

# **Why Rare Earth Prices are Likely to Continue Their Upward Trend**

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*Presented by*

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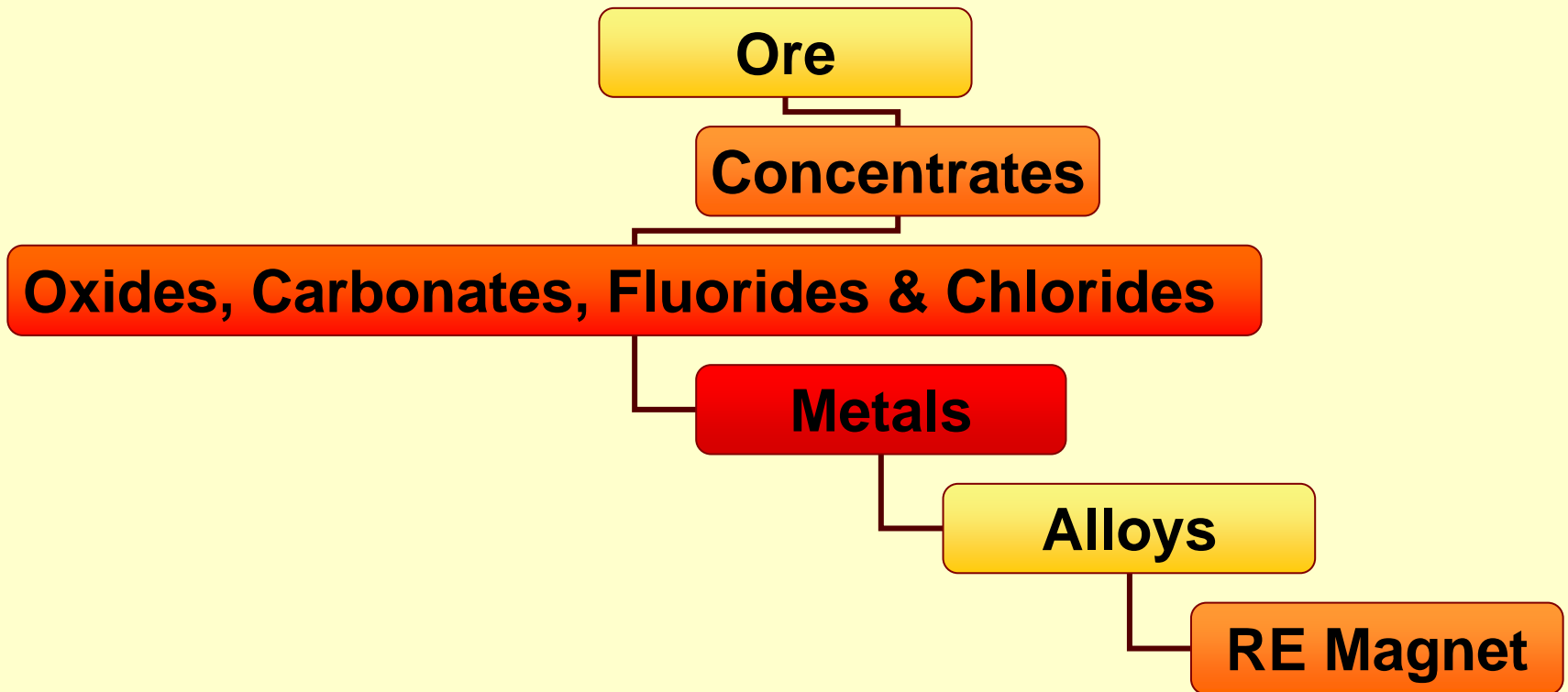
# Outline

- **The Issue**
- **The China factor**
- **Recent production trends**
- **Factors influencing recent price increases**
- **Understanding the future supply-demand equation**
- **“Relief valve” opportunities**
- **Summary and future outlook**

# The Issue

- **Nd and Pr oxide prices have increased by approximately 150% during the past three years**
- **All magnet producers and have been faced with significant raw material price increases during the past 12-18 months**
- **Most of these increases have been passed on to customers and have ranged from as low as 10-15% to as much as 75% or higher**
- **Concern exists about the reasons influencing this trend and the prospects for future rare earth magnet price stability (or lack thereof)**

