

Issues concerning strategic metals: the case of rare earth elements

Public hearing organized by the Parliamentary Office for Scientific
and Technological Assessment (OPECST)

Messers Claude Birraux and Christian Kert, French MPs

Tuesday, March 8, 2011

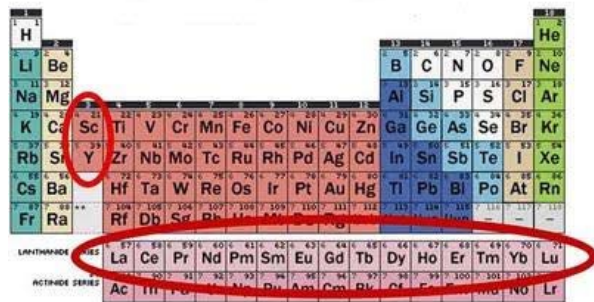
The pressure put on supplies of strategic metals, resulting from the continued growth of industrial production in emerging countries, in the course of the last decade, has demonstrated, beyond the inconveniences resulting from the increase in the price of these materials, the vulnerability of France and Europe faced with the question of their availability in the short and long term.

This public hearing organized by Messers Claude Birraux, MP, President of OPECST, and Christian Kert, MP, was intended, in particular through the example of the rare earth elements, first, to identify the impact of these supply difficulties on French industries or European ones, and, secondly, to identify possible measures that could reduce the risk of shortages or limit their effects.

The case of rare earth elements

The first round table, chaired by Mr. Christian Kert, was intended to clarify the specificities and significance of rare earth elements, shed light on how the current crisis came about in the sector, and present the solutions adopted and implemented.

Mr. Paul Caro, Member of the Academy of Technologies, a former deputy director of the Rare Earth Laboratory of the National Research Center (CNRS) first of all recalled the contribution of Swedish, American, and French scientists, especially Louis-Nicolas Vauquelin, Paul-Emile Lecoq de Boisbaudran, and George Urban, to the discovery, and the separation of the seventeen rare earth elements, before describing their particular physical and chemical characteristics.



The image shows a standard periodic table of elements. The lanthanide series (elements 57-71) and the actinide series (elements 89-103) are circled in red. The lanthanides are labeled 'LANTHANIDE SERIES' and the actinides are labeled 'ACTINIDE SERIES'.

Rare earth elements in the periodic table

Mr. Michel Latroche, Director of Research, CNRS, East Paris Institute of Chemistry and Materials, listed some of the applications of rare earth elements being studied in research laboratories, such as lasers, magnets, catalysis, ceramics, or alkaline batteries.

Mr. Benoît Richard, Strategic Director for Saint-Gobain Solar, explained, on the one hand, the superiority in performance and price of CIGS technology, based on rare metals (indium, gallium, selenium) for the manufacture of solar panels, over the technology using silicon, even if this element is abundant and inexpensive. He also commented on the approach undertaken by his firm to assess reserves, reduce consumption and, ultimately, ensure the recycling of these metals.

After a review of the historical precedents of twentieth century wars aimed at monopolizing minerals, **François Heisbourg**, Special Advisor to the Foundation for Strategic Research, highlighted how China, even though rare earth elements are present in the subsoil of many other countries, has achieved an almost world monopoly, up to 97% of their production, and acts as if they were weapons in economic terms.

Mr. Eric Noyrez, President and Chief Operating officer of Lynas Corp., justified the measures taken by China to regulate the conditions, disastrous for the environment, of the exploitation of rare earth elements, which China herself will soon be importing. The increase in the prices of these metal will henceforth offset the heavy investment costs required for setting up waste treatment facilities. Moreover, new mines should become operational in the near future in Australia and in the United States.

Mr. Frédéric Carencotte, Industrial Director of Rhodia Terres Rares, described the solutions adopted by his company to secure their supply: diversifying the deposits, in partnership with operators, such as Lynas Corp., and carrying out research on optimizing the use of rare earth elements or recycling them. He also pointed out that Rhodia Terres Rares is the only European company capable of refining and separating all the rare earth elements.

During the discussion that followed this panel, **Mr. Yves Quéré**, Member of the Academy of Sciences and GrameF stressed the decline, over the last fifteen years, of research in metallurgy and the virtual disappearance of training in this discipline.

What is the outlook for strategic metals?

The second panel broadened the scope of the debate, by raising questions so as to identify which metals were essential to our industry and how to ensure their supply.

Mr. Eric Besson, Minister within the Ministry of the Economy, Finance and Industry, in charge of Industry, Energy and the Digital Economy, laid out the five main points of the scheme of action developed by the Government to secure supply for French industries: learn more about the metals necessary for industry, consolidate the mining industry, promote savings and recycling, strengthen international cooperation, and open up the services in charge of Mining and Metals. In this context, the Minister announced the imminent setting up of the Committee for strategic metals (COMES), responsible for implementing and monitoring all these actions.

