Polska Miedź Employers' Association of Polska Miedź

**Mr Rafał Szkop**  
ul. Marii Skłodowskiej-Curie 90  
59-301 Lubin  
**Poland**  
Tel.: 00 48 0 76 847 85 85 6  
Fax: 00 48 0 76 847 85 85 8  
web: [www.pracodawcy.pl](http://www.pracodawcy.pl)  
e-mail: [sekretariat@pracodawcy.pl](mailto:sekretariat@pracodawcy.pl)

### ■ ANIET - Associação Nacional da Indústria Extractiva e Transformadora

**Ms Francelina Pinto**  
N.º Contribuinte 501 419 411  
Sede: Rua Júlio Dinis, 931 1.º Esquerdo  
4050-327 Porto  
**Portugal**  
Tel.: 00 351 22 609 66 99  
Fax: 00 351 22 606 52 06  
web: <http://www.aniet.pt>  
e-mail: [geral@aniet.pt](mailto:geral@aniet.pt)

### ■ Slovak Mining Chamber

**Mr Fedor Boroška**  
Matica Slovenskej, c.10  
SK - Prievidza 97101  
**Slovak Republic**  
Tel.: 00 421 46 54 21 682  
Fax: 00 421 46 54 21 682  
web: <http://www.hbp.sk>  
e-mail: [sbk@hbp.sk](mailto:sbk@hbp.sk)

### ■ SVEMIN - Swedish Association of Mines, Mineral and Metal Producers

**Mr Tomas From**  
Kungsträdgårdsgatan 10  
P.O. Box 1721  
S-11187 Stockholm  
**Sweden**  
Tel.: 00 46 8 762 67 15  
Fax: 00 46 8 611 62 64  
web: <http://www.svemin.se>  
e-mail: [tomas.from@svemin.se](mailto:tomas.from@svemin.se)

### ■ IMMIB - Istanbul Mineral and Metals Exporters' Association

**Mr Mutlu Öktem**  
DİP TİYARET KOMPLEKSİ  
A-Blok Çoğançepme Mevkii  
Sanay Cad.  
Yenibosna Bahcelievler  
TR-345 30 Istanbul  
**Turkey**  
Tel.: 00 90 212 454 0000  
Fax: 00 90 212 454 0001  
web: <http://www.immib.org.tr>  
e-mail: [immib@immib.org.tr](mailto:immib@immib.org.tr)

### ■ Turkish Miners Enterprises Association

**Mr Ismet Kasapoglu**  
İstiklal Caddesi Tunca  
Apt.No: 47/1-1 Tünel, Beyoğlu  
TR-34840 Istanbul  
**Turkey**  
Tel.: 00 90 212 245 1503  
Fax: 00 90 212 293 8355  
e-mail: [turkiyemaden@ixir.com](mailto:turkiyemaden@ixir.com)

### ■ Mining Association of the United Kingdom

**Mr Robert Fenton**  
78 Copt Heath Drive Knowle  
West Midlands  
GB-B939PB Solihull  
**United Kingdom**  
Tel.: 00 44 1564 20 50 79  
Fax: 00 44 1564 20 50 79  
web: <http://www.mauk.org.uk>  
e-mail: [bob.fenton@mauk.org.uk](mailto:bob.fenton@mauk.org.uk)

### ■ Anglo American Plc

**Mr John Groom**  
20 Carlton House Terrace, St. James  
GB-SW1Y 5AN London  
**United Kingdom**  
Tel.: 00 44 207 698 8732  
Fax: 00 44 207 698 8560  
web: <http://www.angloamerican.co.uk>  
e-mail: [jgroom@angloamerican.co.uk](mailto:jgroom@angloamerican.co.uk)

### ■ Boliden AB

**Mr Pierre Heeroma**  
PO Box 44  
SE-10120 Stockholm  
**Sweden**  
Tel.: 00 46 8610 1528  
Fax: 00 46 8315545  
web: <http://www.boliden.com>  
e-mail: [pierre.heeroma@boliden.com](mailto:pierre.heeroma@boliden.com)

### ■ Cleveland Potash Ltd

**Mr David Pybus**  
Boulby Mine  
Loftus Saltburn-by-the-Sea  
GB-Cleveland TS13 4UZ  
**United Kingdom**  
Tel.: 00 44 12 87 64 01 40  
Fax: 00 44 12 87 64 09 34  
web: <http://www.clevelandpotash.ltd.uk>  
e-mail: [david.pybus@clevelandpotash.co.uk](mailto:david.pybus@clevelandpotash.co.uk)