# From the Ore to a Magnet



# The Very Rare Earths

**Rare Earth Elements**

<b>La</b>	<b>Ce</b>	<b>Pr</b>	<b>Nd</b>	Pm	<b>Sm</b>	<b>Eu</b>	<b>Gd</b>	<b>Tb</b>	<b>Dy</b>	<b>Ho</b>	<b>Er</b>	<b>Tm</b>	<b>Yb</b>	<b>Lu</b>
57	58	59	60	61	62	63	64	65	66	67	68	69	70	71

Lanthanides

H																	He	
Li	Be											B	C	N	O	F	Ne	
Na	Mg											Al	Si	P	S	Cl	Ar	
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
Rb	Sr	<b>Y</b>	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
Cs	Ba		<b>Lu</b>	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	An	Lr															

# **China's Long Term Strategy: Dominate Rare Earth Production**

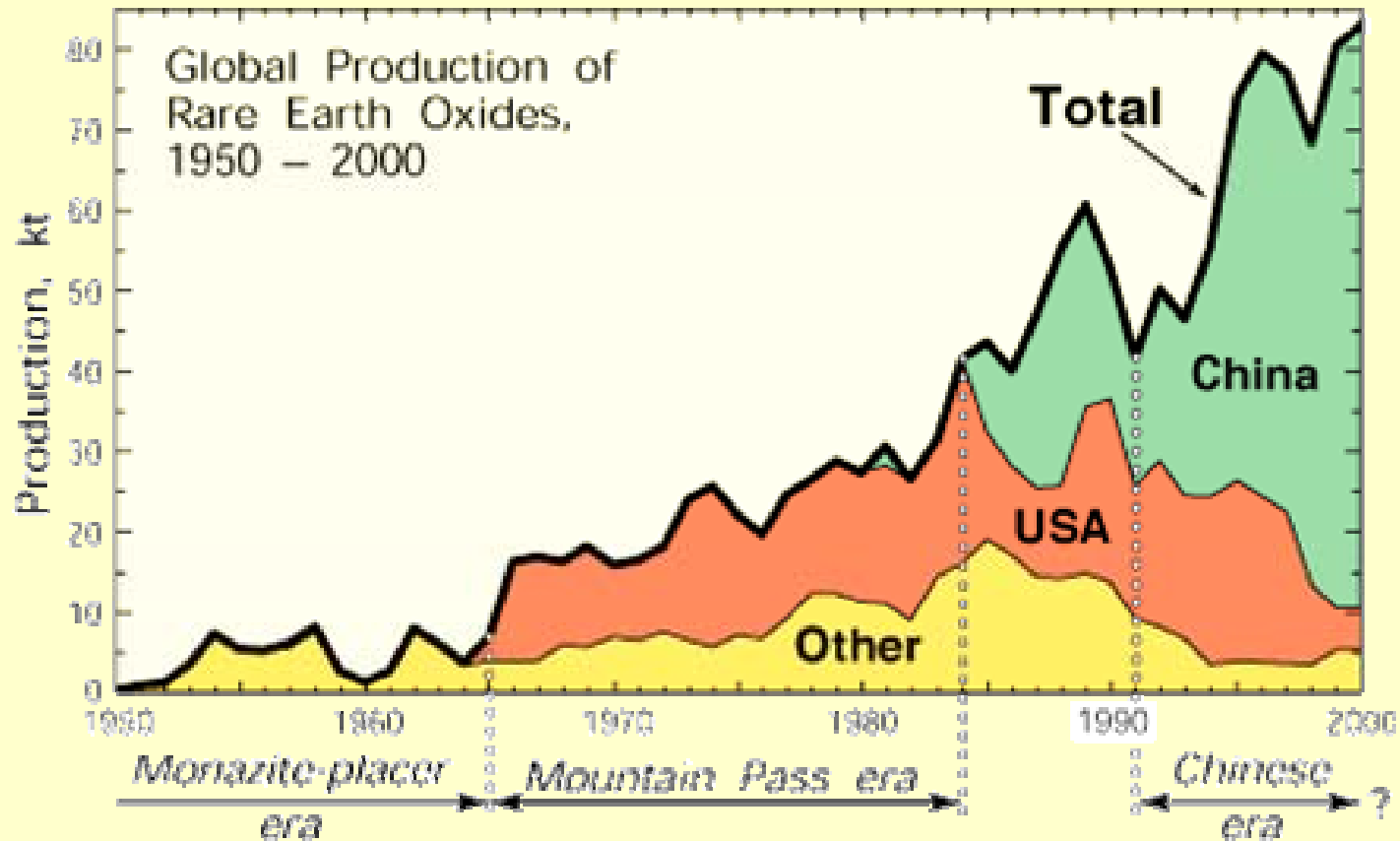
**“There is oil in the Middle  
East....there is rare earth in China”**

