

## CHINA'S RARE EARTH TRADE ANALYSIS

### Abstract

*In current times, eco trend is promoted in all areas, therefore finding alternative energy sources is required. Most modern technology that does not harm the environment is based on different amounts of Dysprosium, Terbium, Neodymium, and so on. Solar panels, wind turbines, hybrid cars and many other electronics such as televisions are using such elements. Respecting the principles of free trade, countries such as Japan or the U.S. imported from China large quantities of rare earth to pursue technological progress.*

*However, quantitative restrictions as export quotas imposed by this country stirred panic in the world, determining Chinese rare earths dependent countries to find other sources of supply, difficult to detect and at higher prices.*

*China's actions are viewed with suspicion globally, because are hiding the true goals that China would like to achieve, among which is to be the main exporter of technology, or to "tempt" largest companies specializing in technology on Chinese territory to be closer of the source of raw material. But is China's trade with rare earths effective and profitable? Will China become in the next 15 years the greatest technological power?*

**Keywords:** *rare earth, power, technology, trade efficiency, cost effectiveness, terms of trade, quantitative restrictions*

### 1. Introduction

In any book on economics the problem of resources is discussed, regardless of their nature, closely related to that of Needs. Even from the law of scarcity we know that the volume, the quality and structure of resources changes more slowly than the volume, structure and intensity of needs, therefore, efficient and rational use of these resources is an imperative of any economy.

The needs evolve, becoming increasingly difficult to satisfy and in order to satisfy, progress is required. Global thirst for power is so high that countries are willing to sacrifice anything just to be one step ahead of others. What other industry provides a safe and fast growing if not technology? What other elements bring a country's uniqueness if not natural resources? We have Saudi Arabia, we have oil. We have China, we have rare earths. And yet, we have a new world order.

Rare earths are non-toxic elements, with magnetic and phosphorescent properties, being among the most popular materials for high tech industries and modern technology: terbium and neodymium are used for wind turbines generators, neodymium and dysprosium are used for hybrid cars engines, and so on. However, scientific studies show that, basically, rare earth elements are abundant in the subsoil of the Earth, but extremely high costs of extracting and processing determine that only truly affluent regions in such elements deserve to be exploited. China is the biggest (and for some types of rare earth, the only) manufacturer of rare earth, and the biggest exporter and the dependence on the imports from China of the countries is highly visible. This paper aims to examine China's rare earth trade, not only in terms of efficiency, but also in terms of the main players on this market.

### 2. Rare Earths Imports and Exports

The main importers of rare earth compounds in 2008 were the United States, Europe and Japan. Imported quantities of rare earth estimated by the national statistical offices are listed in the following table:

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Table 1

## Imports of rare earth compounds of Europe, United States and Japan in 2008

	Imports	Share of imports from China	Data source	Compounds included in the statistic
<b>EU 27</b>	23.013 t	90 %	Eurostat 2010	Metals, intermixtures or interalloys of rare-earths, Sc and Y
<b>USA</b>	20.663 t	91 %	U.S. Geological Survey 2010	Rare-earth and Y compounds, Rare-earth metals, Mixtures of rare-earth chlorides
<b>Japan</b>	34.330 t	91 %	Trade Statistics Japan 2010	Cerium-, Lanthanum- and Yttrium Oxide, other cerium compounds

Source: „Study on Rare Earths and Their Recycling”, Darmstadt, Ianuarie 2011<sup>2</sup>

According to this table, Europe, USA and Japan imported a total of 78.006 tonnes of rare earth compounds. Of this total, around 71.000 tonnes were imported from China.

