

# China Rare Earth Holdings Limited



- Wide applications of rare earths in high technology products
- One of the world's largest producers of very high purity rare earths
- Strong long term profit growth from high value-added products and economies of scale

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04 December 2001



## Content Summary

<b>1. Investment Highlights</b>	<b>2</b>
<b>2. Business Overview</b>	<b>3</b>
Rare Earth Business	3
Refractory Materials	4
<b>3. Competitive Advantages</b>	<b>6</b>
<b>4. Financial Statements</b>	<b>7</b>
<b>Appendix: Background Information on Rare Earth</b>	<b>9</b>
Rare Earth Elements	9
Rare Earth Industry	10
Rare Earth Reserves	11
Rare Earth Products	11



## 1. Investment Highlights

- ➔ **Rare earth is a misnomer.** It is neither rare nor very valuable in an impure form. However, rare earth elements are essential to many of today's high technology products such as computers, TVs, VCRs, mobile phones and CD players.
- ➔ **CRE is one of the world's largest producers of very high purity rare earth.** Refining to very high purity is a technology-intensive process, and hence very value-added.
- ➔ **The global economic slowdown has adversely affected the technology and electronics industry, and CRE will be affected.** However, the impact on smaller and weaker competitors will be much greater, and we expect CRE to benefit from reduced competition in the long run.
- ➔ **Following the recent sharp correction in the share price,** due in part to the weakness in technology and electronics stocks, we expect investors to refocus on CRE's longer term growth drivers:
- ➔ **CRE is technologically strong,** enabling it to produce high purity rare earth in volume and giving it superior economies of scale.
- ➔ **It has shifted its product mix** towards higher value-added high purity products.
- ➔ **CRE has an increasing range of applications** for rare earth elements.
- ➔ **Its high-grade refractory materials will become important** for earnings growth.
- ➔ **We recommend BUY with a target price of HK\$4.00.**

CHINA RARE EARTH HOLDINGS LIMITED						(0769.HK)
Share Price:		HK\$2.125	52 Wk High/Low:			HK\$3.05/1.08
Shares O/S:		814mn	Market Cap:			HK\$1,731mn
Y/E 31 December		1999	2000	2001F	2002F	2003F
Turnover	HK\$m	448	558	717	886	1,097
Net profit	HK\$m	81	141	169	176	245
EPS	HK\$	0.17	0.23	0.21	0.22	0.30
P/E	x	12.6	9.2	10.2	9.8	7.1
P/FCF	x	69.0	28.3	(13.5)	113.4	11.5
DPS	HK cents	2.0	4.0	5.5	6.0	7.0
Yield	%	0.9	1.9	2.6	2.8	3.3

## 2. Business Overview

CRE's principal business is the manufacturing and sale of various rare earth products and refractory materials. In the past few years, roughly two-thirds of its revenue and profit was from rare earth products and one-third was from refractory materials.

### **Rare Earth Business**

There are over 100 rare earth producers in China, but less than 10 of these (including CRE) are operating at economies of scale.

### **Capacity**

CRE is one of the largest rare earth producers in the world. It has successfully upgraded its existing production facilities and completed the installation of new rare earth extraction lines last year. As a result, its annual production capacity increased by 40% YoY, from 3,500 tonnes to 4,900 tonnes of rare earth oxide (REO).

CRE's efforts to improve its rare earth yield and production efficiency have been further strengthened by the installation of a new ion-absorption ore separation line in June this year. The new production facilities can process up to 3,000 tonnes of rare earth raw materials per annum, and separate all 17 rare earth elements continuously. In practice, after the ion-absorption ore is processed, the light, medium, and heavy rare earth elements are usually separated into groups. It is more cost effective to extract all rare earth elements than only one or two elements. The new production line will help CRE to improve both economies of scale and economies of scope.

### **Products**

Not all rare earth is equally valuable. The price for high purity rare earth products can be hundreds, if not thousands, of times higher than low purity products. CRE is capable of producing high purity products ranging from 90% to 99.9999% in rare earth oxide or rare earth metal.