### ■ Dundee Precious Metals Inc.

**Mr Jonathan Goodman**  
200 Bay Street, Ste. 3060  
Royal Bank Plaza, South Tower  
CAN - ON M5J 2J1 Toronto  
**Canada**  
Tel.: 001 416 365 24 08  
Fax: 001 416 365 56 31  
web: <http://www.dundeeprecious.com>  
e-mail: [jgoodman@dundeeprecious.com](mailto:jgoodman@dundeeprecious.com)

■ **European Goldfields Services**

**Mr David Reading**

Level 3, 11, Berkeley Street  
GB -London W1J 8DS

**United Kingdom**

Tel.: 00 44 20 74 08 95 34  
Fax: 00 44 20 77 63 71 49  
web: <http://www.egoldfields.com>  
e-mail: [dr@egoldfields.com](mailto:dr@egoldfields.com)

■ **Iberpotash**

**Mr David Pybus**

Boulby Mine  
Loftus Saltburn-by-the-Sea  
GB-Cleveland TS13 4UZ

**United Kingdom**

Tel.: 00 44 12 87 64 01 40  
Fax: 00 44 12 87 64 09 34  
web: <http://www.clevelandpotash.ltd.uk>  
e-mail: [david.pybus@clevelandpotash.co.uk](mailto:david.pybus@clevelandpotash.co.uk)

■ **KGHM Polska Miedz**

**Dr Ing. Herbert Wirth**

Ul. Marii Skłodowskiej Curie 48  
PL-59-301 Lubin

**Poland**

Tel.: 00 48 76 84 78 836  
00 48 71 78 12 357  
Fax: 00 48 76 84 78 500  
00 48 71 78 12 357  
web: <http://www.kghm.pl>  
e-mail: [h.wirth@kghm.pl](mailto:h.wirth@kghm.pl)

■ **Koza Altin Sirketi -**

**Ovacik Altin Madeni**

**Mr Ismet Sivrioglu**

P.K: 14-15, Bergama  
TR - 35700 Izmir

**Turkey**

Tel.: 00 90 23 26 41 85 18  
Fax: 00 90 23 26 41 80 19  
e-mail: [ismet.sivrioglu@ovacik-altin.com](mailto:ismet.sivrioglu@ovacik-altin.com)

■ **LKAB**

**Mr Anders Furbeck**

Varvsgatan 45, Box 952  
SE-97128 Luleå

**Sweden**

Tel.: 00 46 92 03 81 78  
Fax: 00 46 70 31 96 113  
web: <http://www.lkab.com>  
e-mail: [anders.furbeck@lkab.com](mailto:anders.furbeck@lkab.com)

■ **Lundin Mining Corp.**

**Mr Peter Nicoll**

Hovslagargatan 5  
S-111 48 Stockholm

**Sweden**

Tel.: 00 46 8-550 560 00  
Fax: 00 46 8-550 560 01  
web: [www.lundinmining.com/s/Home.asp](http://www.lundinmining.com/s/Home.asp)  
e-mail: [ka.waplan@lundinmining.com](mailto:ka.waplan@lundinmining.com)

■ **Magnesitas de Rubian**

**Mr Eduardo Jimenez Dominguez**

Ctra. Comarcal 546, Km. 35  
ES-27341 Vila De Mouros (O Incio)  
E-27341 Lugo

**Spain**

Tel.: 00 34 982 42 42 11  
Fax: 00 34 982 42 42 50  
web: <http://www.mgr.es>  
e-mail: [comercial@mgr.es](mailto:comercial@mgr.es)

■ **Magnesitas Navarras S.A.**

**Mr Nicolas Gangutia**

Avenida Roncesvalles, s/n, Zubiri  
ES-31630 Navarra

**Spain**

Tel.: 00 34 948 42 16 17  
Fax: 00 34 948 30 42 53  
web: <http://www.magnesitasnavarras.es>  
e-mail: [n.gangutia@magnesitasnavarras.es](mailto:n.gangutia@magnesitasnavarras.es)

■ **Magnezit Group**

**Mr Sergey Odegov**

Bld. 2, 2, Paveletskaya pl.  
RUS - 115054 Moscow

**Russia**

Tel.: +7 49 57 83 70 91  
Fax: +7 49 57 83 70 94  
e-mail: [sodegov@magnezit.com](mailto:sodegov@magnezit.com)