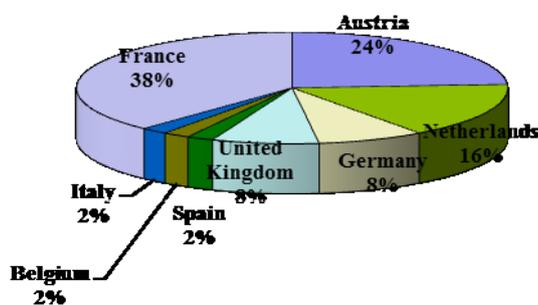


Chart 1. Share of different EU countries in the total rare earth compounds imported by the EU-27 (Eurostat 2010)

In the diagram above, we can see some countries from Europe, in percentage, and their imports of rare earth compounds. So, France's imports are the biggest, a quantity of 8.745 tonnes, followed by Austria with 5.523 tonnes and the Netherlands, with 3.682 tonnes. According to the "Innovation Union Competitiveness Report 2011", for 2008, France's technology exports represented 16.4% of total exports, a higher share than in Austria, which exported only 10.8% and the Netherlands, with 16.2%. Thus, France's imports of rare earths are explainable because it exports a significant amount of technology products, manufactured using these items.<sup>3</sup>

Regarding the China's exports of rare earth situation, this country is trying to implement measures to protect its resources to ensure sustainable development, rapid and healthy rare earth industry in China. The State Development Planning Commission of China has decided that foreign companies are not allowed to invest in mining and extraction of rare earth minerals in China. Foreign capital is necessary for the processing intensive applications, but also in the advanced materials made from rare earths.

<sup>2</sup> [http://reinhardbuetikofer.eu/wp-content/uploads/2011/01/Rare-earths-study\\_Oeko-Institut\\_Jan-2011.pdf](http://reinhardbuetikofer.eu/wp-content/uploads/2011/01/Rare-earths-study_Oeko-Institut_Jan-2011.pdf), accessed on 13/03/2011

<sup>3</sup> [http://ec.europa.eu/research/innovationunion/pdf/competitivenessreport/2011/chapters/part\\_iii\\_chapter\\_4.pdf](http://ec.europa.eu/research/innovationunion/pdf/competitivenessreport/2011/chapters/part_iii_chapter_4.pdf), p.405

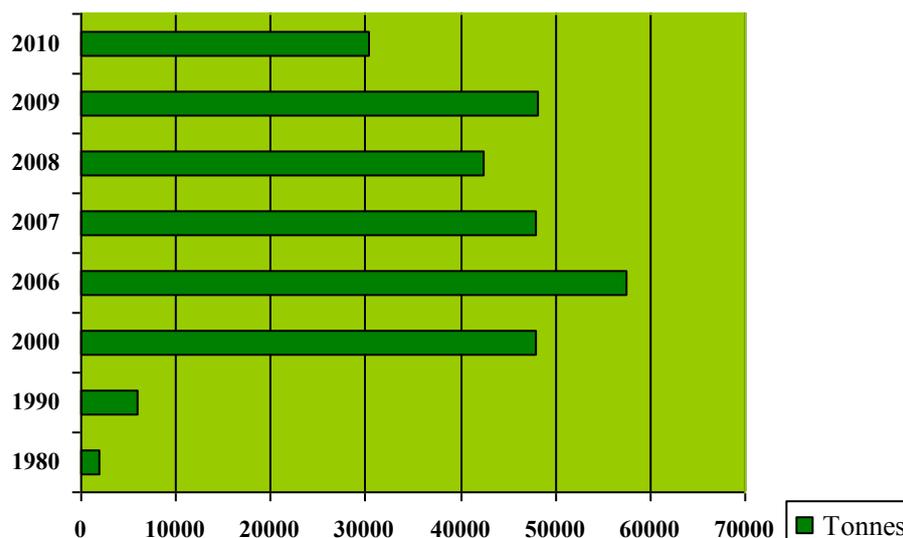


Chart 2. Gross volume of Chinese exports of rare earth from 1980 to 2010

Source: Adapted from „Study on Rare Earths and Their Recycling”, Darmstadt, Januarie 2011