Currently, CRE has 15% market share of the global supply of high purity rare earth products. The profit margin for pure rare earth metal is much higher than that of REO products. CRE is building a rare earth metal production line with capacity of 1,000 tonnes per annum which is scheduled for completion by end-1H02.

One of the major downstream high value-added rare earth products that CRE has been developing is fluorescent material used in low energy light bulbs. Given the magnitude of the power shortage in some states of the US and the growing concerns for environmental protection around the world, we expect demand for low energy light bulbs to increase significantly.

Rare earth products can be highly differentiated in terms of elements, purity, metal or REO. For some of its products, CRE has a virtually monopoly and is able to set its prices.



## Research & Development

By working with its customers closely, CRE's R&D staff is able to collect information on market trends and customer needs, thus enabling CRE to tailor its products and provide value-added services. This is one of CRE's key success factors in maintaining high profit margins. Its premium customers include 'GE', 'Siemens', 'Toshiba', 'Osram', and 'Samsung'.

## Management

CRE is operated by its founder and major shareholder, Mr. Jiang Quanlong, and his wife. The couple manages the daily operations, including raw material purchases, production, sales, marketing, budgeting, administration and accounting. CRE's entrepreneurial management team is one of the key elements for its success.

## Refractory Materials

Refractory materials are inorganic non-metallic materials that can withstand temperatures of over 1,580°C. They have a high degree of heat and wear resistance, as well as good volumetric stability.

Refractory materials are used in petrochemical, metallurgy, non-ferrous, glass and cement industries. High-grade refractory materials are vital to the production of industries that require the use of heat treatment facilities.

CRE is one of the few manufacturers capable of producing high-grade refractory materials in China, though there are currently over 3,000 refractory materials manufacturers in China, with a combined annual production capacity of over 10mn tonnes. More importantly, CRE is the most competitive manufacturer in China that supplies RH steel furnace bricks, which are in strong demand by both domestic and Asian steel producers, including Shanghai Baoshan Steel Corporation, Wuhan Steel Works, Panzhihua Steel Works, Tianyuan Steel Works and New Nippon Steel.

As many steel and petrochemical companies in China strive to improve product quality and production efficiency, demand for high-grade refractory materials will continue to grow. According to the China Refractory Materials Association, China imported 28,218 tonnes or US\$63.66mn of high-grade refractory material products in 2000, up 34% and 49% YoY, respectively. In particular, China consumes 100,000 tonnes of RH steel furnace bricks per annum. Usually, steel furnace bricks are replaced every two years or after the designed life of usage on a rotation basis. CRE's bricks are priced at around Rmb 8,000 per tonne, which is about 30% below the price of imported bricks, without any compromise on quality.

In the next five years, China will spend Rmb300bn on building a modern high-speed railway network. Those tracks require special steel that can only be manufactured from RH steel furnaces. As a result, major steel producers in China plan to upgrade their facilities, which in turn will create huge demand for RH steel furnace bricks.



To accommodate increased demand for its refractory materials, CRE completed a new production line last year, increasing its annual production capacity from 30,000 tonnes to 50,000 tonnes. In particular, CRE increased its annual production capacity of both RH steel furnace bricks and unshaped refractory products to 10,000 tonnes. The new 101.8mn tunnel kiln can withstand temperatures of up to 1,850°C. It has won a good reputation from Japan and has improved the quality of CRE's refractory products. CRE has also been expanding its international market share by exporting to Japan's New Nippon Steel, whose demand is far beyond CRE's capacity to supply. CRE intends to increase its annual exports from 10-20% of total turnover of refractory materials up to 50%. A new production line, which is funded by the share placement early this year, will be completed next year and increase its capacity from 50,000 tonnes to 80,000 tonnes per annum. The exports can help CRE gain international recognition of its quality refractory products and to diversify its customer base.

Recently, CRE signed an agreement with Krosaki Harima Corporation (Japan), the largest refractory material manufacturer in the world, to launch a new co-operation project. The full-scale co-operation covers manufacturing, technology, R&D, management and marketing. This will improve CRE's core competence, including product quality, R&D capability, profit margins and market share. New products will be developed in Al<sub>2</sub>O<sub>3</sub>-graphite series, magnesia-chrome series, magnesia series and paraffin-silicon-carbide series.