**Deng Xiaoping (1992)**

# **China Does Now Dominate Rare Earth Production**

**For the past ten years, China  
has supplied over 90% of the Rare  
Earth Oxides produced in the  
entire world**

# China Assumed Command in the Late 1990's





# 2005 Reality #1

## (World REO Production)

<u>Country</u>	<u>Production (mT)</u>	<u>%</u>
<b>China</b>	<b>98,000</b>	<b>93.3%</b>
India	2,700	2.6
Thailand	2,200	2.1
United States	-	-
Australia	-	-
All Other	<u>2,100</u>	<u>2.0</u>
<b>TOTAL</b>	<b>105,000</b>	<b>100.0%</b>

Source: U.S. Geological Survey (January 2006)

# 2005 Reality #2

(China REO Production)

<u>Region</u>	<u>Production (mT)</u>	<u>%</u>
Baotou	49,000	41.3%
Ion Absorption	44,000	37.1
Sichuan	25,709	21.6
<b>TOTAL</b>	<b>118,709</b>	<b>100.0%</b>

**Previous Slide: 98,000 ?**

Source: Baotou National RE Hi-tech Industrial Development Zone (September 2006)

# **China's Rare Earth Production is Under Serious Pressure**

- **Environmental problems**
- **Weather difficulties**
- **Strengthening Yuan**
- **Strong domestic market demand**

# China “Speak”

**“We think prices rising this year (2006) is the comprehensive effect of many factors. It is the result of macro control of Chinese government and stable growth of Chinese economy. Self-adjustment of the RE industry and other factors from Chinese and oversea markets have a conjunct effect to the prices as well”**

Source: China Rare Earth Information Center (September 2006)

# 2005 Global REO Consumption

<u>Country</u>	<u>REO (MT)</u>	<u>%</u>
China	51,900	51.2%
Japan	22,000	21.7
USA	13,000	12.8
Europe	8,000	7.9
South Korea	3,500	3.5
All Others	2,900	2.9
<b>TOTAL</b>	<b>101,300</b>	<b>100.0%</b>

Source: Baotou National RE Hi-tech Industrial Development Zone (September 2006)

# Major Rare Earth Applications

- **NdFeB Magnets**
- **NiMH Batteries**
- **Catalysts (auto & chemical)**
- **Phosphors (fluorescent lights)**
- **Glass Additives**
- **Polishing Compounds**

# REO Demand (MetricTons)

<u>Application</u>	<u>2005</u>	<u>2010</u>	<u>%AAG</u>
Magnets	17,150	31,100	12.6%
NiMH Batteries	7,200	27,300	30.5
Catalysts	21,230	25,960	3.8
Polishing	15,150	23,500	9.2
Glass	13,590	13,990	0.6
Phosphors	4,007	7,512	13.0
Other	16,935	24,950	8.0
<b>TOTAL</b>	<b>95,262</b>	<b>154,312</b>	<b>10.1%</b>

Source: BCC Research (2006)

# Other Rare Earth Applications

<u>Application</u>	<u>2005 MT</u>	<u>2005-10 AAG</u>
Metallurgy	9,730	10%
Fertilizers	3,000	-
Adv.Ceramics	2,120	6
Mischmetal	930	3
Lasers	800	6
Miscellaneous	355	30
<b>TOTAL</b>	<b>16,935</b>	<b>8%</b>

Source: BCC Research (2006)



# Primary Rare Earth Demands

**X = Necessary**

**x = Casual**

<b><i>Application/REO</i></b>	<b>Nd</b>	<b>Pr</b>	<b>Dy</b>	<b>Tb</b>	<b>La</b>	<b>Ce</b>
<b>Magnets</b>	<b>X</b>	X	X	X		
<b>NiMH Batteries</b>	X	X			<b>X</b>	X
<b>Catalysts</b>	X	X			<b>X</b>	<b>X</b>
<b>Glass Additives</b>	X	X			<b>X</b>	<b>X</b>
<b>Polishing</b>		X			<b>X</b>	<b>X</b>
<b>Phosphors</b>		X	X	<b>X</b>	X	X

# Rare Earth Demand (MetricTons)

<u>REO</u>	<u>2005</u>	<u>2010</u>	<u>%AAG</u>
Cerium	37,736	53,272	7.1%
Lanthanum	28,041	47,197	11.0
Neodymium	15,915	28,331	12.2
Praseodymium	5,705	11,972	16.0
Dysprosium	1,715	3,110	12.6
Terbium	259	547	16.1
Other	5,891	9,883	10.9
<b>TOTAL</b>	<b>95,262</b>	<b>154,312</b>	<b>10.1%</b>

