

The strategic issues concerning rare earth elements and strategic and critical raw materials

*Summary of the report carried out for the OPECST, by
Mrs. Delphine Bataille, Senator, and Mr. Patrick Hetzel, MP.*

On February 24, 2014, a referral was made to the OPECST by Mr. Daniel Raoul, Chairman of the Economic Affairs Committee of the French Senate, requesting a study on the strategic issues concerning rare earth elements, so as to “contribute to the strengthening of the competitiveness of the French economy”.

On April 16, 2014, the OPECST appointed two parliamentarians to carry out this study:

Mrs. Delphine Bataille, Senator, and Mr. Patrick Hetzel, M.P. Following a feasibility study which was approved by the OPECST on July 8, 2014, both rapporteurs set up several private hearings and two public hearings on July 6, 2015 and February 29, 2016. They also travelled to Sweden, Finland and Japan, as well as to La Rochelle in France. On May 19, 2016, the OPECST unanimously adopted their report and its fourteen proposals which are cited in this summary.

Rare earth elements: a subject whose importance is often overlooked

Rare earth elements, whose importance was highlighted in 2010 during a geopolitical crisis between China and Japan, remain relatively unknown despite their undeniable usefulness and the precautions which must be taken concerning their use.

These seventeen elements of Mendeleïev's periodic table, which were relatively recently discovered, have specific properties and uses. Their production is limited and highly concentrated and their processing and development are based on techniques which require specific precautions regarding public health and the protection of the environment. These rare earth elements are contained in ores and alloys and must be processed, in order to separate and purify them, by hydrometallurgy, by pyrometallurgy or by fine chemistry.

They fulfil an ever-growing need in many industrial areas. They are thus used to produce permanent magnets, mobile telephones, catalytic convertors, batteries for hybrid cars, large-scale wind turbines, elements for low-consumption bulbs and for light-emitting diodes (LEDs). Much progress has also been made in their use in the medical field.

Their future use is highly dependent upon the choices made by industrialists and on the development of technologies. For example, by choosing an electric engine without rare earth elements, Renault went for a different option than Nissan. Siemens has also stated that they could do without using dysprosium in the production of large-scale wind turbines. This would help to avoid substantial requests for this element which is also used in the production of mobile phones. In addition, LEDs will, in the future, replace phosphor elements in bulbs.

This development is worrying and requires to think in terms of strategic needs

The production of rare earth elements is concentrated in China, and this became particularly clear during the Sino-Japanese crisis of 2010-2011 which created a psychological shock and was felt as an alarm signal. China, in fact, produces 90% of rare earth elements and owns 50% of the world's reserves.

The huge rise in prices which resulted from the crisis did not last. The prices fell again and China, which was called into question by the World Trade Organization (WTO), abolished its quotas and its export taxes. It also reorganized its production and has been developing activities which include always more added value whilst, at

the same time, attempting to monitor deposits abroad, such as in Kvanefjeld in Greenland where the European Union was extremely naïve in its approach. This means that production and development plans outside of China have great difficulties in emerging, especially as the prices are, for the moment, insufficient.

The development of the markets for rare earth elements and for strategic and critical raw materials is thus a cause for concern. The growing demand of countries and continents which are on the road to industrialization is difficult to master. The supply will be subject to greater constraints and risks becoming even more concentrated on China.

If we think in terms of strategic needs and of criticality, we can better understand the issues at stake. Several raw materials, including rare earth elements, have a strategic interest for states and can play a critical role in industry. In addition, the European Commission considers as ‘critical’ the products which are necessary for cutting-edge industries, which are subject to an oligopoly made up of two or three producers which together make up at least 80% of world production. The combination of these two characteristics makes the problems to be solved more difficult.

It is already clear that we must be ready to prepare for the risk of scarcity in the field of non-agricultural and non-energy raw materials. Consequently, Mrs. Delphine Bataille and Mr. Patrick Hetzel have thought about the drawing-up of a list of “sensitive” products and consider strategic and critical metals as a particularly relevant case. Several countries have already adhered to this initiative.

Solutions are already being implemented

The *rapporteurs* underline that if we are faced with the risk of a scarcity of rare earth elements and of strategic and critical raw materials, two major types of solution could be implemented by the State and by companies. The first type, which is classical, has mainly already been applied. The second type requires a certain amount of imagination and a specific political will.

