

FIGHT FOR RARE EARTH



From iron ore to timber, China relies on foreign supplies to fuel its growth. But when it comes to rare earth metals—essential for clean energy and electronics—China dominates. The rest of the world is worried.

Reuters analyses the issues

NOVEMBER 2010



REUTERS

DREAM FOR RARE EARTHS RESTS ON GRIM COSTS

By Chris Buckley
BAOTOU, China

CHINA'S QUEST FOR A GREEN FUTURE built on rare earths metals seems a world away from Ren Limin as he casts lumps of one of the metals in a chemical-spattered shed thick with acrid fumes.

Ren tends cauldrons of sputtering acid, additives and ore in a shed in north China's Inner Mongolia region, smelting lanthanum, one of the 17 rare earths that Beijing hopes will power the nation up the clean technology ladder.

Yet Ren and a workmate use few safety protections as they stir and poke the red-hot cauldrons. Holes in the roof and windows act as main ventilation.

"This place doesn't have anything but it's got mines. We live off the rare earth mines," Ren, who gave his age as 32 but looked years older, told Reuters journalists who visited Baotou, a city of 1.8 million people about 650 kilometres (404 miles) west of Beijing that calls itself the "capital of rare earths".

"It's not that dangerous. You get used to the smells, but there's also the heat," he said.

China says it must curb rare earth ore sales abroad for the sake of its environment, though its own rare earths industry is marked by pollution and primitive production that tightening export quotas alone appears unlikely to staunch.

China supplies 97 percent of the world's rare earths, used in computers and clean energy technology such as wind turbines and electric cars. The battery of a Toyota Prius hybrid car uses 10 to 15 kg (22-33 lb) of lanthanum.

Beijing has sparked international concerns by curbing exports of rare earths which it says it needs for its own green growth.

Ren was unaware of the diplomatic fuss and met questions about environmental and health problems linked to production with gruff bemusement.

"We sell it on. That's all I know. I'm not sure who buys it or what it's for," he said of a pile of lanthanum bricks lying on the floor, among discarded cotton gloves and scrap.

He worked without a mask but wrapped a towel around his face and donned a visor when pouring the molten compound into molds.

He said they made 1,100 yuan (\$165) a tonne,

working 12-hour days, with a few days off every two weeks.

The plant he works in lies in a northern corner of Baotou, a city and surrounding expanse of Inner Mongolia that produces more than half of the world's rare earths, especially the lighter ones, from the fenced-off Bayan Obo mines.

The government says it wants to end unfettered exploitation of rare earths, and has been shutting unlicensed mines and smelters. But China's biggest producers still pollute at levels far beyond what would be allowed in the United States, Australia and other countries now looking to ramp up production as Beijing curbs exports.

Near Baotou city, where Baotou Steel Rare-Earth Group processes the metals on a vast scale, villagers said the resulting toxins were poisoning them, their water and air, crops and children. At



GREEN FUTURE

Workers load discarded piles of sacks onto a truck at a rare earth smelting plant located on the outskirts of the city of Baotou in China's Inner Mongolia Autonomous Region
REUTERS/David Gray

least one official has backed that claim.

"If we take into account the resource and environmental costs, the progress of the rare earths industry has come at a massive price to society," Su Wenqing, a Baotou rare earths industry official wrote in a study published last year.

"MIDDLE EAST" OF RARE EARTHS

Baotou wants to remake itself as a crucible of China's ambitions to turn its rare earths into green-tinged gold.

The city has a rare earths high-tech zone, a shiny Rare Earths Tower for officials and investors, and Rare Earths Street.

The city's Rare Earths Park features carvings of scientists and leaders who pushed China to turn its reserves into an engine for economic growth, including Deng Xiaoping, the revolutionary veteran who guided the nation to market economic reforms.

"The Middle East has oil, and China has rare earths," a carving records Deng as saying in 1992.

"China's rare earths resources can be likened in importance to the Middle East's oil. They have immense strategic significance and we must certainly deal with rare earths issues with care, unleashing the advantages they bring."

The Baotou Steel Rare-Earth Group is at the heart of China's ambitions to turn rare earths into a lucrative ingredient of growth. It dominates rare earths production in Inner Mongolia, where most of the ores come out of the ground mixed with iron ore, which is the parent company Baotou Steel's main business.

THE CITY HAS A RARE EARTHS HIGH-TECH ZONE, A SHINY RARE EARTHS TOWER, AND RARE EARTHS STREET

China wants enough rare earths for its expansion into clean technology, especially advanced wind turbines, hybrid and electric vehicles and other innovations.

Minutes from the mines of Bayan Obo north of Baotou city, hundreds of wind turbines jut above the grasslands, their three blades and parts using rare earths in compounds that give them strength and lightness.

"MOTHER SHIP" BESET BY POLLUTION

At the heart of Baotou's rare earths smelting, those environmental aspirations are blighted by pollution that can cut visibility around the main plants to a few dozen metres.

Su Wenqing, the Baotou industry official, wrote that companies there had dumped tailings, including mildly radioactive ore scrap, into local water supplies and farmland and the nearby Yel-



[CLICK FOR SLIDESHOW](#)

low River, "creating varying levels of radioactive pollution."

Repeated faxes and phone call inquiries to Baogang city authorities and Baotou Steel Rare-Earth Group were not answered.

The outer walls of the Huamei plant proclaim its ambitions to become the "mother ship" of Chinese rare earths production. But villagers near the rare earths plant live in a blanket of fumes, a constant reminder of how much China still allows near-unfettered industrial growth.

Separating out the minerals is usually done by dousing the rare earths in acids and other chemicals. The tailings from Huamei and other nearby metals plants end up at a 10 square kilometre dam. The reservoir can hold 230 million cubic metres of the dark, acrid waste. That, according to a sign on its banks, is equal to 92,000 Olympic-sized swimming pools.

The residents of Xinguang village said the chemicals from the dam have been seeping into the underground waters that feed their wells, crops and livestock, including fluoride. They complained of nausea, dizzy spells, arthritis, migraines, wobbly joints and slow-healing injuries.

"The pollution is too much for even our crops to grow, and a lot is from the rare earths plants," said Wu Leiji, a ruddy-faced farmer. "It's not getting any better. In fact, it's worse. Look at the kids. They're the worst off. What will all this pollution do them?"

A report last month in a Chinese newspaper, the Yangcheng Evening News, cited experts supporting the villagers' complaints of damaged health from rare earths and other smelting pollution.

"When we boil the water to drink, this white scum forms on top and it tastes bitter," said Guo Gang, a 58-year-old farmer. "We used to grow vegetables, but now all we can grow is corn, and even the crops for that are far smaller than 10 years ago." (\$1=6.68 yuan)

(Additional reporting by David Gray in Baotou and Sabrina Mao in Beijing; Editing by Ken Wills and Jonathan Thatcher)

ANALYSIS

CHINA'S RARE EARTH HAMMER HITS ECONOMIC RAW NERVE

By Chris Buckley
BEIJING

CHINA WANTS TO USE ITS MONOPOLY over global rare earth supplies to win the race for clean energy technology that depends on the metals, but it is a strategy that could backfire, costing Beijing its advantage.

Japanese companies, which use the metals in hi-tech products, worry that Beijing is already using its power to squeeze supplies as a political tool in diplomatic disputes with Tokyo -- something China denies.

It has slashed export quotas to about 40 percent below 2009 levels.

"I don't think it's political. I think it's strictly economic," said Jon Hykawy, an industry analyst with Toronto-based Byron Capital Markets, who specialises in rare and other minerals used in clean technology, referring to China's export cuts.

"Japanese companies are in full panic mode. As far as they are concerned, this is a red-alert situation," said Hykawy.

China, as other producers have given up environmentally destructive mining of rare earths, now supplies 97 percent of the world's demand for the metals, whose magnetic, luminescent and other qualities make them essential for clean energy, computers and electronics.

For a country with a voracious appetite for imported commodities, it is one over which China can exert control as an exporter. It now wants the metals for itself for technology that it can use at home and export.