Mr. Christian Hocquard, Expert economist with the Department of Mineral Resources of BRGM, defined the two characteristics differentiating the

"critical" metals from the other rare metals: their supply vulnerability and criticality for the industry. These characteristics also account for their price volatility all the more so when they are integrated with disruptive technologies, whose particular dissemination cycle shows strong variations.

Mr. Jean-Claude Samama, former Director of the National School of Geology in Nancy and Emeritus Professor of Applied Geology, highlighted the importance, with respect to global competition, of anticipating the implementing of a process to secure the supply of critical metals, given the time necessary to activate the three complementary levers: access to mineral resources, recycling, and strategic stocks.

Mr. Benoît de Guillebon, Engineer of the Paris École centrale, director of APESA, the technological centre for the environment and risk control, and co-author of *What future for metals?*, advocated the generalization of eco-design incorporating the metal scarcity factor. The exponential increase in the use of metal by global industry requires, in fact, for extraction purposes, additional energy resources. The latter are themselves in the process of depletion.

Mr. Marcel Van de Voorde, Professor at the Delft University of Technology, confirmed that the United States and Japan were concerned, like our country, with supplying their industries with strategic metals. If the Americans formulate their strategies in secret, the Japanese have announced significant basic research programs and applied research schemes in both the field of recycling and alternatives.

Mr. Gwenole Cozigou, Director for chemical, metal, mechanical, electrical, construction, and raw materials industries within the "Enterprise and Industry" General Directorate of the European Commission, outlined the three pillars of European strategy vis-à-vis the problem of critical raw materials: access to materials outside the Union, access within the Union, as well as their efficient use and recycling.

Mr. Philippe Joly, Director of Strategy and Financial Communication of Eramet, and **Ms. Catherine Tissot-Colle**, Director of Communication and Sustainable Development of the same company, discussed the activities of their group, specialized in metal alloys, having both mineral deposits and metal production

capability, but also involved in research and development, in close collaboration with high-tech companies.

Mr. François Bersani, General Mining Engineer, General Secretary of the Committee for Strategic Metals, clarified the role of the different players involved in setting up the measures announced by the Minister of Industry: BRGM, which is updating land mineral resources, Ifremer, prospecting the sea beds, ADEME, involved in recovery and recycling, the mining schools, the universities, and CESMAT ENAG responsible for the training of engineers and geologists. These actions, coordinated by COMES, are carried out, in close collaboration with the industry, especially Areva and Eramet.

During the debate that followed this round table, Mr. Claude Birraux raised the issue of tailings. Ms. Gwenole Cozigou and Mr. François Bersani, as well as the industrialists present, agreed on the fact that legislative improvement and technical progress have allowed better control of these tailings.

Overall conclusions adopted by the Office during the meeting on June 21, 2011

The Office is used to dealing with the most diverse subjects at public hearings, and to receiving, in this context, experts in the most varied disciplines.

This public hearing was no exception to this form of eclecticism, as it brought together scientists, economists, but also industrialists, including two French ones and one Australian, an expert on geopolitical issues, and Government officials.

Many policy makers indeed became aware, in 2010, of the importance of this subject, during a border incident that occurred between China and Japan, and which led, for a few months, to a situation of embargo, jeopardizing the industrial activity of the latter country.

If this question has worried officials and industrialists so much, it is because the extraction of these metals is often controlled by a small number of countries, sometimes just one. Thus, for rare earth elements, China provides today more than 95% of world production, even though it has only one third of the reserves. This fact is all the more alarming as China did not hesitate to use its monopoly as leverage vis-à-vis Japan, and

this leverage is used constantly as a trade weapon, to force industries that use these metals to shift their production to China. In fact, China is reducing its export quotas every year, and will one day become a net importer of these materials.

During the hearing, the Office found that strategic metals, which are little known to the general public, have become essential for the development of many new technologies, such as renewable energy, due to very specific physical and chemical properties. It is very difficult for wind turbines to do without neodymium, a metal of the family of rare earth elements used in the manufacture of the most efficient turbines. The same is true for thin-film solar panels, more efficient and promising than the traditional panels made from silica.

From the different contributions, two main areas of improvement, directly interesting the Office, have clearly emerged.

The first is the inadequacy and fragmentation of training and research on strategic metals, and more particularly, on the rare earth elements.

In reality, this problem affects the entire metallurgy industry. In this connection, it is significant that no engineering school has the term metal in its title. Metallurgy has not completely disappeared from training and research, but it is now scaled down, particularly within the curriculum and the laboratories oriented towards the study of the applications of materials.

This situation appears to be all the more unsatisfactory as training and research in metallurgy continue in the U.S. and are being developed in China and in Japan. One solution in this area would be to include training and research on strategic metals, more especially on metallurgy, within the consistent cooperative framework, from which it is absent today.