The solutions which are usually applied do not require any great political change. On the one hand, they involve recycling and substitution and, on the other hand, training and research.

Recycling is already an economic reality. Its interest is no longer questioned, even though it is not a panacea for both technical and economic reasons. It can develop on account of the market, but it can also develop, when it is not profitable or has not yet become a habit, through regulations. In France, such regulations already exist for batteries and accumulators. Recycling would be even more efficient if it were to become part of the circular economy. The example of Japan is excellent in this field. There, a pragmatic and pro-active policy, based on a partnership between industries and public bodies, led to the implementation of a law defining the products to be recycled: television sets, air conditioning machines, fridges and washing machines.

For the moment, substitution is in its infancy but its results can be surprising. This is the case for dysprosium, which is no longer necessary for the construction of large-scale wind turbines. Substitution, however, can only work if it allows us to obtain products of the required quality and if it is technologically possible. In Japan, the NIMS (*National Institute for Materials Science*) considers that substitution can offset the lack of recycling and the upcoming unavailability of certain critical products. Consequently, the NEDO (*New Energy and Industrial Technology Development Organization*) and the METI (*Ministry of Economy, Trade and Industry*) have developed an ambitious substitution programme concerning the electronics, automobile and industrial instruments sectors.

In this respect, the *rapporteurs* underline that a new form of dynamism must be introduced in the training field. Indeed, the situation is alarming. The future for students following a high-level education in engineering schools or in universities is not ensured, as their prospects are uncertain. Several such career paths have disappeared or are under threat and this carries the risk of losing a certain amount of know-how in the metal industry. The teaching of toxicology or mining engineering has not been sufficiently developed. Consequently, the support of public authorities is necessary to help to get through this difficult period and to provide a new impetus.

The current state of research and development is not as widespread and is less efficient than in the past, even if the involvement of research bodies remains extremely high.

Therefore, Mrs. Delphine Bataille and Mr. Patrick Hetzel judge it is necessary to support and encourage research, which has led us to make substantial progress, especially in the field of less intrusive, more miniaturized and more efficient techniques than in the past. Research in the field of toxicology should be fostered. It is also necessary to think about what can be accomplished and the means necessary to implement it, as the funding granted at a national level does not use all of the available instruments. The National Agency for Research (ANR) has no specific programme and does not play the dynamic role it has in other areas. However, the input of the National Agency for the Environment and for the Use of Energy (ADEME) is substantial. Although the funding of the European Union has been more clearly defined, especially within the framework of the Horizon 2020 programme, it does not allow the financing of projects which are really research oriented. In addition, the *rappoteurs* consider that the networks and the partnerships must be supported in their development. They raise the question of the setting-up of a raw materials “alliance”. The establishment of a federation of French actors, which is currently taking place, is another avenue of reflection.

The need to implement strategic choices

Mrs. Delphine Bataille and Mr. Patrick Hetzel recall that the drawing-up of a more ambitious strategy will require strong political decisions, especially regarding a pro-active approach to the metal and mining industries, as well as the implementation of strategic stocks and the development of a form of economic diplomacy regarding raw materials.

Developing a new mining strategy is not a pipedream as we know very well the technical, organizational, economic, financial and legal conditions necessary for the success of the investment which must be undertaken. Every mining project must take several stages into account. We need to better understand the sub-surface and this requires a targeted relaunching of prospection both in France and in Europe, as well as the drawing-up of a new mining inventory.

It appears more and more important to carry out a prospective analysis of the needs and of the regulatory context and even of the media. The market must be more transparent. New funding techniques can be found. Competitiveness must

be improved. Above all else, we must be sure of the acceptability of mining projects in order to ensure that they will last. This acceptability, which cannot be taken for granted today, as the example of the reopening of the mine at Salau (Ariège), will depend upon the initiation of a dialogue with the affected population and it must take all the generations into account.

Experiences in various countries, especially Japan, Sweden and Finland have shown the utility of the definition of a real mining strategy and the interest of the implementation of mechanisms leading to the financing of research in the field of mineral resources. This helps to underline the balance to be achieved between industry and the environment but also between economic activities and cultural values.