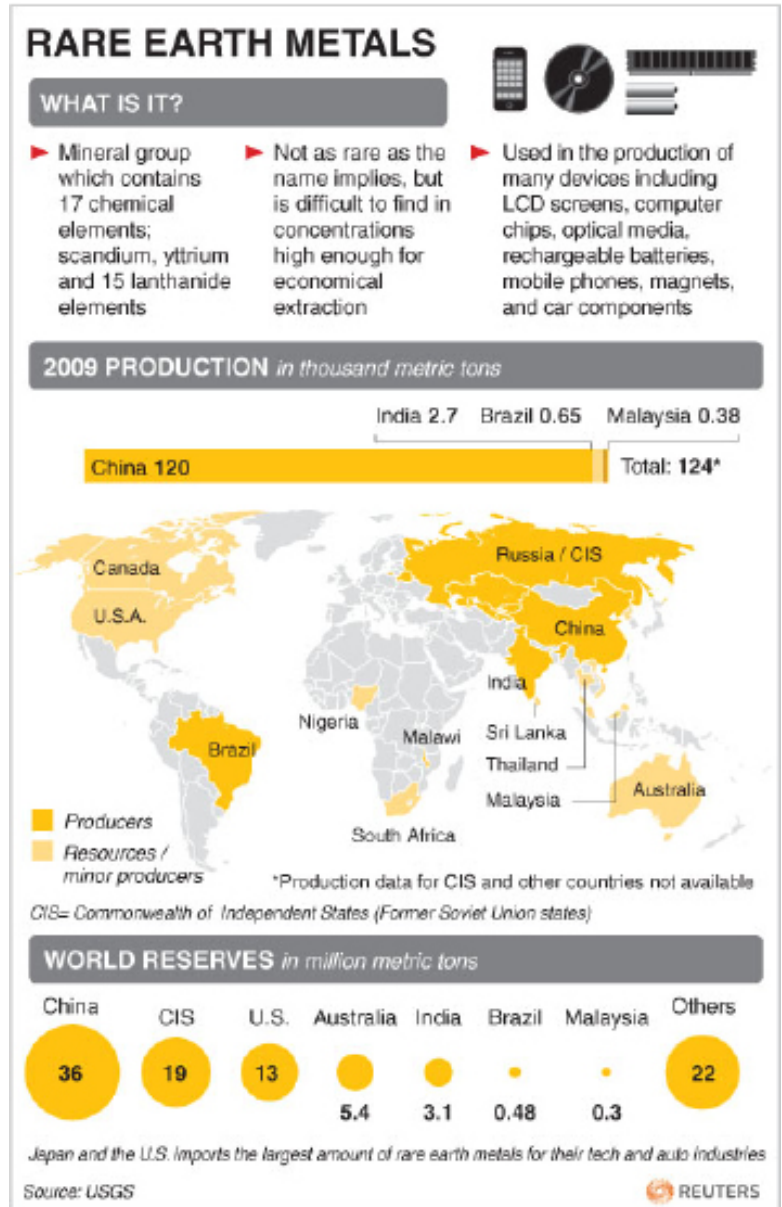
It has ambitious goals for advanced wind turbines, hybrid and electric vehicles and other clean energy innovations that use rare earth metals.

The properties of the 17 elements called rare earths also make them handy for military hardware, where Beijing spends big.

"The biggest driver in the Chinese system is continued job growth and economic growth, and if they can move a number of high-value manufacturing jobs in the green sector, as well as a lot of the intellectual property, to China by swinging the rare earth hammer, then they're willing to do that," said Hykawy.

COULD BACKFIRE

Spooking the market, however, could backfire and discourage companies hungry for the minerals from setting up shop in China.



Japan has said it will hurry to secure supplies from outside China. U.S. lawmakers are backing plans to restart a shut mine in California. Beijing's advantage could crumble in a few years.

"It's a shrinking window they're dealing with," said Hykawy.

Transforming the rocks in the ground into clean energy dominance will not be easy, said John Seaman, a researcher at the French Institute of International Relations in Paris, who has studied

China's rare earths policies.

"I think they are well on their way but still have quite some distance to go," Seaman wrote in emailed answers to questions.

"They may be hammering down on smuggling and illegal mining, he added. "But effective, longer term oversight on the rare earths industry is still a ways away."

Rare earths are the MSG of high technology, added in machines and computers components to boost performance, like the flavour enhancer used in Chinese restaurants, some Chinese observers say.

For years, China treated its rare earth reserves, about 36 percent of currently known mineable global reserves, as cheap and ubiquitous. Not any more.

"Industry insiders joke that we've been selling gold for the price of carrots," said an overview of the rare earths sector published this month in *Macroeconomics*, a journal of Beijing's Academy of Macroeconomic Research, which advises policy-makers.

China became strong in rare earths using the recipe it has for many other industries: state support, cheap labour and little concern over pollution, illegal mining or smuggling.

It mined about 120,000 tonnes of rare earths in 2008.

The United States shut the rare earths mine in California, unable to compete against cheap Chinese exports. Markets became used to relying on China.

"This happens all the time in China, but because rare earths is such a small industry, nobody paid attention," said Jack Lifton, co-founder of Technology Metals Research, an Illinois-based company that follows the area.

"We cannot continue to pretend that we're outraged that China has a monopoly on the supply of

rare earths when we're the ones who gave them that monopoly," he said.

CHEQUE BOOK IN HAND

The recent political ructions may have been an excuse to withhold shipments and prod foreign companies to buy more magnets and other components containing rare earths from China, and even move production there, said some industry analysts.

But if new mines open in Australia and elsewhere and processing and recycling plants also expand, China's bargaining advantage will be eroded, said Hykawy.

"There are some Japanese corporations and some others who are basically walking around with cheque books in their hands, saying 'We'll help bankroll these projects as long as we can get what we need,'" he said.

Abrupt curtailing of rare earth shipments from China could make foreign companies more wary of moving there, said Seaman, the Paris-based researcher.

"Companies were already worried about sovereign risk, relying too much on China for their chains of production."

China will also have to contend with home-grown problems that could stifle efforts to turn rare earths into high-tech gold.

Illegal mining has eroded reserves, and smuggling has been common. Even the legitimate sector remains fragmented and inefficient, said the Chinese magazine, *Macroeconomics*.

"Our rare earths industry is big yet weak," it said. "The resource advantage has yet to turn into an economic one."

(Additional reporting by Paul Eckert in Washington; Editing by Jonathan Thatcher)

FACTBOX

WHAT ARE RARE EARTH ELEMENTS?

RARE EARTH elements are used in a wide range of consumer products, from iPhones to electric car motors. Rising tensions between China and Japan over an embargo on rare earth elements may spell good news for miners looking to fund projects outside of China. Here are some facts on this elusive group of 17 metals.

WHAT ARE RARE EARTHS?

Lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium, scandium, yttrium.

WHAT ARE RARE EARTHS USED IN?

Rechargeable batteries for electric and hybrid cars, advanced ceramics, magnets for electric car motors, computers, DVD players, wind

RICH MINERAL A

piece of bastnasite ore containing rare earth elements from Molycorp Minerals' Mountain Pass mine in California. The open-pit mine holds the world's richest proven reserve of rare earth metals. REUTERS/David Becker



Q+A

WHY THE JITTERS?

BEIJING

CHINA'S DOMINANCE OF RARE EARTHS used in high-tech products has aroused growing international attention after reports that the government has been choking off shipments, possibly out of political pique. Here is an explanation of the issue and why it matters.

WHY ARE CHINA'S RARE EARTHS IMPORTANT?

The computer you're possibly reading this on almost certainly contains rare earths, a set of 17 minerals with magnetic, luminescent and other properties that make them useful in hard drives, magnets, lasers and other gadgets important in computing, clean energy and military applications.

Rare earths are relatively common in the ground but are much more scarce in concentrations that make mining them worthwhile.

China produces about 97 percent of the world's rare earths, and that means its policies in the sector ripple across the world. It has about 36 percent of the world's known exploitable reserves of rare earths. Since the 1990s, Chinese miners and processors have massively expanded production while foreign competitors in the United States and elsewhere have shut down.

China's dominance has been helped by state support, together with relatively low wages and loose regulation of environmental damage caused by mining and processing rare earths.

HAS CHINA BEEN BLOCKING EXPORTS?

Reports in the New York Times have said that China cut some shipments of rare earths to Japan, possibly out of anger over a sea territory dispute.

The reports have also cited industry sources as saying China may have taken similar steps against the United States and Europe after Washington launched a trade investigation into Chinese state support for clean energy technology.

