

# THE RARE EARTH CRISIS – HOW IT IMPACTS YOU!

Karl A. Gschneidner, Jr.

Ames Laboratory, U.S. Department of Energy and  
Department of Materials Science and Engineering  
Iowa State University  
Ames, Iowa 50011-3020, USA

Rotary Club  
Ames, Iowa  
July 16, 2012

# THE RARE EARTH ELEMENTS IMPACT EVERYONE

Many times a day

They can't be avoided,  
except by

packing up a sleeping bag

heading for the deep woods or a cave in the desert

But don't bring your cell phone or lighter flint

# As a consumer the largest rare earth containing product (or contains a product derived by using rare earths) **you will purchase** **is the automobile**

## PRODUCTS

Electric motors (~35 in an average car) [Nd,Pr,Dy] } magnets  
Speakers for sound system [Nd,Pr,Dy] }  
Sensors to measure and control oxygen content in burning the  
fuel (lean/rich mixture) [Y]  
3-way catalytic converter [Ce]  
Optical displays – phosphors [Y,Eu,Tb]

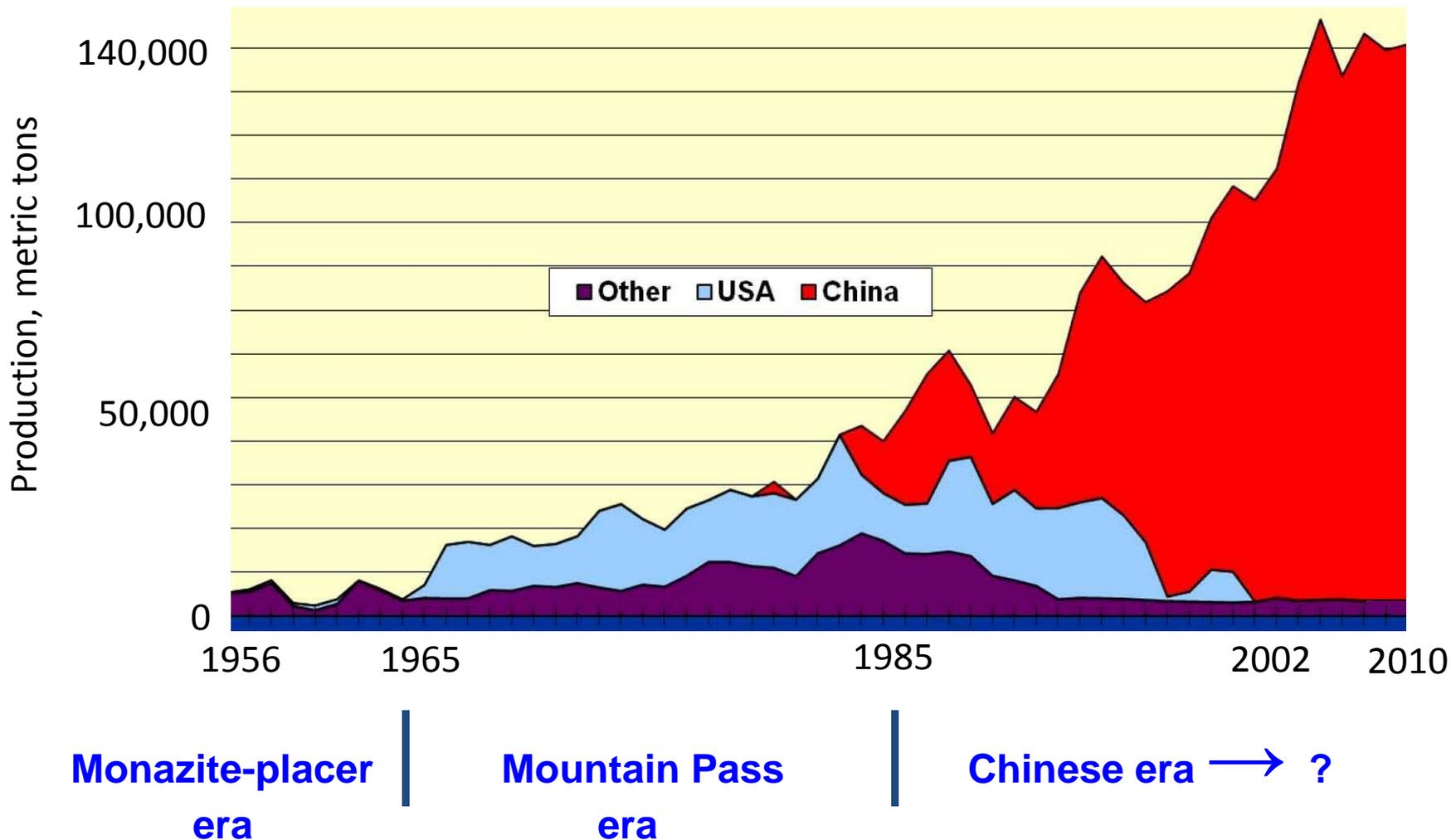
Ni-metal-hydride battery [Hybrid Vehicles]  
[La,Mischmetal]  
Electric traction motor [Hybrid Vehicles]  
[Nd,Dy] – magnets