CRE is well positioned to expand its market share and profit from the growing demand for its refractory materials in the domestic and international markets because of its ability to supply high-grade refractory materials as well as other high-end products. In fact, CRE's refractory materials business faces less competition than its rare earth business.

Based on our analysis of the rare earth industry, CRE obviously has a competitive advantage over its competitors. Going forward, CRE's profit drivers will be its high value-added products developed from intensive R&D and co-operation with its clients and new applications and demand for rare earth in various industries.

For its refractory material business, CRE will also enjoy high sales growth and high profit margin in the next few years. CRE's co-operation with Krosaki Harima, New Nippon Steel's refractory material supplier, will enable it to increase its exports to Japan substantially.

### 3. Competitive Advantages

#### ***Threat of Buyer's Bargaining Power: Low***

In a situation of relatively high buyer concentration, CRE has a virtual monopoly in some areas because of its product differentials, high quality products, and ability to fulfil high volume requirements. It is not the high purity rare earth oxide (REO) that differentiates CRE from its competitors. It is the ability to control the non-rare earth impurities (i.e.,  $\text{Fe}_2\text{O}_3$ ,  $\text{SiO}_2$  and  $\text{CaO}$ ) and the particle size of the REO products, which require substantial R&D and co-operation with clients, that makes CRE outstanding. From a buyer's point of view, a capable and reliable substitute is scarce in this highly specialised industry.

The cost of rare earth is negligible for buyers, but rare earth can improve their profits substantially. For example, the cost of catalysts, phosphors and permanent magnetic materials, where rare earth plays a key role, are insignificant comparing to the end products such as automobile exhaust purifiers, CRT and motors. Demand for rare earth is therefore quite price inelastic. CRE has the power to set its price or pass the price hike of raw materials onto buyers.

#### ***Threat of Supplier's Bargaining Power: Moderate***

Supplier concentration and the input volume from each supplier are moderate for CRE. The input differentials are also moderate so that CRE has the flexibility to switch suppliers. The price fluctuation in the international rare earth market has a significant impact on the supply and demand of rare earth raw material. Adequate inventory levels can lower suppliers' bargaining power. As the global economy is slowing down, CRE is able to lower the costs of its raw materials to maintain its profit margin.

#### ***Threat of New Entrants: Low***

Capital requirements and industry-specific knowledge are major entrance barriers for new domestic entrants. Economies of scale, customer base, product differentials and quality also make it difficult for new entrants to compete directly with CRE. Foreign involvement in the upper-stream rare earth business is highly restricted in China.

#### ***Threat of Substitutes: Low***

Relatively inexpensive rare earth has unique features that make it difficult to substitute, and makes it indispensable, in many industries. In addition, various new rare earth applications in the hi-tech industry have been discovered and developed, which underpins the role of rare earth in the information technology era.

**Threat of Rivalry among Competitors: Moderate**

The whole rare earth industry and market size is growing. There is enough room for all major rare earth producers to differentiate their products and provide high value-added and high profit margin products. CRE can produce very high quality rare earth products with competitive prices in the international market, which is one of the key reasons that it is gaining market share from Rhodia (France) – one of the leading players in the rare earth industry.

However, while the price of rare earth products is important, it is not the only factor that rare earth users will consider while choosing their suppliers. Other factors are physical properties of the rare earth products, consistent quality in large volumes and a long-term relationship. Nevertheless, more and more users are starting to shift to suppliers in China.

CRE can separate all 16 rare earth elements in large quantities, which is very cost effective. Most of the small domestic rare earth producers usually produce a few rare earth elements when the price is high and shut down their operations completely when the price is low. CRE has the advantages of economies of scale and economies of scope over small competitors.