China does not have a history of using its economic sway as a blunt political weapon, and nor does it have many resources it can withhold. Perhaps that is changing.

The difficulties some foreign purchasers have had may have arisen from China's stricter enforcement of export quotas and related measures, not out of pressure for political ends, said Gareth Hatch, the founding principal of Technology Metals Research, an Illinois-based company that follows the sector.

China has said it has been alarmed to see its rare earths reserves being mined so voraciously and then sold abroad at prices that it says do not reflect the metals' real importance and the environmental cost of processing them.

That push to control exports has been stoked by China's efforts in green technology, where rare earths can be used to make more efficient batteries, wind turbines and other technology.

It has been imposing stricter controls on mining and cracked down on unlicensed mining and smuggling.

Beijing has introduced export duties and quotas for rare earths. This year it steeply cut export quotas so total exports for 2010 will be about 40 percent below 2009 levels. For the second half of the year they will be 72 percent below levels in the second half of 2009.

"I have heard of a handful of consumers of rare earths outside of China have had a challenge acquiring certain materials -- samarium would be one, used in permanent magnets; compounds of lanthanum and cerium would be others -- used in a variety of applications," Hatch wrote in an email.

"But this has been driven by the traders not wanting to ship lower value light rare earths, in favor of the heavier, more-valuable stuff. Most other folks I've spoken to have not mentioned any issues, beyond grumbling about the price," he wrote.

WHAT DOES CHINA WANT TO DO WITH ITS RARE EARTHS?

The government wants to get into more profitable higher-end production and to nurture homegrown industry champions.

China is also pushing to become a major force in green technology in which rare earths are an important ingredient.

Restricting exports will force foreign com-

turbines, catalysts in cars and oil refineries, computer monitors, televisions, lighting, lasers, fiber optics, glass polishing, superconductors, and weapons.

THE IPHONE CONNECTION

Rare earths make for smaller, lighter batteries and motors. The drive to miniaturization was first popularized by the Sony Walkman personal cassette tape player. Rare earths are now key to making hand-held devices like Apple's iPhone and Research In Motion's BlackBerry.

BIGGEST CONSUMERS

China uses 51 percent of the world's rare earths, while Japan uses 17 percent. Global demand is forecast to grow rapidly as demand for green products increases.

BIGGEST PRODUCERS

China produces over 90 percent of global supplies. China mined 120,000 tonnes in 2008. Molycorp in California produces 3,000 tonnes per year, while Silmet Rare Metals in Estonia produces 2,400 tonnes per year. There are

panies to buy more of the completed products containing rare earths from China until other countries increase their own production. Beijing's quotas do not apply to finished products.

WHAT ARE THE IMPLICATIONS AND WHAT COULD HAPPEN?

China's push has ignited economic and geo-political jitters.

One worry is that Beijing's chokehold on exports could hurt foreign companies and drive up international prices.

Hatch said some purchasers were "aghast at the current pricing as it puts them at a terrible price disadvantage compared to their competitors based in China."

A more distant worry voiced by some in Washington is that China could cut off the United States and other potential rivals of access to minerals used in military equipment.

Chinese officials from Premier Wen Jiabao down have said that their government is not using its rare earth as a political weapon.

Last week officials denied a Chinese newspaper report that China would cut quotas by 30 percent next year.

Industry players will be waiting to find out what quotas Beijing will set in place next year and beyond, and also want a finer sense of how the quotas will work.

Already some governments have said for-

foreign companies should not be so dependent on China for such an important ingredient.

Mining outside China that offers access to rare earths could benefit from this push, including in the United States, Vietnam, South Africa, Australia and Canada.

But mining rare earths is the easy part. The more difficult and expensive part is separating and processing the minerals so they can be used for final applications.

Governments and companies will have to decide whether they are willing to pay for that capability. It could be very expensive and take years to set up such production facilities.

Sources: Reuters; Gareth Hatch, Technology Metals Research; U.S. Government Accountability Office, "Rare Earth Materials in the Defence Supply Chain"; John Seaman, "Rare Earths and Clean Energy"; U.S. Congressional Research Service, "Rare Earth Elements: The Global Supply Chain"

(Reporting by Chris Buckley; Editing by Ken Wills and Jonathan Thatcher)

small amounts of rare earths mined in India, Malaysia and Brazil.

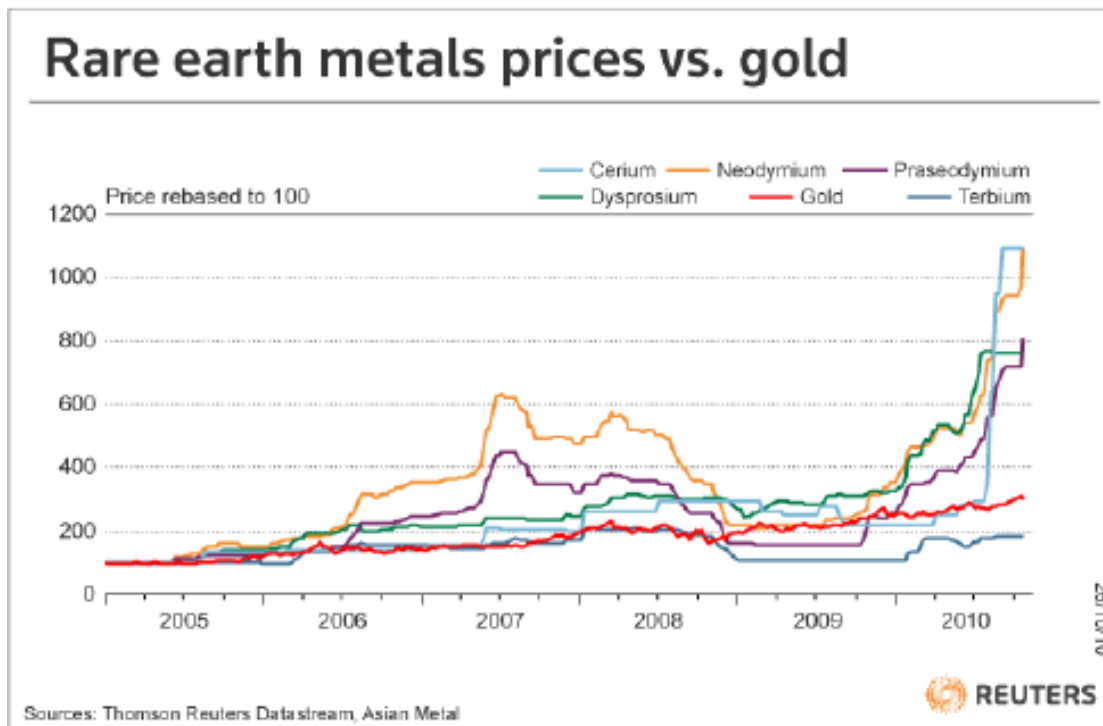
BIGGEST DEMAND

The demand for dysprosium, terbium, neodymium, praseodymium and europium is set to grow by a minimum of 8 percent a year. Electric vehicle demand for dysprosium, neodymium and praseodymium is set to grow by an average of 790 percent in the next five years.

MINES UNDER DEVELOPMENT OUTSIDE CHINA

- Great Western Minerals, Steenkampskraal, South Africa
- Avalon Rare Metals, Nechalacho, Canada
- Molycorp, Mountain Pass, U.S.
- Lynas Corp, Mount Weld, Australia
- Arafura Resources, Nolans, Australia

Sources: U.S. Geological Survey, company web sites, Byron Capital Markets (Reporting by Julie Gordon; Additional reporting by Steve Gorman and Sonali Paul; Editing by Michael Perry and Paul Tait)



Sources: Thomson Reuters Datastream, Asian Metal

Reuters graphic/Scott Barber

ANALYSIS

RARE EARTHS GIVE CHINA AN EDGE IN JAPAN TIES

By Tim Kelly and Chikako Mogi
CHIGASAKI, Japan

SUPPLIES OF A BRICK-RED POLISHING powder crucial for Japan's electronics industry could run out soon and the shortage may persist even if Japan sidesteps a Chinese embargo on the main ingredient, a metal called cerium.

Even before Japan's latest diplomatic spat with the producer of 97 percent of the world's rare earth metals, concern about China's ability to disrupt global supply chains had surged as the country slashed shipments of a score of the exotic metals.