## DERIVED PRODUCTS

Gasoline – FCC cracking catalysts  
[La,Ce,mixed REO]  
Windshield, mirrors – polishing [Ce]



# REE PRODUCTION TRENDS



Source: USGS Fact Sheet 087-02 updated with recent USGS Minerals Yearbook

In 2010 China produced (mined) 97% of the rare earths utilized in commerce

In 2011 it was down to 95%

Estimate China's share to be 76% in 2012 and 60% in 2014, assuming China's production remains constant at ~120,000 tons from 2011 → 2015, and an overall growth rate of the rare earth demand continues to grow at the historical average of the last 20 years of 10% per annum

# RESERVES (in percent)

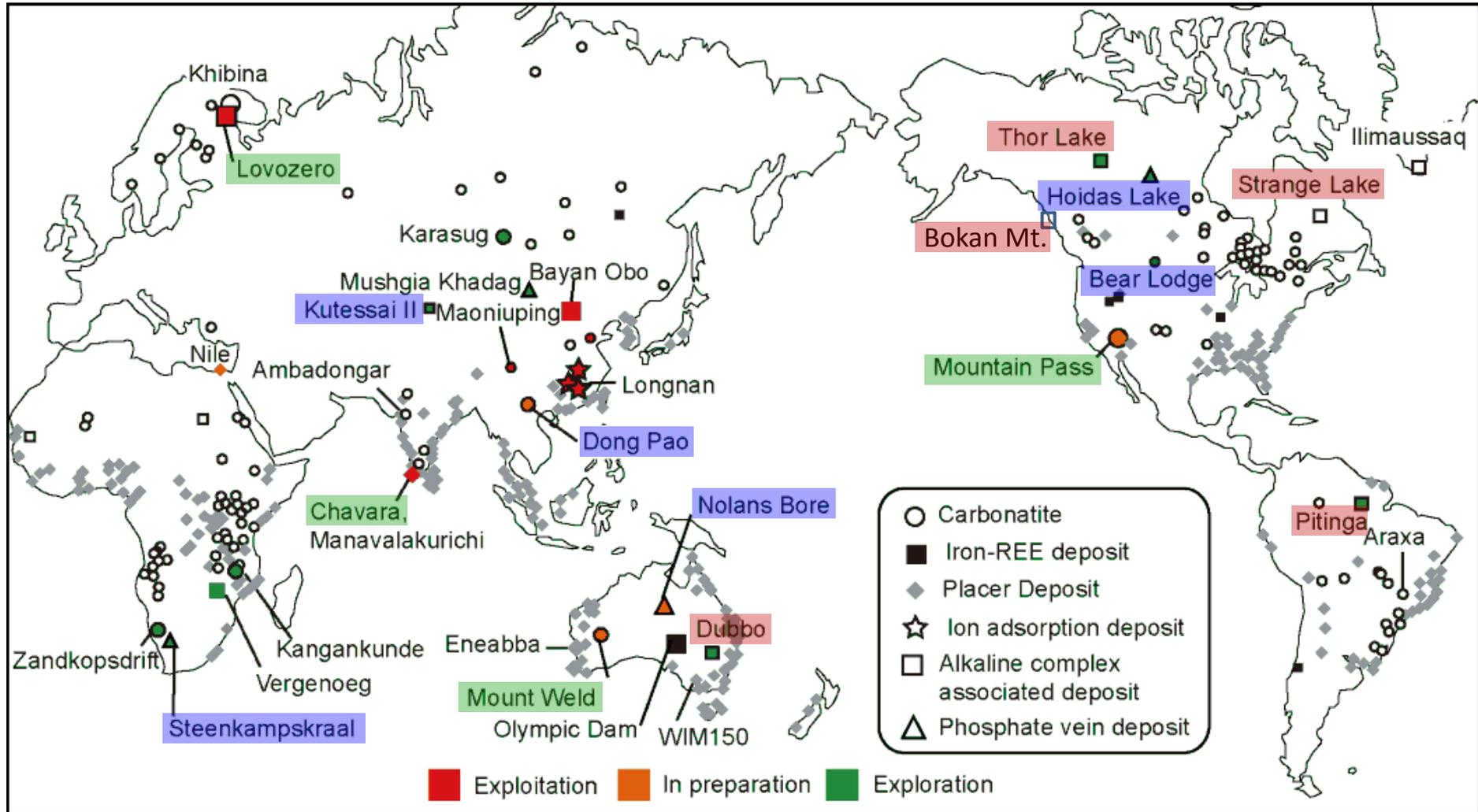
<u>Country</u>	<u>1980<sup>a</sup></u>	<u>1992</u>	<u>2010</u>
Australia	3	6.1	6.0
China	70 <sup>a</sup>	51.3	30.9 <sup>b</sup>
India	4	2.7	1.3
CIS	2	0.5	21.8
Malaysia	--	<1	<1
USA	20	15.0	14.9
Other	1	24.4	25.2
Total (M metric tons)	26	84	88