**4. Financial Statements**

<b>Profit &amp; Loss Forecast</b>					
<b>Y/E (HK\$mn)</b>	<b>12/99</b>	<b>12/00</b>	<b>12/01F</b>	<b>12/02F</b>	<b>12/03F</b>
<b>Turnover</b>	<b>448</b>	<b>558</b>	<b>717</b>	<b>886</b>	<b>1,097</b>
Rare earth products	304	371	454	545	654
Growth rate (%)	6	22	23	20	20
Refractory materials	143	187	261	340	442
Growth rate (%)	9	30	40	30	30
Gross profit margin (%)	36	34	33	35	38
<b>Gross profit</b>	<b>160</b>	<b>190</b>	<b>236</b>	<b>310</b>	<b>411</b>
Operating cost	(30)	(25)	(22)	(45)	(55)
<b>EBITDA</b>	<b>130</b>	<b>165</b>	<b>214</b>	<b>265</b>	<b>356</b>
EBITDA margin (%)	29	30	30	30	33
Depreciation	9	14	34	49	57
EBIT	121	151	180	216	299
<b>Profit attributable to shareholders</b>	<b>81</b>	<b>140</b>	<b>169</b>	<b>175</b>	<b>244</b>
Dividends	18	26	37	40	47
Retained earnings	63	114	132	135	197

<b>Free Cashflow to Equity Forecast (HK\$mn)</b>					
<b>Y/E</b>	<b>12/99</b>	<b>12/00</b>	<b>12/01F</b>	<b>12/02F</b>	<b>12/03F</b>
Profit attributable to shareholders	81	140	169	175	244
Depreciation	9	14	34	49	57
Changes in WC	38	59	131	59	71
Capex forecast	27	34	200	150	80
FCFE	25	61	-128	15	150





<b>Combined Balance Sheet</b>		
<b>Y/E 31 December (HK\$'000)</b>	<b>1999</b>	<b>2000</b>
<b>Current Assets</b>		
Bank balances and cash	123,570	149,789
Inventories	55,034	111,000
A/R	100,119	91,341
Prepayments, deposits & other assets	43,904	99,704
Due from related company	408	797
Total current assets	323,035	452,631
<b>Non-Current Assets</b>		
Fixed assets	133,459	216,569
Total assets	456,494	669,200
<b>Current Liabilities</b>		
Short-term bank loans	10,804	0
Long-term bank loans, current	0	39,506
A/P	37,003	24,031
Accruals and other payables	30,637	31,372
Dividends payable	12,563	20,259
Tax payable	11,933	4,302
Due to a director	0	1,290
Due to related companies	1,550	1,944
Total current liabilities	104,490	122,704
Net current assets	218,545	329,927
<b>Non-Current Liabilities</b>		
L/T loans	39,339	0
Convertible bonds	0	34,320
Minority interests	6,229	11,582
Total liabilities	150,058	168,606
<b>Equity</b>		
Share capital	60,000	67,529
Reserves	246,436	433,065
Shareholders' equity	306,436	500,594



## Appendix: Background Information on Rare Earth

### Rare Earth Elements

Rare earth is neither rare nor earth. It is a group of 17 chemically similar elements. In the periodic table of elements (see below), the rare earth elements comprise three members of Group IIIb, and all 14 members of one of two series of elements are generally written apart from the main table. The rare earth elements all have certain common features in the electronic structure of their atoms, which is the fundamental reason for their chemical similarity.

Periodic Table of Chemical Elements

period	group																	
	1* Ia	2 IIa	3** IIIb	4 IVb	5 Vb	6 VIb	7 VIIb	8 ← VIIIb →	9	10	11 Ib	12 IIb	13 IIIa	14 IVa	15 Va	16 VIa	17 VIIa	18 0
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub						
			6	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	
			7	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	

\*Numbering system recommended by the International Union of Pure and Applied Chemistry (IUPAC)