The cuts, which translated into a squeeze of 40 percent for cerium, the most critical metal, are still in place and there is a chance of more next year, said Toshio Nagayama, a general manager at AGC Seimi Chemicals in Chigasaki, a town near Tokyo.

But even without further supply interruptions, makers of flat panel TVs and hard disk drives, in particular, could face critical shortages as soon as next month, besides soaring prices.

Cerium is a dull silver malleable ingredient of the abrasive powder used to polish sheets of glass as thin as credit cards, between which television makers sandwich drops of liquid crystal to make flat panel displays.

It is also used by makers of the glass hard disk drives that are rapidly displacing less robust

aluminium drives in devices designed to stand up to the rigours of mobile computing.

"Companies don't have enough abrasive in stock to see them through," said Nagayama, whose firm is one of three Japanese companies that make 80 percent of world supplies of the abrasive. "The serious pinch in supply will be in November and December."

The prospect is worrying Japanese firms, which take 56 percent of China's rare earth exports. They face a further cut of as much as 30 percent in supply next year, according to Chinese media, although the country's commerce ministry has denied the claim.

China issued export quotas for only 30,258 tonnes of cerium by the end of July, down 40 percent from last year, saying it was a necessary step to protect the country's environment.

CHINA'S EDGE IN WOOLING TECH FIRMS

China's squeeze gives it an edge in attracting technology companies hungry for its ready supplies of rare earths.

Nagayama's employer, AGC Seimi, and its two Japanese rivals, Showa Denko and Mitsui Mining and Smelting, are scrabbling for supplies.

FACTBOX WINNERS AND LOSERS

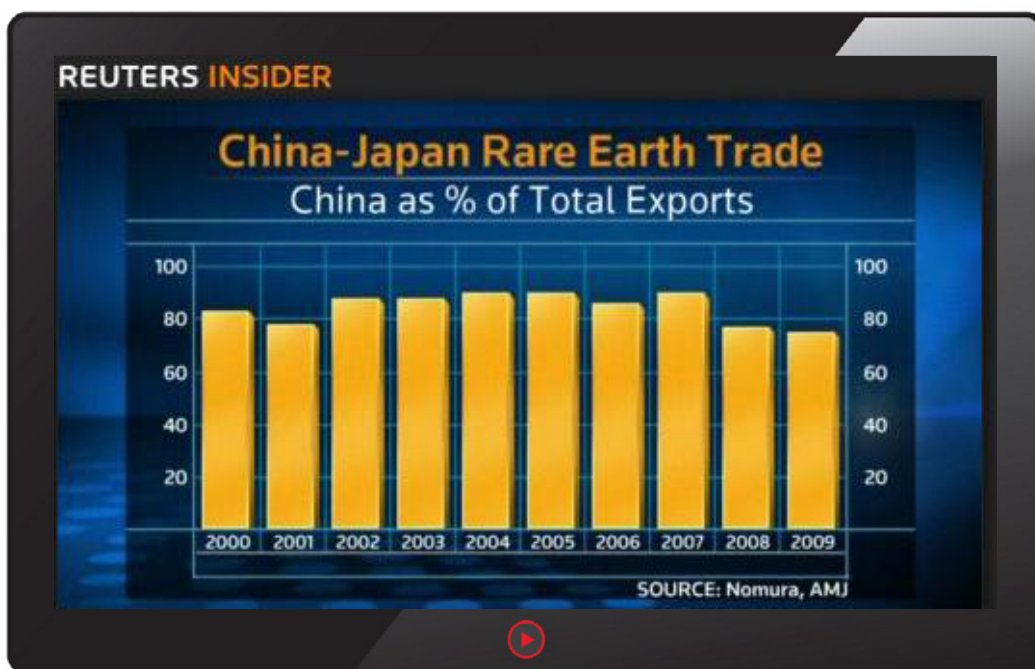
CHINA HAS curtailed exports of rare earths, causing offshore consumers to consider alternative supply sources for the minerals which are used in everything from TV screens and computers to mobile phones and toys.

China supplies about 95 percent of the world's rare earths.

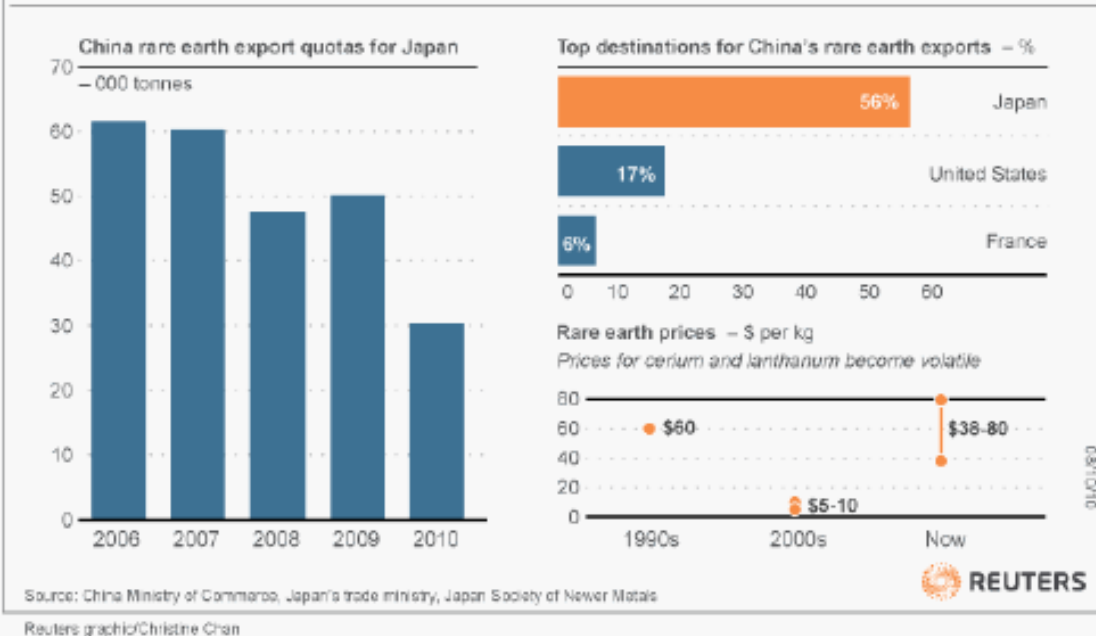
Following is a list of winners and losers if China's rare earths exports dry up:

LOSERS

MANUFACTURERS
* Industrial manufacturers in Japan and Korea, which consumed a fifth of the world's rare earths last year, would be hardest hit by reduced Chinese exports. Sectors that would bear the brunt of restricted supplies would be makers of metal alloys, magnets, catalytic converters and polishing compounds.



Rare earth elements



Together, the three companies make around 12,000 tonnes of the cerium abrasive a year, or four-fifths of global output, an industry source said.

Scared their abrasive will run out, customers are asking for five times more than usual and prices have soared, Nagayama said.

Japan says cerium costs up to \$80 a kg, a jump of 16 times in less than a decade. AGC Seimi is promising existing customers regular shipments at a higher price. New buyers are turned away.

Companies will just have to get used to the heftier expense, Nagayama said.

"It is a serious concern and a burden to our customers," Sadao Senda, president of rival Mitsui Mining, told a news briefing in Tokyo in September.

Senda, who also chairs a Japanese mining industry body, said he was consulting with customers but did not say how he would guarantee supplies.

Much of AGC Seimi's output, according to the industry source, goes to its parent company, Asahi Glass, which turns out a quarter of the world's LCD glass sheets.

Another chunk ends up at leading glass hard disk drive maker Hoya Corp.

The shadow they cast across the component supply chain means any production cut caused by a cerium abrasive shortage will spread to the United States and Europe.

Both Asahi Glass and Hoya declined to comment on whether the squeeze would force output cuts, as did Sharp Corp, Japan's leading maker of flat panels, and Sony Corp, which are one step along in the supply chain.

Panasonic spokesman Akira Kadota said his company had no plan to cut production of TV sets.

Alternatives include recycling, made viable by the price jump, and cerium sources outside China, officials of Asahi Glass and other firms said. Despite its name, cerium is not scarce and is as common as copper or zinc.