As in Scandinavia, it is the concept of a “green” mine or a “responsible” mine which could lead to the development of an ambitious mining project in France. In Sweden, this concept is based on the intervention of an environmental court. In Finland, it is based on public debate, launched by the Government. This represents a new approach which allows us to answer genuine concerns: how can we forecast and avoid risks? How does one deal with the situation after the closure of the mine, especially when those in charge have defaulted? How can we ensure the traceability of all the elements which make up the project, which respond, more and more often, to the requests of the eventual buyers, especially in the case of minerals emanating from conflict zones? Which balance can be found between regulation and the voluntary implementation of good practices? Which balance can be found between regulation and the market? Mrs. Delphine Bataille and Mr. Patrick Hetzel consider that the modernization of the mining code, which should now be drawn up, could be the opportunity to put this idea of responsible mining forward and to begin to implement it.

In addition, they consider that the examination of the possibility of building up strategic stocks should be implemented in order to provide answers to three crucial questions, in spite of the complexity of the situation and the cost of such stocks. 1) Can we do without certain critical raw materials if they are so strategic? 2) Are we ready to pay the price in the case of scarcity? 3) What would be the utility, the cost and the methods if we were to consider preventative stocking? The

examples provided by several countries of such a preventative stocking can answer some such concerns, either from an economic point of view, as in Japan, or from a strategic and financial point of view as in the United States, Russia, China, Korea or Finland.

In the end, the *rapporteurs* consider that French economic diplomacy can become the essential instrument for a pro-active mining policy. The bases for such a policy have been created within the French Foreign Affairs Ministry, within Business France and within the French Treasury. The examples of bilateral cooperation with Germany, Vietnam and Japan show how this can be developed and how it could be inspired by the especially ambitious German framework programme which was set up to secure Germany's raw materials supplies. French economic diplomacy could enhance the raw materials policy of the European Union, since, despite its dynamism, the Union has no real competence in this area.

Fourteen propositions

Following their analysis of the strategic issues concerning rare earth elements and strategic and critical raw materials, the *rapporteurs* put forward the following fourteen propositions:

1. The establishment of a French mining policy based on the identification of needs and resources, on the relaunching of prospection, on the drawing-up of a new mining inventory and on a deep reflection concerning modern and responsible mining.
2. The establishment of a strategy concerning rare earth elements and strategic and critical raw materials as it has been carried out in Sweden, Finland and Japan.
3. The development of the French mining sector which is essential for its industrial and economic impact as well as for its contribution to employment, growth and innovation.
4. Ensuring the supply of strategic and critical raw materials by means of active international cooperation.
5. Envisaging the stocking of the most sensitive strategic and critical raw materials.
6. The development of recycling and research into substitution products for strategic and critical raw materials.
7. Reaching, at a European level, a standardization of legislation on the transport of waste, so as to enable its recycling.
8. The increased financing of research concerning rare earth elements and strategic and critical raw materials, which should lead to significant results. The funding envisaged for the ANR and PIA programmes must be clearly set down and its complementarity with European funding must be improved.
9. The relaunching of training and education in the field of mining studies, especially in French higher education, at all levels. This should lead to the safeguarding and development of a particularly precious know-how.
10. The development of economic, regulatory and media monitoring of strategic and critical raw materials.
11. Asking the BRGM to better identify the level of needs regarding strategic and critical raw materials and the drawing-up of technical and financial mechanisms to enable stocking; asking it to carry out a monitoring mission on rare earth elements and on strategic and critical raw materials, in order to raise consciousness concerning the current situation in France, in Europe and in the world and to improve technological scrutiny.
12. The creation, at a European level, of a public investment bank, like the Japanese JBIC, which would help European companies to invest abroad in order to obtain products at a stable price and to ensure the long-term supply of critical raw materials as they are defined in the European list.
13. The development of international cooperation to measure and control the environmental impact of prospection, as well as the development of mines and deep-sea resources.
14. Strengthening the means of the IFREMER so that it can participate entirely in cooperation with Japan in the search for, and use of deep-sea resources, especially in the Asia-Pacific zone where France's presence is very important.



The report can be viewed on the website of the OPECST :
<http://www.assemblee-nationale.fr/commissions/opecst-index.asp>
<http://www.senat.fr/opecst/index.html>

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