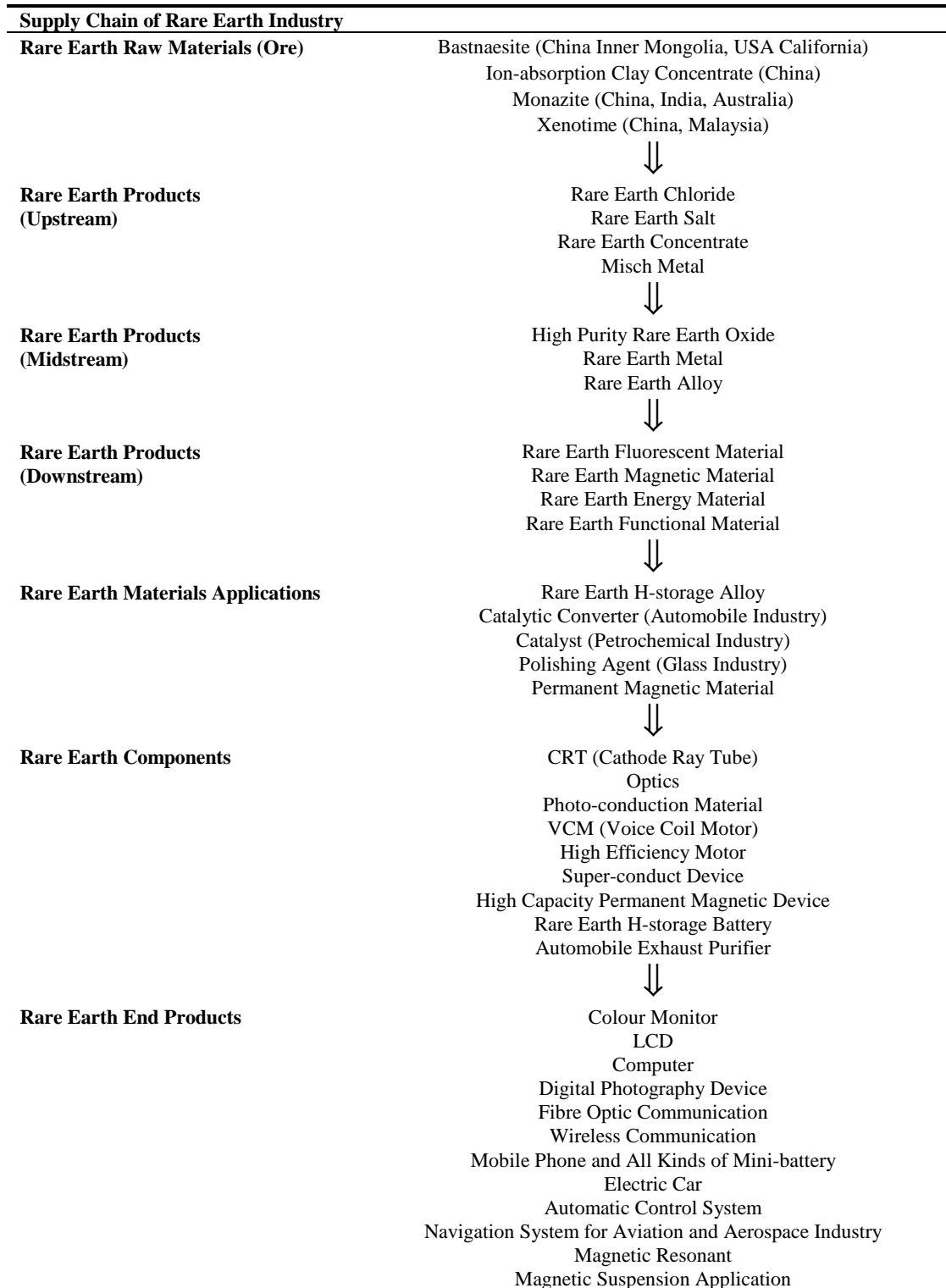
\*\*Numbering system recommended by the Chemical Abstracts Service

Although there are an abundance of rare earth elements in the earth's crust, they are difficult to find in commercially exploitable deposits.



### Rare Earth Industry

To understand the rare earth industry, we need a roadmap or supply chain of the industry (see chart below).