There is a mine at Sillamae in Estonia and another at Mountain Pass, California in the United States. Others are planned in Vietnam, Kazakhstan, India and even Mongolia.

The challenge, however, is not finding deposits but having the equipment to dig it up and ship it to cerium-famished Japan, says Joji Sakurai, head of Mitsubishi Corporation Unimetals, a unit of Japan's No.1 trading company, Mitsubishi Corp.

That snag will not be overcome in time to relieve the imminent pinch in supply, he added.

"There is no alternative source readily available," Sakurai said at his firm in Tokyo. "It's the worst I've seen it in more than 30 years working."

And even when those shipments start, China will remain the dominant source of the rare earth elements.

Molycorp Inc, operator of Mountain Pass, sees global demand of some 220,000 tonnes by 2015, from less than 150,000 tonnes now.

Nine-tenths of that will still be dug up in China, leaving Japanese firms at the sharp end of China's whims for years to come.

(Editing by Clarence Fernandez)

* In the United States, manufacturers of catalytic converters would suffer the most, followed by the metal alloying and ceramic-making sectors.

* European Union consumers would face shortages mainly in manufacturing of catalytic converters, given the high concentration of auto-making in the region.

WINNERS MINERS

* Some new and mothballed rare earths producers would likely get the green light to proceed if China's exports dried up. Many of these projects did not make economic sense while China completely dominated the market. The major projects are:

* Mountain Pass, located in the United States and owned by Molycorp Minerals: once the world's largest producer of rare earths, the mine ceased removing ore from its open pit in 2002. Molycorp has continued some production from existing stocks and plans

ANALYSIS

MINE-TO-MARKET MODEL IS KEY FOR RARE EARTH MINERS

By Julie Gordon
TORONTO

RARE EARTH ELEMENTS ARE ESSENTIAL components in everything from iPhones to wind turbines, and the buzz around this obscure group of 17 metals is growing as green technology fuels demand at the same time as supplies are shrinking. China, which produces over 90 percent of the world's supply, is chopping exports by almost half this year.

A looming global shortage has pushed numerous Canadian miners into the spotlight, all of them eager to chase down the Holy Grail of a massive rare earth deposit.

But like the legendary Grail, a viable rare earth mine outside of China may be difficult to find. Processing costs are huge, making it difficult to compete with Chinese producers even as promising new deposits are identified.

"We're going to run into shortages of rare earths within the next year or two," said Byron Capital Market analyst Jon Hykawy, adding that the heavy rare earths, used in electric vehicles, will likely run out first.

"But simply identifying a potential mine is not a reason to celebrate victory," he said. "I would say it is very tough to make a go of producing rare earths without at least separation and purification as a part of the model." In the end, analysts say, it will take a deposit with the right mix of rare

earth elements to make a non-Chinese mine into a profitable operation.

This means Canadian rare earth companies like Avalon, Great Western Minerals and Quest Rare Minerals face a daunting challenge breaking into a market dominated by the Chinese.

Cheap labor and lax environmental policies allowed China to undercut other global producers in the 1990s, leading to rare earth mine shut-downs around the world. Then, China reduced export quotas to build up its refining, processing and alloy production industry.

Currently, there are only a few non-Chinese companies that produce the rare earth powders and metal alloys needed for green technologies, military use and consumer electronics.

One of these companies is Great Western, a Saskatoon, Saskatchewan-based outfit that buys concentrates from China and makes alloys to sell to most major magnet manufacturers.

With China tightening its rare earth exports, Great Western has secured the rights to the Steenkampsraal mine in South Africa, which has high concentrates of rare earth oxide.

By 2013, Great Western plans to take rare earths through the entire process from mining to finished product, putting it in direct competition with the Chinese.

to restart mining an annual rate of 18,000 tonnes in 2012.

* Hoidas Lake (Canada, Great Western Minerals Group): the project is at an advanced exploration stage with start-up tentatively scheduled for post-2014 at an annual rate of 3,000-5,000 tonnes a year.

* Nechalacho (Canada, Avalon Ventures Inc): early exploration and costing work is underway to develop a project in about five years producing 3,000-5,000 tonnes a year.

* Mt Weld (Australia, Lynas Corp): due to start up in 2011, initially producing about 10,500 tonnes, rising to 21,000 tonnes annually in 2013.

* Dubbo Zirconia (Australia, Alkane Resources): could be activated as early as 2013 at an annual rate of 2,500 tonnes.

* Nolans (Australia, Arafura Resources): tentatively scheduled to be in production in 2014 and operating at an annual



"Because of our full integration, we are unique in the industry," said Chief Executive Jim Engdahl. "We already have clients that are magnet manufacturers around the world."

The key to Great Western's potential is its mine-to-market model, said Hykawy, adding that vertically integrated miners are best placed to benefit from rapidly rising metal prices.

Cerium oxide, the lowest value rare earth, has jumped 930 percent since 2007 to over \$35 per kilo, while the more valuable dysprosium has jumped 220 percent to \$286 per kilo.

"The math is easy," Hykawy said.

HEAVY VS LIGHT

But is vertical integration enough to ensure rare earth success? Independent commodities commentator and strategic metals expert Jack Lifton isn't so sure.

He puts more emphasis on mineral concentrations, favoring the heavy rare earths.

All rare earth deposits contain the 17 elements in varying concentration. The heavy rare earths are in far shorter supply, and as such, are more valuable.

"The Chinese have such enormous reserves of light rare earths that I find it very, very improbable that there could be a profitable light rare earth company developed outside of China," he said.

To get at the heavy elements, miners must also process the less valuable light ones. This could spell disaster for companies whose deposits are low in heavies, said Lifton.

"If I make 9,600 white Chevrolets, and 400 black ones, and only the black sell, please don't tell me that's good economics," he said. "Making something is not what counts, it's selling something that's important."

Avalon Rare Metals is one company that will have a lot of heavy rare earths to sell, if it can raise the money it needs to bring its Nechalacho mine into production.

The mine, located in northern Canada, has a low total concentration, but is rich in valuable dysprosium and terbium.

"That greater enrichment in heavy rare earths makes for a more valuable ore in the ground," said Avalon Chief Executive Don Bubar. "And much bigger potential profit margin on production."

Avalon's goal is to further increase profit margin by including a mill and a hydrometallurgical plant on site.

But because of the remote location and heavy infrastructure needs, the project will cost an estimated C\$844 million (\$792.6 million) to bring into production, which analysts see as a tough pill for investors to swallow.

"If Avalon came online it would solve the world's problems, but it wouldn't solve Avalon's problem," said Lifton. "Their problem is how do you raise that kind of money?"

One idea is to approach the Chinese for funding. While China has over half the global deposits of rare earths, its heavy resources are almost depleted, said Hykawy.

"If the 'heavy' deposits were to approach the Chinese for certain guarantees, it might make their financing approaches much simpler," he said. "Right now, we believe they are going to have a tough time."

(Reporting by Julie Gordon; Editing by Frank McGurty)

rate of 20,000 tonnes.

* Kvanefjeld (Greenland, Greenland Minerals & Energy): the mine is being designed to produce 20,000 tonnes of rare earths as a co-product to uranium. No start date has been disclosed.

Source: Thomson Reuters, U.S. Geological Survey

(Reporting by James Regan; Editing by Mark Bendeich)

CHINA VOWS NOT TO USE RARE EARTHS AS LEVERAGE

By Aileen Wang and Lucy Hornby
BEIJING

CHINA SAID IT WILL NOT USE ITS dominance of supplies of rare earths as a bargaining tool with foreign economies, and the United States said it hoped trade in the high-tech ores would continue as normal.

China has slashed export quotas and reduced shipments to Japan, igniting international concern that it could use rare earth exports as an economic or political lever. Prices have spiked and mining firms are rushing to develop sources of the minerals outside China.

The U.S. and European Union this week said they were pressing for solutions to fears that China was

choking supply of the substances used in lasers, computers and superconductors, among other applications, and the issue is expected to figure at next month's G-20 summit.

Chinese Ministry of Industry and Information Technology spokesman Zhu Hongren said Beijing sought international cooperation.

"China will not use rare earths as an instrument for bargaining," he told a news conference. "Instead, we hope to cooperate with other countries in the use of rare earths on the basis of win-win outcomes and jointly protecting this unrenewable resource."

The ministry is one of several in China that oversee rare earths.