---

<sup>a</sup>In 1970 it was 75%.

<sup>b</sup>The actual tonnage of the known Chinese reserves increased by almost 300% from 1980 to 2010.

# ORE SOURCES AND MINING OPERATIONS



Operational in 2011/12

Operational by 2015/16 (HRE)

Operational by 2015/16 (LRE)

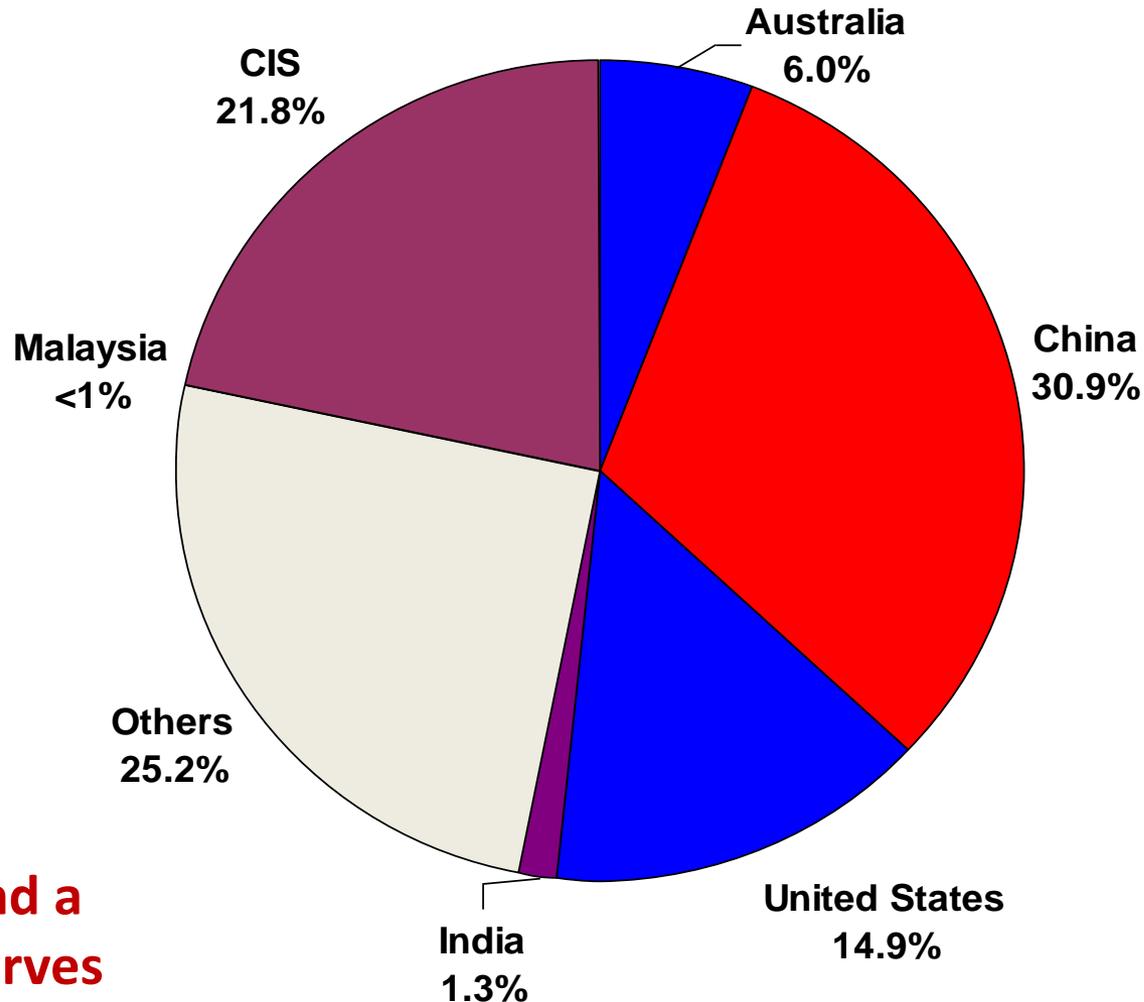
# REE MINERAL RESERVES

88 million metric tons of contained rare-earth oxide (REO)

Enough rare earths  
for >700 years at  
current production  
levels

Enough rare earths  
for ~69 years at a  
10% growth rate  
per annum

Enough rare earths  
For ~75 years at a  
10% growth rate and a  
1% increase of reserves  
per annum



# PROBLEMS FOR USA

## Military Security

All US weapon systems depend on rare earths – especially  $\text{Nd}_2\text{Fe}_{14}\text{B}$  permanent magnets in electric motors, computers, guidance systems

## Energy Security

Electric motors and batteries, wind turbines, petroleum refining, optical displays, fluorescent lighting, oxygen and electrical sensors (automotive engines)

## U.S. Teenager; Yourself

i-pods, cell phones, TVs, automobiles (gasoline, catalytic converters)

# U.S. AND CANADIAN RARE EARTH DEPOSITS



# SUBSTITUTION

## NO SUCH LUCK

People have been looking

Eu – red color in TV; used for ~50 years – yet no substitute

Nd – permanent magnets; used for ~27 years – yet no substitute

Sm – permanent magnets; used for over 30 years – yet no substitute

Ce – 3-way catalytic converters (automotive exhaust), used for ~30 years – yet no substitute

Mixed REO FCC catalysts – used for ~47 years (Half-life of a new catalyst is ~5 years) – yet no substitute