The second area of improvement concerns reducing our dependence vis-à-vis these metals.

In this field, current research is mainly involved with the recycling of strategic metals. On this subject, a French industrialist, from Rhodia Rare Earths, presented results which were quite impressive. But these solutions will inevitably reach their limits, stemming from the very properties of these materials. They are used in small quantities in alloys, much like vitamins. This is obviously a problem when it comes to

recycling them. Moreover, some uses, known as dispersive uses, such as in cosmetics, inks or dyes, prohibit recycling. **That is why the reporters suggest we add to the ongoing research on the recycling of strategic metals, research into how to find substitutes for these metals, on a par with what is happening in Japan.**

Finally, at the societal level, the example of strategic or critical metals again shows that the interest of technological advances must be evaluated more comprehensively, taking into account the impact, upstream and downstream, of their production as well as all the costs incurred, environmentally and socially.

It is only a change in behavior that will allow our societies to maintain a sustainable capacity to innovate. Otherwise, we may find ourselves trapped in a vicious circle, with metal extraction requiring more and more energy. Furthermore, obtaining this energy will mobilize infrastructure increasingly consuming more and more metal.

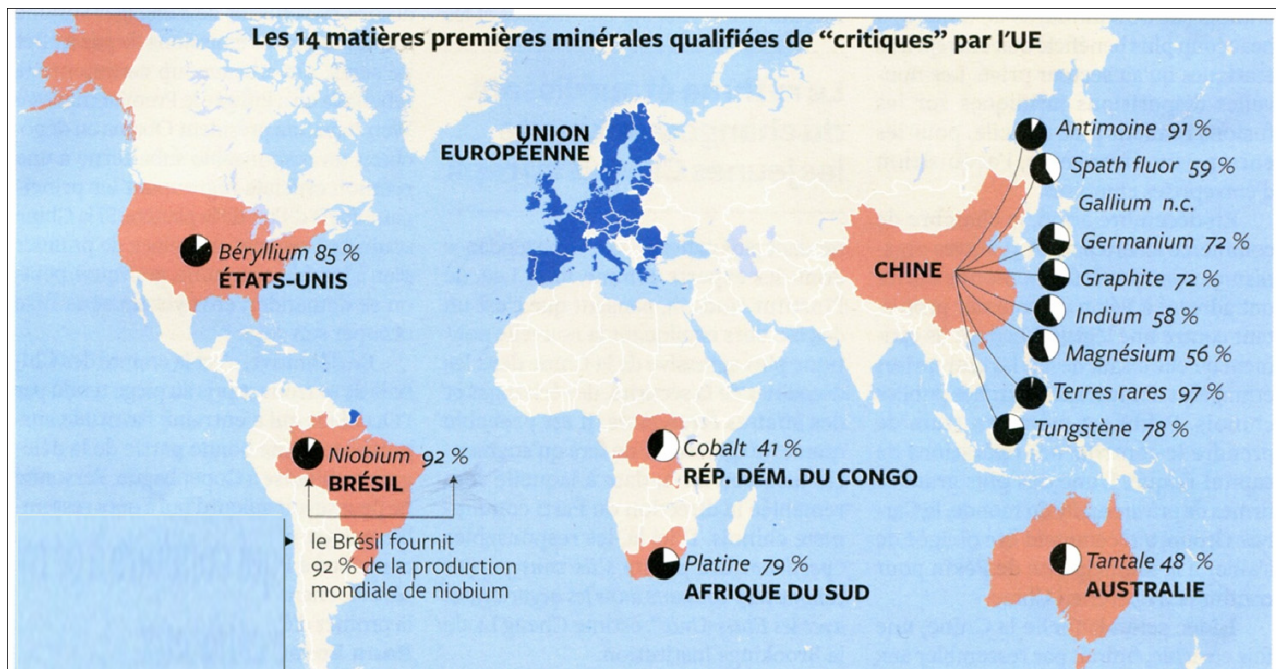
In addition, eco-design should become the norm and the traceability of products and alloys using strategic metals should be implemented to

encourage recycling. Other areas of improvement, such as identifying the needs of industry or the reconstruction of strategic reserves, which France abandoned in the mid-90s, are more directly related to government action.

During the hearing, organized by the Office, Mr. Eric Besson, Minister of Industry, announced the setting up of the Strategic Metals Committee (COMES) and the additional tasks of BRGM.

François Bersani, Secretary General of COMES, presented the first actions undertaken in this field.

As a conclusion, while we welcome the ambitious action, pledged by the Government, to ensure the supply of strategic metals for our industries, we believe that this approach would benefit from being accompanied in the field of science, by better coordination and by consolidating the means devoted to training and research in metallurgy as well as an advanced investigation into possible alternatives.



The full report in French can be downloaded at <http://www.assemblee-nationale.fr/13/rap-off/i3716.asp>
<http://www.senat.fr/rap/r10-782/r10-7821.pdf>

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