Zhu was speaking on the same day a newspaper published by China's Ministry of Commerce urged China to resist pressure to allow foreign firms more access to its rare earths.

U.S. Secretary of State Hillary Clinton said she was unaware of China's vow not to use them as a bargaining chip, and, speaking in Hawaii, said she would welcome any clarification of China's stance on the minerals.

"I ... hope that it means trade and commerce around these important materials will continue unabated and without any interference," Clinton told a news conference with Japan's foreign minister.

"At the same time, because of the importance of these rare earth minerals, I think both the minister and I are aware that our countries and others will have to look for additional sources of supply," she said.

One engineering firm, Japan's Nidec, has already said it will start making motors that do not use rare earths to lessen reliance on the minerals.

China supplies about 97 percent of the world's demand for rare earth metals, which possess magnetic, luminescent and other properties used in emerging clean energy technologies, computers and electronics.

Prices of some rare earths on world markets have increased tenfold this year, reversing a long-trend towards lower prices caused largely by greater Chinese production over the past two decades.

In response to higher prices and worries among major consumers such as Japanese hi-tech industries that they will be unable to rely on large scale deliveries from China, mining firms are scrambling to speed up mine development timetables.

Shares in potential producers of the minerals outside China, such as Molycorp and Lynas Corp



HOT COMMODITY

Rare earth metals are used in electronic products such as the iPhone

REUTERS/Eric Thayer

have rocketed since July, when China said it was reducing exports by 72 percent in the second half of the year.

Australian firm Arafura Resources on Thursday raised A\$90 million (\$87.5 million) to develop a rare earths project, but some analysts have said the long-term investment case for the minerals may be weak, and the market has the makings of a bubble.

(Writing by Daniel Magnowski, editing by Miral Fahmy)



GERMAN INDUSTRY WARNS RARE EARTHS MARKET CRITICAL

By Dave Graham
BERLIN

GERMANY'S ELECTRONICS INDUSTRY said the market for rare earths used to manufacture a range of high-tech products had become "critical" due to restrictions on exports imposed by China.

China's dominance of rare earths used in high-tech products has aroused growing international attention after reports that the government has been choking off shipments, possibly out of political pique.

The warning by the ZVEI industry group, which represents firms with an annual turnover of some 150 billion euros (\$210.6 billion), follows a drive by Berlin to improve access to raw materials.

"The market for rare earths has become particularly critical due to the export restrictions in China," ZVEI Executive Director Klaus Mittelbach said in a statement.

Germany, which depends on raw materials from abroad to power its export-driven economy, is so concerned about prospective bottlenecks that its main industry federation is staging a congress to

address the issue.

The ZVEI said it was worried China could cut exports of metallic elements like samarium, scandium, yttrium and neodymium further in 2011, disrupting production of parts needed for hybrid motors, rechargeable batteries and other goods.

"China has this year cut exports (of rare earths) to 38,000 tonnes from 60,000 tonnes, which among other things has pushed up the price of samarium ninefold," said Mittelbach.

German Economy Minister Rainer Bruederle rebuked Beijing during a visit to China this month for restricting supply of raw materials, access to which in Africa has also been at the centre of a tug-of-war between western powers and China.

Chancellor Angela Merkel has urged German industry to improve its channels of supply in former Soviet republics in central Asia which have extensive mineral resources.

(Reporting by Dave Graham)

GOING DEEP Rick Sixberry, operations general foreman at Molycorp Minerals' Mountain Pass Mine in California, surveys the world's richest proven reserve of "rare earth" metals. REUTERS/David Becker



INTERVIEWS

ESTONIA'S AS SILMET SAYS RARE EARTH METAL PRICE TO DOUBLE IN 2011

By Michael Taylor
LONDON

CHINA LOOKS SET TO REMAIN THE LEADING producer of rare earth metals for years to come, with prices to double next year, top European producer AS Silmet of Estonia said.

China is the world's biggest producer of rare earth metals, vital for the auto and electronics industries.

But concerns over global supplies have increased in recent months, after tensions rose between China and top consumer Japan, over imports.

"There are more than 200 rare earth projects outside of China," David O'Brock, chief executive at the privately owned AS Silmet told Reuters.

"There are a lot of very optimistic projects out there -- which may never be realised.

"If the Chinese leave the quotas at what they are today, I would guarantee that prices will at least double for next year."

Investors have watched for some time rising global demand coupled with limited supplies of rare earth metals.

Trading and mining giant Glencore International said it had entered into an agreement for the joint development of a rare earth mine.

"The way things are today, it's quite bad for a lot of our customers," said O'Brock, whose firm is one of the biggest rare earth metal producers in Europe. "Last year they ran all their stocks down ... this happened in a lot of Japanese companies.

"They ended up with very little in stock, and the Chinese come out and say 'next year we're not giving any quotas.' Of course it starts a panic."

Cheap labour and lax environmental policies allowed China to undercut other global producers in the 1990s, leading to rare earth mine shut-downs around the world.

Then, China reduced export quotas to build up its refining, processing and alloy production industry.

"In 1999 our customers were paying 85 cents a kg for lanthanum," O'Brock said about a metal used to make rechargeable batteries for hybrid cars. "Today, I'm assuming lanthanum can be sold for about \$35 a kg in the European Union.

"2008 was quite strong for us. 2009 I couldn't give the stuff away and now in 2010 everybody is screaming for material."

Rare earth metals produced by AS Silmet include steel ingredient niobium and tantalum, which is used in aerospace and computer manufacturing.

DEMAND TO RISE

Analysts say demand for rare earth metals is likely to increase by between 10 percent and 20 percent each year.

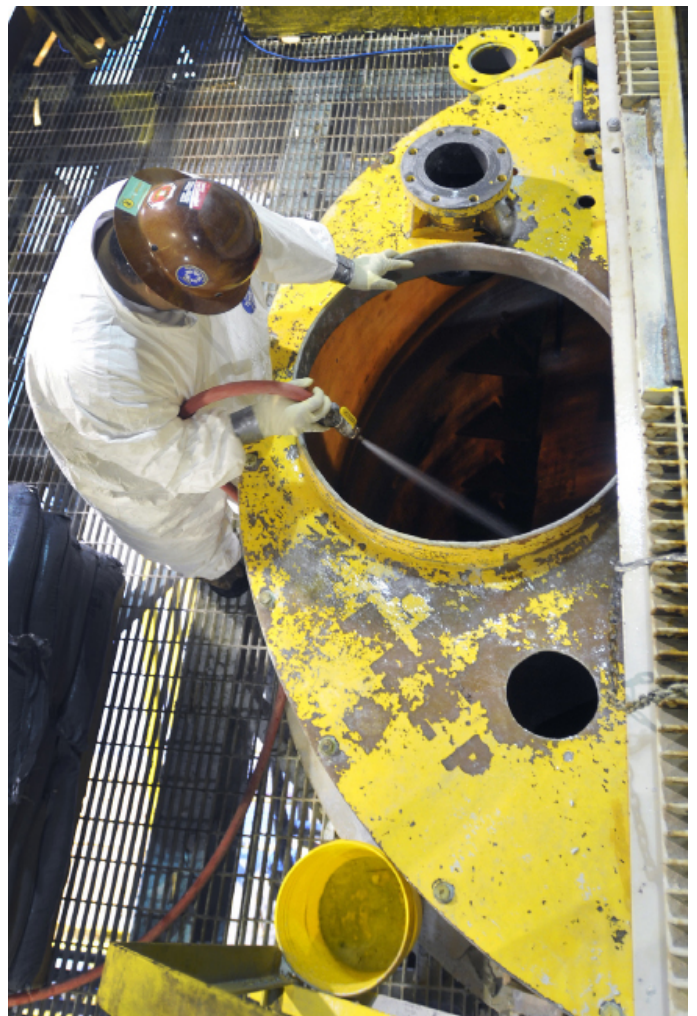
"Will (demand) stay the same? Absolutely not," O'Brock said. "Which way is it going to go? I don't know."

The AS Silmet factory began processing rare earth metals in the early 1970s, and processed and enriched uranium before that.

The factory in Estonia gets untreated raw earth metals from a mine near the Kola Peninsula close to Murmansk.