# RARE EARTH CRISIS – WHERE DO WE STAND TODAY

Part 1: The mining portion is basically solved, just needs time:  
Molycorp has been mining for nearly one year (since  
January 2, 2011).

Mined ~6,000 tons in 2011; will mine 20,000 tons in 2012  
and 40,000 tons in 2013.

Lynas started mining on May 14, 2011 Mound Weld, Australia  
Lynas Advanced Materials Plant in Malaysia to process and  
separate rare earths built and ready to go: February 1, 2012  
temporary (2 year) operating permit granted, but still held  
up by environmental activists using court actions.

**TODAY** America's Crisis is basically parts 2 and 3

# PARTS 2 AND 3 OF AMERICA'S (Rest of World's) CRISIS

Rebuilding of rare earth industry, especially beyond mining

Smaller mining companies – may need assistance

Loan guarantees to help businesses, manufacturers  
get started

Tax incentives (federal, state, local)

This is critical for the military: who would build devices,  
supply parts for devices in a time of national crisis?

Education and training

Need to rebuild and then continuously resupply  
intellectual capital

# HOW DOES THE RARE EARTH CRISIS IMPACT YOU DIRECTLY

## TODAY

Not at all – you can buy the things you need and desire.

## THREE YEARS FROM NOW (2015)

Probably not much different from today; prices may be higher but at the rate of inflation (rare earth generally do not have a big impact on the price of a commodity).

# SHOULD WE BE CONCERNED – YES

Military Security

Energy Security

Employment in companies producing  
high tech products

*This is seriously lacking today*