Source: BCC Research (2006)

# Chinese Government Decisions Seriously Impact the Magnet Industry

- **2006 Mining Licenses Granted**
  - 86,620 metric tons REO
  - Nd/Pr content ~17,300 metric tons
  - 2005 Nd/Pr production was 20,600 metric tons!
  - **20% reduction from 2005 output**
  - Sources: Neo Material Technologies, Inc. & China Rare Earth Information Center

# One Imbalance Projection

- “Although only 150,000 metric tons of REO will be needed a year [*in 2010*], **a total of 350,000 metric tons have to be mined to meet the demand by sintered NdFeB.**”
- **“This represents the magnitude of the imbalance issue between REO resources and consumption”**
- **Source: Neo Material Technologies, Inc. (September 2006)**

# REO Price Projection (\$/Kg)

Source: Wardrop Engineering – December 2006

	<b>Actual November 2006</b>	<b>Forecast 2007 Average</b>	<b>Forecast 2008 Average</b>	<b>2008 Versus Nov '06</b>
<b>Nd</b>	<b>\$20.89</b>	<b>\$27.51</b>	<b>\$33.01</b>	<b>+ 58%</b>
<b>Pr</b>	<b>\$19.11</b>	<b>\$25.16</b>	<b>\$30.20</b>	<b>+ 58%</b>
<b>Dy</b>	<b>\$78.03</b>	<b>\$94.58</b>	<b>\$108.77</b>	<b>+ 39%</b>
<b>Tb</b>	<b>\$522.29</b>	<b>\$687.79</b>	<b>\$825.35</b>	<b>+ 58%</b>

# Alternate Rare Earth Sources

(Estimated Capacity in Metric Tons)

<b>Company</b>	<b>Country</b>	<b>Site</b>	<b>Annual Capacity</b>	<b>Start</b>
<b>Molycorp</b>	<b>USA</b>	<b>Mountain Pass</b>	<b>25,500</b>	<b>?</b>
<b>Lynas</b>	<b>Australia</b>	<b>Mt. Weld</b>	<b>10,500</b>	<b>2008</b>
<b>Great Western</b>	<b>Canada</b>	<b>Hoidas Lake</b>	<b>4,000</b>	<b>2010</b>

# Status of Alternate Sources

- **Molycorp** has not yet announced plans to start up production
- **Lynas** has announced plans to begin production in 2008
- **Great Western Minerals Group** is currently in pre-feasibility stage assessment

# Lynas and Great Western Have Financial Incentive

<u>Mine</u>	<u>REO Value (\$/MT)</u>
Hoidas Lake	\$6,026
Mt. Weld	5,158
Baotou	4,197
Mountain Pass	3,454

Oxides Included: Nd-Pr-Dy-Tb-Sm-Ce-La-Eu

Source: Great Western Minerals Group (based on 2006 prices)