CLEAN UP *Precipitation operator at Molycorp Minerals Rick Pacheco transfers didymium from holding tanks to the finishing room during the production of rare earth elements*

REUTERS/David Becker



“Our customers get the majority of materials from China ... we’ve been able to be so flexible that maybe a shipment didn’t come in from China, we can fill the hole,” he said.

Silmet’s annual production ranges up to 3,000 tonnes for rare earth products, according to its website.

“In relation to the Chinese, we produce just a couple of drops,” O’Brock said. “In order for us to increase our capacity, we would have to do some major investment,” he said.

Earlier this month, U.S. business groups urged the Obama administration to press China to ease export restrictions on rare earth metals, while Japan is considering starting a stockpile.

“I don’t believe there is enough materials for industry today, let alone stockpiling,” said O’Brock.

(Editing by James Jukwey)

FACTBOX
RARE EARTHS IN INDUSTRY

RARE EARTHS have stormed to the forefront of global worries over fears that China’s policy of curbing exports will increasingly cause shortages in other industrialised economies, given its status as the dominant global supplier.

Despite their name, rare earth elements are a relatively abundant group of 17 chemical elements. They were originally described as rare because they were unknown in their elemental form and difficult to extract from the rocks that contained them.

Below is a summary of rare earth industrial applications and some key areas where they are employed:

Catalysts Petroleum cracking catalysts and auto catalysts use lanthanum and cerium.

Glass Cerium is the major constituent of this sector, where it is used in

NEO MATERIAL CEO SEES PRICE BUBBLE

By Julie Gordon
TORONTO

A PRICE BUBBLE HAS DEVELOPED IN THE market for “rare earth” metals used to build components for the iPhone, electric cars and a range of other products, raising the prospect of a steep decline, the head of Canada’s oldest rare earth operation said.

Such a scenario could derail the economics of developing new mining projects designed to ease the current supply crunch, said Constantine Karayannopoulos, chief executive of Neo Material Technologies.

“At the end of the day, rare earths are not that rare,” he said in an interview. “Bubble economics aside, there just isn’t enough value in the ground

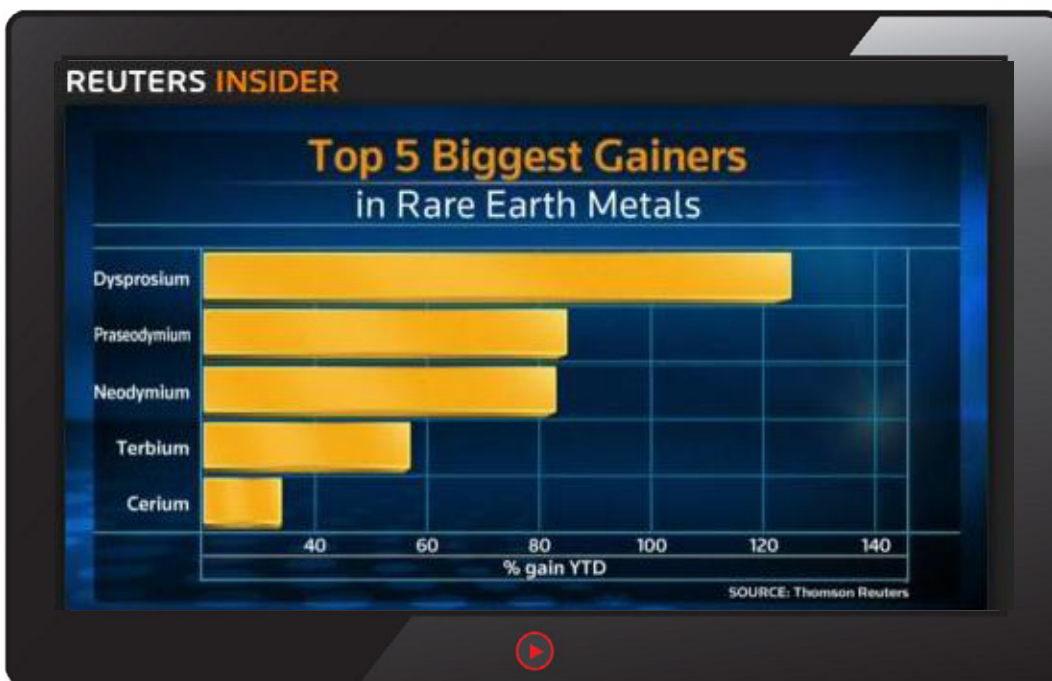
to justify digging the stuff up and processing it.”

China is chopping exports by almost half this year, creating a big gap in the supply needed to meet a surge in demand as green technology goes mainstream.

Rare earths like neodymium and dysprosium are used to build the batteries and motors for electric vehicles. Neodymium is also used in wind turbines.

Other rare earths are essential for the vibration motor in smartphones, for display panels, and in the catalyst industry, among other uses.

The current supply would easily meet the demand for most rare earths if not for the Chinese quotas. Even so, companies outside China are



eager to secure new resources.

"It's very, very dangerous for people to be committing hundreds of millions of dollars to projects that will take another five years or more to see the light of day," said Karayannopoulos.

"With today's prices, a lot of stuff makes sense ... but I also think prices at this level are unsustainable."

Neo, which makes rare earth alloys and magnets, has bought concentrate from China since 1993.

Karayannopoulos believes China has overreacted to reports of pending shortages and will soon ease export quotas, flooding the market again with cheap rare earth concentrates.

"There's a glut of this stuff in China," he said. "Because they don't consume enough, they have to export it."

Karayannopoulos is also quick to point out that the money is in rare earth alloys and magnets, not in rare earth ore or concentrate.

This poses another challenge for junior miners and explorers, because producing the alloys and magnets is labor intensive and expensive.

"These are not minerals that you are selling," he said. "You're selling highly, and very precisely, engineered materials that are customized for each customer."

HEAVY CRUNCH

To be sure, not all rare earths are in such high supply. The group consists of two types: heavy

and light. The heavies -- used in electric vehicles, display panels and lasers -- are in much smaller supply, and therefore, far more valuable.

"If there is a crunch," said Karayannopoulos. "It will come in the heavies."

China currently produces most of the world's heavy rare earths from its ion absorption clays, but that resource is running out.

That has prompted Neo to look to Brazil for new sources of heavy rare earths.

Last year, the company signed a deal with Minsur's Mineracao Taboca subsidiary to process rare earths from the tailings of its Pitinga tin mine in the Amazon.

Karayannopoulos said Neo's tests indicate that the mine is producing very high concentrates of terbium and dysprosium, two of the key heavy rare earths.

Pitinga "could potentially completely upset the heavy rare earth supply and demand situation in the world," he said. "That's the prize as far as I'm concerned, that's the Holy Grail."

The Pitinga project will cost about \$100 million to develop, including building a new processing facility.

Neo Material Technologies was down 1.14 percent at C\$4.32 on the Toronto Stock Exchange in morning trade on Wednesday. (\$1.00=\$1.03 Canadian)

(Editing by Frank McGurty)

ultra-violet light filtering.

Polishing A rapidly growing sector that is based on the unique chemical and mechanical properties of cerium in the polishing of glass, including multi-level electronic components.

Metal Alloys Nickel metal hydride (NiMH) batteries are the key driver of demand and could put pressure on lanthanum supply.

Magnets Currently, the most dynamic market for rare earths with growth in demand increasing at 15 percent a year for the past 10 years, causing neodymium and terbium to increase by more than 40 percent over the past 12 months

Phosphors Necessary for the production of phosphors for TVs and energy-efficient lamps.

This is the smallest sector by volume (only 6-8 percent) but the largest sector by value (30-40 percent) as europium and terbium are amongst the least common rare earths.

Ceramics Yttrium stabilised zirconia is used throughout the resources industry where a material with high-wear resistance is required.

WORLD WILL NOT RUN OUT OF RARE EARTH

By Pratima Desai
LONDON

THE WORLD WILL NOT RUN OUT OF RARE earth metals used in new technology, and those who think it will do not understand the difference between reserves and resources, British Geological Survey (BGS) said.

Andrew Bloodworth, head of minerals and waste at the BGS, a supplier of geological information, told Reuters rare earth metals were so named because the minerals they were originally extracted from, by early chemists, were rare.

"They are not rare, as a group they are more abundant than silver. It's very common for the media to get mixed up between reserves and resources," he said.