It can be seen that rare earths exports grew gradually during this period of analysis, the maximum point was in 2006 when exports were 57.400 tonnes, followed by the year 2007 that marked a decline in the export of these items. Also in 2000 the situation was favourable, and in 2001 it fell sharply, a understandable phenomenon, given the problems in the United States on 11 September 2001 that have contributed to weakening the U.S. – China trade relations. To protect domestic production and consumption, in addition to non-quantitative restrictions or quotas to limit imports of rare earth, China decided to implement other measures to protect the resources. Thus from 1 April 2011 it was decided to apply a tax rate of 60 yuan (9.1 dollars) per tonne for light rare earths (Light Rare Earth Elements), whose demand is higher and one of 30 yuan per tonne for heavy rare earths (Heavy Rare Earth Elements).<sup>4</sup>

Table 2

Chinese rare earths exports of state and foreign-invested enterprises from 2008 - 2010

	2008	2009	2010 (Approved exports)
<b>Chinese-invested enterprises (tonnes)</b>	34.156	31.310	
<b>Foreign-invested enterprises (tonnes)</b>	8.210	16.845	30.258
<b>Total (Tonnes)</b>	42.366	48.155	30.258
<b>Reduction in % compared to 2008</b>	0%	14%	-29%

Source: „Study on Rare Earths and Their Recycling”, Darmstadt, Januarie 2011

We notice a decrease by 29% in 2010 compared to 2008. From 2009 to 2015, export quotas imposed by the rare earths China's Ministry of Commerce would be 35.000 tonnes according to the “Rare Earths Industry Development Plans 2009-2015”. The objectives of control of rare earth exports are to regulate the current situation of non-transparent rare earth industry, to protect resources and environment and to ensure domestic demand growing. In recent years, China is interested in renewable energy and “green technology” and in these conditions, domestic demand for rare earths will increase rapidly as rare earths are related to the green industries like wind turbines or electric cars.

<sup>4</sup> [http://news.xinhuanet.com/english2010/china/2011-03/24/c\\_13796465.htm](http://news.xinhuanet.com/english2010/china/2011-03/24/c_13796465.htm), accessed on 28/04/2011

The data presented above do not include illegal exports from China. According to the China Security Journal from 9 October 2010, in 2009 around 20.000 tonnes have been sold illegally in foreign countries, apart from legal exports. Compared to the illegal quantity from 2008, in 2009 we can observe an increase of 10 %. However, the amount of illegal exports is 60.500 tonnes in 2008 and 68.000 tonnes in 2009. Comparing the Chinese exports with the data of the main importers it can be seen that imports from China to Europe, U.S.A. and Japan were 71.000 tonnes in 2008. The main exporters of semi-products from rare earths outside China are Japan, USA and Europe. They import from China mainly primary material and export semi-product. The following table shows the situation of exports in 2008.

Table 3

## Exports of semi-products of rare earths of Japan, USA and Europe in 2008

	Exports of rare earth compounds in 2008	Data source	Compounds included in the statistic
EU 27	4.704 t	Eurostat 2010	Metals, intermixtures or interalloys of rare-earths, Sc and Y
USA	8.253 t	U.S. Geological Survey	Rare-earth and Y compounds
Japonia	8.997 t	Trade Statistics Japan 2010	Cerium-, lanthanum- and yttrium oxide

source: „Study on Rare Earths and Their Recycling”, Darmstadt, Ianuarie 2011, p. 39

Destination countries of Japanese exports of rare earths are South Korea (33%), China (17%), Taiwan (14%) and U.S.A. (9%). The author Robert Bryce, in his book published in 2010, “Power Hungry: The Myths of “Green” Energy and the Real Fuels of the Future” refers to the importance of the lanthanides or rare earth in the context of green energy. He argues that China has a “de facto” monopoly in international trade with lanthanides. We live in a global economy, especially when it comes to energy trade. Due to globalization, the market role is to ensure the price understanding between buyers and sellers. China takes advantage of these resources, so that has more than 1.000 doctoral students specializing in the technology industry working in the extraction and processing of rare earth, turning them into marketable products. As I mentioned above, as China develops its knowledge in this field, it has decided to reduce its exports of these items. Also, it has increased export taxes, prohibiting foreign companies to invest in the extraction and processing of rare earth. Companies that need a constant supply with these elements are required to move their production facilities in China. General Motors has decided to transfer the direction of international operations from Detroit to Shanghai, and, also, Chevrolet has already begun making the required batteries for automobiles in China. Besides Japan, who officially declared it’s addiction on imports of rare earths from China to support its technological development, there are other countries that are worried about China’s decision. In May 2009, a member of Japan’s Ministry of Economy, Trade and Industry declared for the “Times” newspaper that all technologies depend on the rare earths and all the rare earths world trade depends on China.