# Great Western's "Mine to Market" Business Model

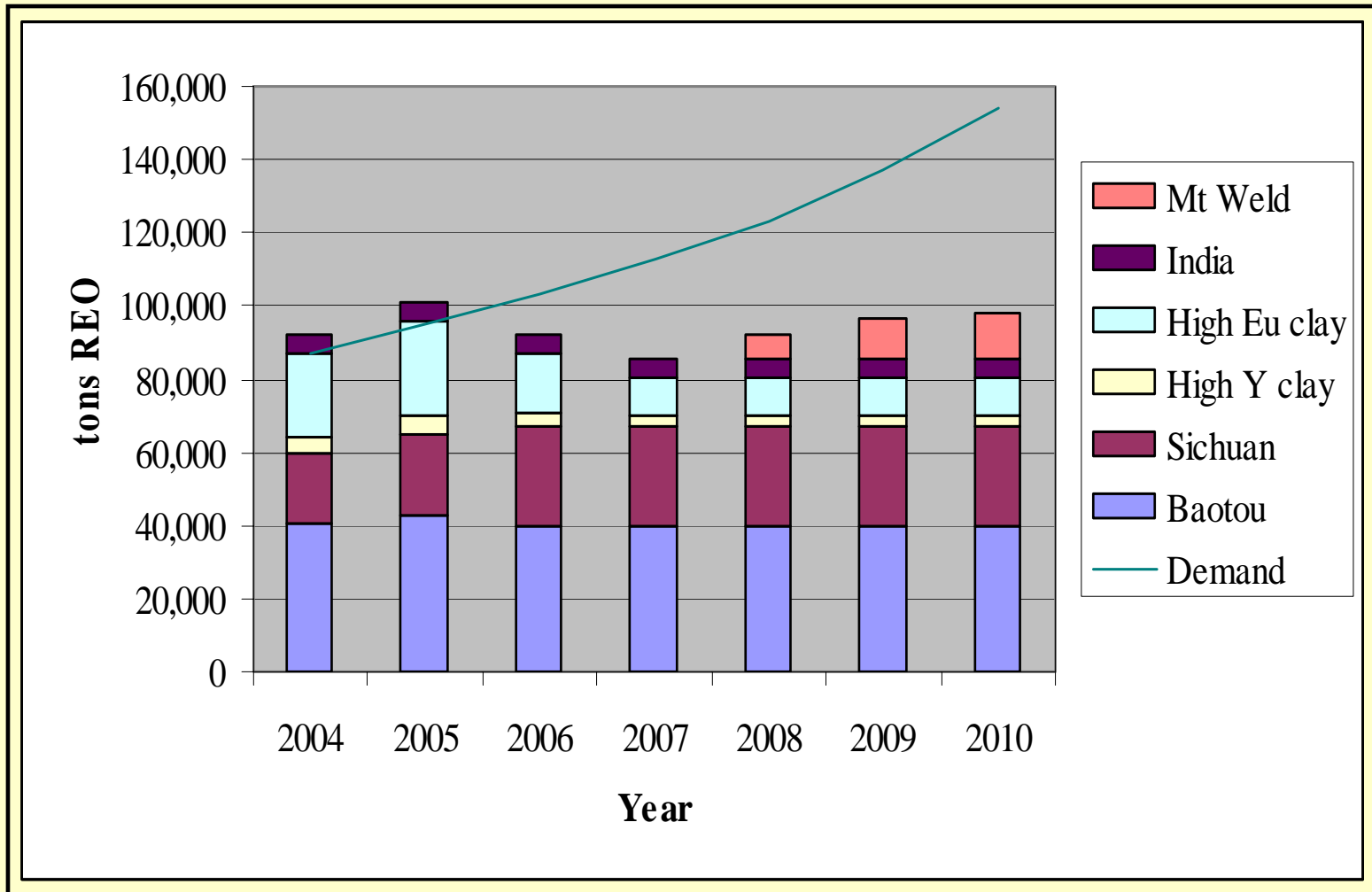
- **Great Western Technologies (Troy, Michigan) offers a fully vertically integrated supply capability:**
  - **Alloy Development**
  - **Vacuum Melting**
  - **Grinding & Powder Processing**
  - **Annealing & Hydriding Services**

# The Reality is.....

**If all three of the potential new REO sources were to immediately start up production, there might still be a shortage of the REO's required by the magnet industry!**

# REO Supply-Demand Summary

Source: BCC Research



# Advice for Magnet Producers

- **Transition all Chinese NdFeB motor arc production to press-to-shape processing**
- **Pursue economical ways to recover Rare Earths from magnet scrap and grinding swarf...in other words - RECYCLE!**
- **Focus R&D on composition changes to achieve material cost reductions – without sacrificing overall magnet performance**
- **Don't purchase “hedge” inventories – this doesn't help the supply-demand equation!**

# Options for Magnet Users

- **Negotiate firm price contracts with suppliers whenever possible**
- **Consider surcharge policies when quoting your customers where magnet cost is significant as a percentage of total cost**
- **Qualify at least two magnet suppliers**
- **Require “press-to-shape” product versus “slice-and-dice” whenever possible**
- **Re-evaluate the Hard Ferrite option!**

# China's Rare Earth Production is Under Serious Pressure

- Environmental problems
- Weather difficulties
- Strengthening Yuan
- Strong domestic market demand
- Government production and export quotas
- Imbalance in REO demand
- Total world demand exceeds supply
- **All these factors will likely push prices UP !**

# Summary

- **A number of significant factors have unfavorably impacted the Rare Earth supply-demand balance**
- **The primary issue is China's current dominance of the world's rare earth production**
- **Additional REO sources will be slow coming on stream and insufficient to satisfy total demand**
- **Forecasts indicate that REO demand will exceed supply for at least the next five years**
- **NdFeB magnet prices are likely to trend upward for a number of years**
- **The magnet industry will continue to be a healthy growth segment of the world economy!**

# *Thank You!*

***Walter T. Benecki LLC***

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