"People look at reserve reports, calculate 20 years' worth at current demand levels and then say 'oh my god we're going to run out' ... In reality reserves are dynamic and tend to run ahead of consumption. Reserves do not provide a reliable

indication of impending shortages."

There are rare earth metal resources on all the continents, a relative abundance of them in the earth's crust, BGS said.

But production of rare earths is currently concentrated in China, which accounts for 95 percent of global supply, and is trying to clamp down on exports of its mineral wealth.

The process of turning rare earth minerals into refined products is the most advanced in China -- estimated to have more than 35 percent of global reserves.

The country has dominated the rare earths arena because other producers have been unable to compete on cost.

"People think China is sitting on all the rare earth resources, that's not true," Bloodworth said. "As concerns grow about the Chinese monopoly, there is growing commercial interest in developing other

deposits and bringing them to mine status.”

A recent example is U.S.-based Molycorp, which produces rare earth elements. It is planning to modernise and expand its Mountain Pass facility in California.

MOTOR MAGNETS DRIVE DEMAND

The main driver of demand for rare earth metals are motor magnets used in hard disk drives, CD ROMS and DVDs and electric cars -- a big theme at the moment in a world worried about energy conservation and global warming.

Neodymium and praseodymium are combined with iron and boron to produce alloy powders that have magnetic properties.

“Weight for weight these magnets are 10 times stronger than the ones you used to play with as a child,” Bloodworth said.

Terbium is also used in magnets for high temperature applications, cerium is used in catalytic converters for cars, while lanthanum is an important catalyst for petroleum refining and is used in rechargeable batteries for hybrid cars.

“It is difficult to predict demand for rare earths over time because they are a complicated group of metals used in many applications, in small quantities,” Bloodworth said.

“Their uses change over time, scientists are always looking for new ways to use them and that’s why it’s quite difficult to get to grips with demand ... Hard to say over a decade what they are going to be used for.”

Latest figures from BGS show total reported world production of rare earth oxide in 2008 was 126,000 tonnes, a four percent increase from 121,000 tonnes in 2007.

“Some analysts forecast consumption of rare earth oxides will reach 190,000-210,000 tonnes by 2015,” Bloodworth said.

“It is also predicted that demand will outpace supply for certain elements, particularly neodymium, dysprosium and terbium, unless sufficient new production capacity comes online.”

(Editing by Sue Thomas)

PRODUCTION AND RESERVES (2009 data)

Country	Production (Metric Ton)	Reserves (Metric Ton)
United States	insignificant	13,000,000
Australia	insignificant	5,400,000
Brazil	650	48,000
China	120,000	36,000,000
CIS	not available	19,000,000
India	2,700	3,100,000
Malaysia	380	30,000
Others	not available	22,000,000
World total (rounded)	124,000	99,000,000

NEXT BIG THING OR WILL THE BUBBLE BURST?

By James Regan
SYDNEY

CHINA’S INCREASING RELUCTANCE TO supply the rest of the world with rare earths is whipping up a gold rush-like frenzy to find new producers of the elements needed to manufacture everything from high-tech weapons to mobile phones.

Producers and would-be producers are forging new supply pacts with consumers, and investors are scooping up shares in mining companies promising to replace the lost Chinese material.

But the ultra-quick global push to find alternative supplies also has investors asking if a classic commodities bubble is in the making.

The world’s biggest money manager, BlackRock Inc, thinks it’s possible.

“The ability to bring on production quickly in the higher-price environment means that the longer-term sustainability of those prices are questionable,” Catherine Raw, a fund manager in BlackRock’s natural-resources division, said on Wednesday.

“We are trying to invest on a three to five-year view, and longer, to identify where you can see long-term structural increases in commodities,” Raw said.

“The jury on rare earths is still out.”

USES IN DEFENCE INDUSTRIES

Lanthanum night-vision goggles

Neodymium laser range-finders, guidance systems, communications

Europium fluorescent and phosphors in lamps and monitors

Erbium amplifiers in fiber-optic data transmission

Samarium permanent magnets that are stable at high temperatures

Samarium precision-guided weapons

Samarium “white noise” production in stealth technology

MAGNETS

Rare earth magnets are widely used in wind turbines. Some large turbines require two short tonnes of rare earth magnets. These magnets are very strong and make the turbines highly efficient. Rare earth magnets are used in turbines and generators in many alternative energy applications.

HYBRID CAR BATTERIES

Every hybrid-electric and electric vehicle has a large battery. Each battery is made using sev-

PRICES UP

The price hikes in rare earths has been meteoric: Cerium, widely used in glass-making is up nearly tenfold since 2009. Prices of neodymium and terbium, needed to make magnets, are up more than 40 percent.

This has propelled shares of Lynas Corp and Molycorp Inc., the biggest non-Chinese rare earth firms, to more than double since July, when China announced it was reducing exports by 72 percent in the second half.

Stock in Arafura Resources Ltd, another promising producer, has more than tripled in just a few months.

Beijing says it simply needs to conserve its mine reserves of rare earths for future domestic consumption or it will run out.

Others say it is using rare earths as a trade axe.

China last month halted shipments to Japan after a long-simmering territorial dispute with Tokyo flared.

"Strategic concerns overall towards China are shaping or increasing the level of worry over these export quotas," said Malcolm Cook, East Asia programme director for the Lowy Institute for International Policy in Sydney.

The European Union and the United States on Tuesday said they were pressing for solutions to concerns China may be exploiting its stranglehold on rare earth metals.

Regardless of China's motives, its future commitment to exporting rare earth products remains questionable, leaving the rest of the world looking for 40,000-50,000 tonnes of material a year at today's consumption rate.

"The basic issue is that China needs to use the rare earths for domestic demand first and the left over amount can go to other countries," said Amy Lee, an analyst at Nomura in Hong Kong.

"They are concerned about the limited rare earths in China, so they need to control it."

There are at least two mines outside of China nearing the production stage and poised to address much of the shortfall: Molycorp's Mountain Pass in California and Lynas' Mt Weld in Austral-

ia, which together will have the capacity to meet at least two-thirds of non-China world demand within three years.

Potentially another 115,000 tonnes coming from Canada to Australia to Greenland is in various stages of pre-development. And as more uranium mines are dug worldwide, consumers can expect additional supplies as by-products, particularly in Australia and Kazakhstan.

"I think the supply response is well under way," said Andrew Driscoll, head of resources research at CLSA.

On top of that, Driscoll believes there are three to four consumers in Japan investing in as many as six projects outside of China to become self-sufficient in the future.

Japanese Prime Minister Naoto Kan this month agreed with Mongolian Prime Minister Sukhbaatar Batbold to cooperate in promoting rare earth mines in Mongolia, according to Kydo.

In Canada, Great Western Minerals Group Ltd. on Wednesday said it had ordered a new furnace needed to process more rare earths, increasing capacity by 50 percent starting in the third quarter of next year.

More untapped supplies ready for plucking are known to exist in Vietnam.

Jonathan Barratt, managing director of Commodity Broking Services in Sydney, said U.S. policy will determine whether the bubble bursts in rare earths.

The Pentagon is due to report on its plans for securing rare earths to U.S. Congress this month.

"Is this a bubble? It depends on what the United States decides to do," said Barratt.

"They have the metal in the ground and if they decide they can cope with the environmental impact and start digging it up, you will see prices adjust quite rapidly."

(Additional reporting by Michael Perry in SYDNEY, Joseph Chaney in HONG KONG, Ruby Lian and Tom Miles in BEIJING and Nick Trevethan in SINGAPORE; Editing by Michael Urquhart)

eral pounds of rare earth compounds. The use of electric vehicles is expected to increase rapidly, driven by energy independence, climate change and other concerns. This is a key growth area for rare earths.

MOBILE PHONES, LAPTOPS

Rechargeable batteries used in mobile phone and portable computers require rare earths. Rare earths were the key to smaller more efficient battery technology.

Source: Arafura Resources Ltd, USGS, Thomson Reuters

(Compiled by James Regan, edited by Bill Tarrant)

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COVER PHOTO: A worker at a rare earth metals mine in Nancheng county, Jiangxi province October 20, 2010. China has denied a report that the government plans to slash export quotas of rare earth metals next year, seeking to ease international jitters about Beijing's stranglehold on supplies. REUTERS/Stringer

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