Nothing new, though. Neodymium is the most important type of rare earth and is used for the Toyota Prius, which is the largest consumer of rare earths, each model use about 1 kilogram of lanthanum and 10 of neodymium. In September 2010, it manufactured and sold over two million units meaning 40 million dollars (in 2010, a kilogram of neodymium costs 20 dollars) just to buy the required amount of neodymium for the production of the models. China has supplied Japan with 2.000 tonnes of neodymium of the total production, between 110.000 and 130.000.

In addition to Toyota Prius, there are other hybrid models that require large amounts of rare earth: Honda Insight or Ford Fusion. David Trueman, a Canadian geologist, has shown the importance of rare earth in one phrase: “without rare earths, you do not have a colour TV[...], Chinese are the oldest capitalists in the world. They would rather build the

entire TV than to sell just a piece of rare metals.” The protection of these resources comes at a strategic moment in which China advances in terms of technology, globally.

Between 1985 and 2005, Chinese exports of technology reached 450 billion dollars. Cheap labour, lax environmental policy and abundance of the rare earth allowed upgrading the United States and Japan in terms of technology exports. Apart from all the rare earths mentioned in my paper content, there are other rare items that are not part of the lanthanides group but are essential in solar energy. For example, Arizona-based First Solar, one of the largest photovoltaic cells manufacturers in the United States of America, is based on cadmium telluride compounds. The first business of this company is based on telluride. In the 2009 annual report, First Solar said that if the suppliers could not supply the company with telluride, prices of this item may raise or the company will be unable to honour its contracts.

If the deficit will occur, First Solar would have lost because the prices of customers contracts do not change depending on raw material price increases, resulting in a reduction in production. In this context, China has an advantage. According to experts, China is the only country that holds tellurium mines. The Chinese are using the access to raw materials, manufacturing large quantities of solar panels. Many factories of solar panels from China have stimulated the production, resulting in a fall in prices of solar panels in the United States by 40% in 2009 compared to 2008. This is a critical issue of competitiveness of the U.S.: if decision-makers in this country decide to support indigenous businesses of rare earth as a way to hedge Chinese suppliers, China could simply decrease the prices of rare earth, making all U.S. start-ups in the industry to become unprofitable.

The United States only hope to supply itself is Molycorp Minerals, which holds only one operable rare earth mine, located in California. The availability of rare earth is not just a matter of trade balance, but also a U.S. national security. The U.S. military is dependent on cutting-edge weapons, guidance systems or computers, all of them call for these items. Assuming that the U.S. imposed sanctions on Chinese trade, because of the litigations related to carbon emissions, what could China do instead? Well, first of all exports of rare earth would stop to the U.S., the Defense Department of this country being unable to get the latest equipment needed. The monopoly position of China on these elements enables the technology to be first created by them, rather by the United States. Here it is important to emphasize the idea relating to role reversal in terms of the technological gap between the U.S. and China, the first would suffer, medium and long term, from China's technological advances.

Chinese companies said they are willing to lose money on manufacturing solar panels, in exchange for a larger market share. The government subsidizes this area, enabling Chinese companies to lower prices, a phenomenon that will occur around the world.<sup>5</sup>