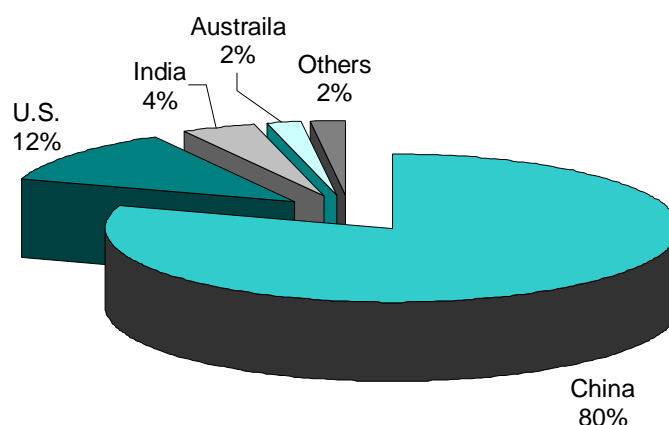
### Rare Earth Reserves

According to statistics issued by the US Minerals Department in 1989, there were 44.8mn tonnes of REO in global reserves available for extraction, of which 36mn tonnes were found in China, accounting for 80% of the world's total reserves. The US has 5.5mn tonnes of REO reserves, which accounts for 12% of the world's total reserves. The statistics are dated but we consider them to be still reliable.

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#### Global Rare Earth Reserves

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Source: US Minerals Departments (1989)

China is in a dominant position in the global rare earth raw material market. The United States and India's resources are primarily in light rare earth, which contains mainly four rare earth elements (La, Ce, Pr, and Nd). China has the largest light rare earth mine and also medium and heavy rare earth deposits. Therefore, in relative terms, China has both the most abundant reserves of rare earth and the greatest varieties of rare earth ores in the world.

### Rare Earth Products

In terms of rare earth mining and separation, the US used to be a leading rare earth supplier. However, for the past decade, the price of rare earth has been falling as producers have continued to increase production capacity in an already oversupplied market. Unable to maintain cost competitiveness, the last rare earth processing plant in the US, owned by Molycorp, was closed in 1998. Its mining and separation plant of rare earth at Mountain Pass, California, was shut down as well.

The trend has continued with further rationalisation of the industry. Rare earth producers in Japan have substantially reduced their separation capacity, which leaves Rhodia (France) as the only rare earth separation plant of any significance outside of China.

France does not have rare earth resources of its own. Rhodia, the only rare earth processor in France, is the world's largest producer of high purity rare earth products. The company has shifted its raw materials from the Australian monazite to the Chinese rare earth chloride. Rhodia has already had a rare earth joint venture in China and is working with new Chinese local partners to produce high value-added downstream rare earth products in China.



China has been developing its rare earth industry since the late 1970s. The mining and separation capacity of rare earth in China has increased from 200 tonnes in 1975 to over 60,000 tonnes in 2000 (see table below).

<b>Mining and Separation Capacity in China (tonnes)</b>						
	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001F</b>
Total mine output	55,373	65,000	68,000	70,000	70,000	75,000*
Concentrate output	46,859	52,000	55,000	55,000	55,000	15,000
Clay output**	7,473	10,000	11,000	13,000	15,000	15,000
Separation products	45,300	46,500	52,000	60,000	60,000	65,000

\* Includes 5,000 tonnes of imported raw material

\*\* About 80% of the clay is medium-Y/High-Eu clay and 20% is High-Y clay.

Source: Worldsec Research

Total exports of rare earth products have also risen exponentially from 16 tonnes in 1975 to 50,000 tonnes in 2000 (see table below). China is now the only country in the world that can provide all kinds of different rare earth products in large quantities at competitive prices.

<b>Rare Earth Products Export from China</b>						
	<b>1975</b>	<b>1985</b>	<b>1990</b>	<b>1995</b>	<b>1997</b>	<b>1999</b>
Total Export (tonnes)	16	4,500	6,140	27,000	31,400	50,000
Total Export (US\$m)	0	38	84	271	320	460
High Purity REO (tonnes)	2	100	799	6,738	12,450	12,000
High Purity REO (US\$m)	0	8	28	138	231	251
High Purity REO/Total Export (%)	15	2	13	25	40	24

Source: Worldsec Research

Rare earth products are used by traditional industries (such as automobile, petrochemical and metallurgy) and high technology industries (such as telecommunications, IT and electronics). Driven by the rapid growth of hi-tech industries, the rare earth industry entered a fast development period in the 1990s. Global consumption of REO soared from 33,000 tonnes in 1990 to 75,000 tonnes in 2000.

China is the leading supplier of rare earth in the international market. To protect China's reserves and prevent a vicious price war, which resulted in a falling rare earth price in the past decade among domestic producers, the Chinese government implemented new regulations, such as quota and export permits, in 1998.