■ **Nedmag Industries**

**Mr Paul Schipper**

Billitonweg 1, P.O.Box 241  
NL-9640 AE Veendam

**The Netherlands**

Tel.: 00 31 598 651 200  
Fax: 00 31 598 452 484  
web: <http://www.nedmag.nl>  
e-mail: [o.krediet@nedmag.nl](mailto:o.krediet@nedmag.nl)

■ **New World Resources N.V**

**Ms Petra Mašínová**

Jachthavenweg 109h  
1081 KM Amsterdam

**The Netherlands**

Tel.: 00 420 225 282 163  
Fax: 00 420 225 282 110  
web: <http://www.okd.cz/en/>  
e-mail: [Petra.Masinova@okd.cz](mailto:Petra.Masinova@okd.cz)

■ **Rio Tinto Plc**

**Mr Shaun Stewart**

6, St. James's Square  
GB-SW1Y4LD London

**United Kingdom**

Tel.: 00 44 207 753 23 48  
Fax: 00 44 207 753 22 88  
web: <http://www.riotinto.com>  
e-mail: [shaun.stewart@riotinto.com](mailto:shaun.stewart@riotinto.com)

■ **Tournigan Energy Ltd.**

**Mr Boris Bartalský**

24th floor  
1111 West Georgia Street  
CAN - BC V6E 4M3 Vancouver

**Canada**

Tel.: 00 42 19 11 90 45 09  
web: <http://www.tournigan.com>  
e-mail: [bartalskyb@mail.t-com.sk](mailto:bartalskyb@mail.t-com.sk)

■ **Barytes Association**

**Mr Peter Huxtable**

12, Avenue de Broqueville  
B-1150 Brussels

**Belgium**

Tel.: 00 44 41 14 92 37 8  
Fax: 00 44 14 33 63 98 79  
web: <http://www.barytes.org>  
e-mail: [barytes@aol.com](mailto:barytes@aol.com)

■ **Euroslate**

**Mr Andreas Jäger**

Barbarastrasse 3  
DE - 56727 Mayen

**Germany**

Tel.: 0049 265 195 51 12  
Fax: 0049 265 195 52 00  
web: <http://www.euroslate.org>

■ **BRGM**

**Mr Patrice Christmann**

3, Avenue Claude-Guillemin  
BP 36009, Cedex 2  
FR-45060 Orléans

**France**

Tel.: 00 33 2 38 64 34 93  
Fax: 00 33 2 38 64 38 61  
web: <http://www.brgm.fr>  
e-mail: [p.christmann@brgm.fr](mailto:p.christmann@brgm.fr)

■ **Consulting Kent**

**Mr Mike Cambridge**

51 Albert Road Ashford  
GB-TN248NU Kent

**United Kingdom**

Tel.: 00 44 12 33 64 61 86  
Fax: 00 44 12 33 64 61 86  
web: [www.cantabkent.co.uk](http://www.cantabkent.co.uk)  
e-mail: [mcambridge@cantabkent.co.uk](mailto:mcambridge@cantabkent.co.uk)

■ **CyPlus GmbH**

**Mr Frank Harenburg**

Rodenbacher Chaussee 4  
DE-63457 Hanau

**Germany**

Tel.: 00 49 61 81 59 69 27  
Fax: 00 49 61 81 59 69 40  
web: <http://www.cyplus.com>  
e-mail: [frank.harenburg@cyplus.com](mailto:frank.harenburg@cyplus.com)

■ **MEED - Matières Premières, Eau, Environnement**

**Mr Alain Louis Dangeard**

51 Rue Spontini  
FR-75116 Paris

**France**

Tel.: 00 33 1 47 04 42 37  
Fax: 00 33 1 47 55 67 23  
web: <http://www.cerna.ensmp.fr>  
e-mail: [aldan@wanadoo.fr](mailto:aldan@wanadoo.fr)

■ **Natural Resources GP**

**Mr Vasili Nicoletopoulos**

11 Maiandrou St.  
GR - 115 28 Athens

**Greece**

Tel.: 0030 210 724 18 86  
Fax: 0030 210 724 12 92  
e-mail: [vasili@hellx.gr](mailto:vasili@hellx.gr)

■ **Euromines National Federations**

■ **Euromines Member Companies**

■ **Euromines Associate Federations**

■ **Euromines Associate Companies**



*European Association of Mining Industries,  
Metal Ores & Industrial Minerals*

*12, Avenue de Broqueville  
B-1150 Brussels  
Belgium*

*[www.euromines.org](http://www.euromines.org)  
Tel.: +32 2 775 63 31  
Fax: +32 2 775 63 03*