### 3. The efficiency and profitability analysis of China's trade with rare earths

I think it is useful to review China's trade with rare earths, which is the largest exporter of rare earth and the largest importer, Japan. In 2009, China's exports were 1.2 trillion dollars and imports were 1.01 trillion dollars, making China's trade balance for 2009 to be in surplus. In September 2010, exports were worth 130.7 billion dollars and imports reached 112.3 billion dollars, which again results in a trade surplus. In March 2011, China's trade surplus is increasing, with an imports value of 152.06 billion dollars and exports of 152.2 billion dollars, resulting in a surplus of 140 million dollars.<sup>6</sup> To express the efficiency of foreign trade we used the indicator known as the exchange ratio or terms of trade. Exchange ratio refers to the quantity and price conditions at which the international trade in goods is performed, showing

<sup>5</sup> adaptation from:

[http://books.google.ro/books?id=OJmtn3rOxH0C&pg=PA133&dq=rare+earths+china+trade&hl=ro&ei=bO6FTbqF4eS4Qazu6DECA&sa=X&oi=book\\_result&ct=result&resnum=10&ved=0CGAQ6AEwCO#v=onepage&q=rare%20earths%20china%20trade&f=false](http://books.google.ro/books?id=OJmtn3rOxH0C&pg=PA133&dq=rare+earths+china+trade&hl=ro&ei=bO6FTbqF4eS4Qazu6DECA&sa=X&oi=book_result&ct=result&resnum=10&ved=0CGAQ6AEwCO#v=onepage&q=rare%20earths%20china%20trade&f=false), pp. 132-138

<sup>6</sup> <http://www.tradingeconomics.com/china/balance-of-trade>, accessed on 27/04/2011

how physical or monetary units must be exported to cover a unit of import. Given that China does not import rare earths, gross exchange report indices and net can not be calculated.

To characterize the efficiency of international trade, the exchange ratio or Terms of Trade must be calculated since it expresses in value terms the results that each country obtains from its entire foreign trade. Since we have no reliable data regarding Chinese imports, to ease our calculation, we note that the country imports insignificant amounts of rare earths. Thus, we get: *In value terms*<sup>7</sup>:

- $TTV > 1$  when the Exports Value  $>$  Imports Value - condition fulfilled by China because exports are above imports;
- China achieved a trade surplus, one that devalues the yuan currency. In these circumstances, China should boost imports and discourage exports, which it has already begun to do, being convicted of violating the principles of international trade.

Therefore, we conclude according to the theory that China has an efficient trade.

*In quantitative terms:*

- $TTQ = \text{Exported Quantity} / \text{Imported Quantity}$ .
- From the theoretical point of view, regarding China, the following condition is valid:  $TTQ > 1$ , where the Exported Quantity  $>$  Imported Quantity, hence unprofitable trade, because the amount exported is greater than the imported.

After verifying the conditions, we found that China's rare earths trade is effective but not profitable. Thus, immediate monetary effects are not very big (profitability), the Chinese receive only 2.503.477 dollars per year in taxes which it chose to apply differentiated in April 2011 on the types of rare earths. Because of this, the theory could apply in practice, but in terms of efficiency, this characterizes the Chinese trade with rare earths, because the elements that are the focus of this paper have contributed to higher growth of the country, being valued correctly.

#### 4. Conclusions

In recent years, the rare earth issue captured the press attention, raising public interest and, therefore, my attention, with regard to a crucial importance of China in this context, surprising with the protectionism it exhibits. Obviously, the refusal has sparked panic among the dependent countries on the imports of rare earths from China, which not coincidentally are among the major exporters of technology: the United States and Japan. Non-tariff instruments as quotas determine the states to find alternatives, or by replacing some components with substitutes, or by using other sources of constant supply, not to stand still in terms of innovation. As I said above, Americans are in a bad situation depending on imports from China. The U.S. imports of rare earths worth over a billion dollars. Imposing quantitative restrictions under the pretext of protecting the environment by stopping or suspending delivery of goods in port, represents nothing but a tactic safe ascent, at least in the short terms, China's relying on these elements. The reduction of exports from 28.000 to 7.800 for the second half of 2010 represents a clear indication of China's plans to attract more foreign investment in its territory, as soon as possible until the other mines in California and Australia will not become functional.

<sup>7</sup> Gheorghe Popescu, *Modele de comerț internațional*, Deva, editura Corvinus, 2001, p. 83

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