As a result, total exports were reduced and exports of less purified rare earth products were tightened. However, a few years ago, the quota was allocated to state-owned trading companies. Rare earth producers had to work with those trading companies to export their products, which was not very efficient. Recently, the lion's share of quota has shifted from the trader to the producer.

These government measures had the effect of restricting exports, raising prices and controlling the volume of exports. Given China's dominant position in the rare earth market, the new regulations have resulted in a pricing turnaround in the world's rare earth market.



**Price of Rare Earth Products from Southern China (Rmb/kg)**

	La <sub>2</sub> O <sub>3</sub>	CeO <sub>2</sub>	Nd <sub>2</sub> O <sub>3</sub>	Eu <sub>2</sub> O <sub>3</sub>	Dy	Y
<b>Purity</b>	<b>4N5</b>	<b>3N5</b>	<b>3N</b>	<b>4N5</b>	<b>3N</b>	<b>4N5</b>
Jan. 1995	70	160	130	3,400	260	190
Jul. 1996	60	120	170	2,900	280	230
Jan. 1997	60	120	135	2,600	260	190
Apr. 1998	50	110	120	2,400	200	170
Jan. 1999	30	60	70	1,550	250	100
Jul. 2000	40	60	70	2,000	360	90
Dec. 2000	60	60	120	3,300	450	110
June 2001	50	55	60	2,500	220	90

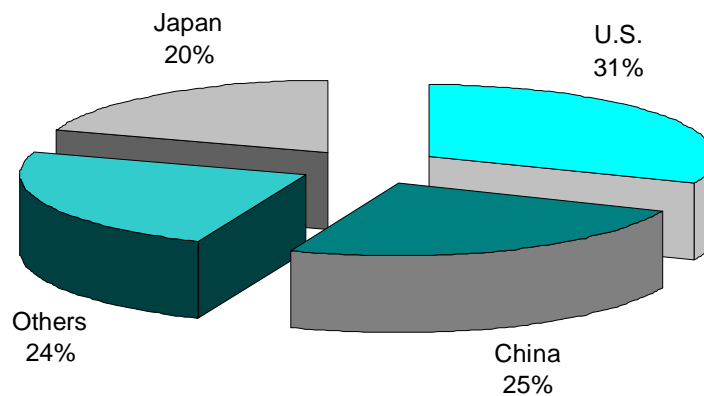
Source: Worldsec Research

As a result, more and more Chinese producers have shifted their product mix from upstream low value-added rare earth chloride/concentrate to midstream or downstream high value-added rare earth products such as rare earth metal, high purity REO, fluorescent material and magnetic material.

### Rare Earth Production and Consumption

In 2000, the United States consumed 23,000 tonnes of rare earth products, which accounted for 31% of the 75,000 tonnes of global rare earth consumption. China ranked second (25%) and Japan third (20%).

**Global Rare Earth Consumption (2000)**



Source: [www.cre.net](http://www.cre.net), Mining Engineering (1997-2000), Industrial Minerals (January 1999-2000)

Statistics show that total combined rare earth consumption by the US, China and Japan accounted for over three-quarters of the world's total in 2000. Therefore, a look into the rare earth applications of the three countries will help towards gaining a general picture of rare earth applications in the world and predicting future development trends. Details of rare earth applications in the three countries are shown in below.



Comparison of Rare Earth Application (%)					
	Metallurgy	Catalyst	Glass/Ceramics	New Materials	Others
China	27	21	10	25	16
Japan	0	6	49	42	3
US	8	72	3	12	5

Source: Worldsec Research

### Japan

Glass and ceramics is the largest consumer of rare earth in Japan, accounting for 49% of its total rare earth consumption. Rare earth in this field is mainly applied as polishing powders and additives for anti-violet glass. The second largest consumer of rare earth in Japan is new materials, including permanent magnetic materials, phosphors and NiMH batteries, accounting for 42% of total consumption.

### United States

The application of rare earth in the US differs greatly from that in Japan. Roughly 72% of rare earth is consumed in catalysts in the US, of which about 90% is used for auto emission control and 10% for petroleum cracking catalysts. This is because the US is the world's largest vehicle producer and consumer and has strict controls over auto emissions.







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