

Asian Metal 5th Rare Earth Summit


New York City 2013

Alliance LLC, by Robert Wolf

RECENT HISTORY, CURRENT EVENTS AND THE FUTURE OF RARE EARTH AND FERRITE MAGNETS

Introduction

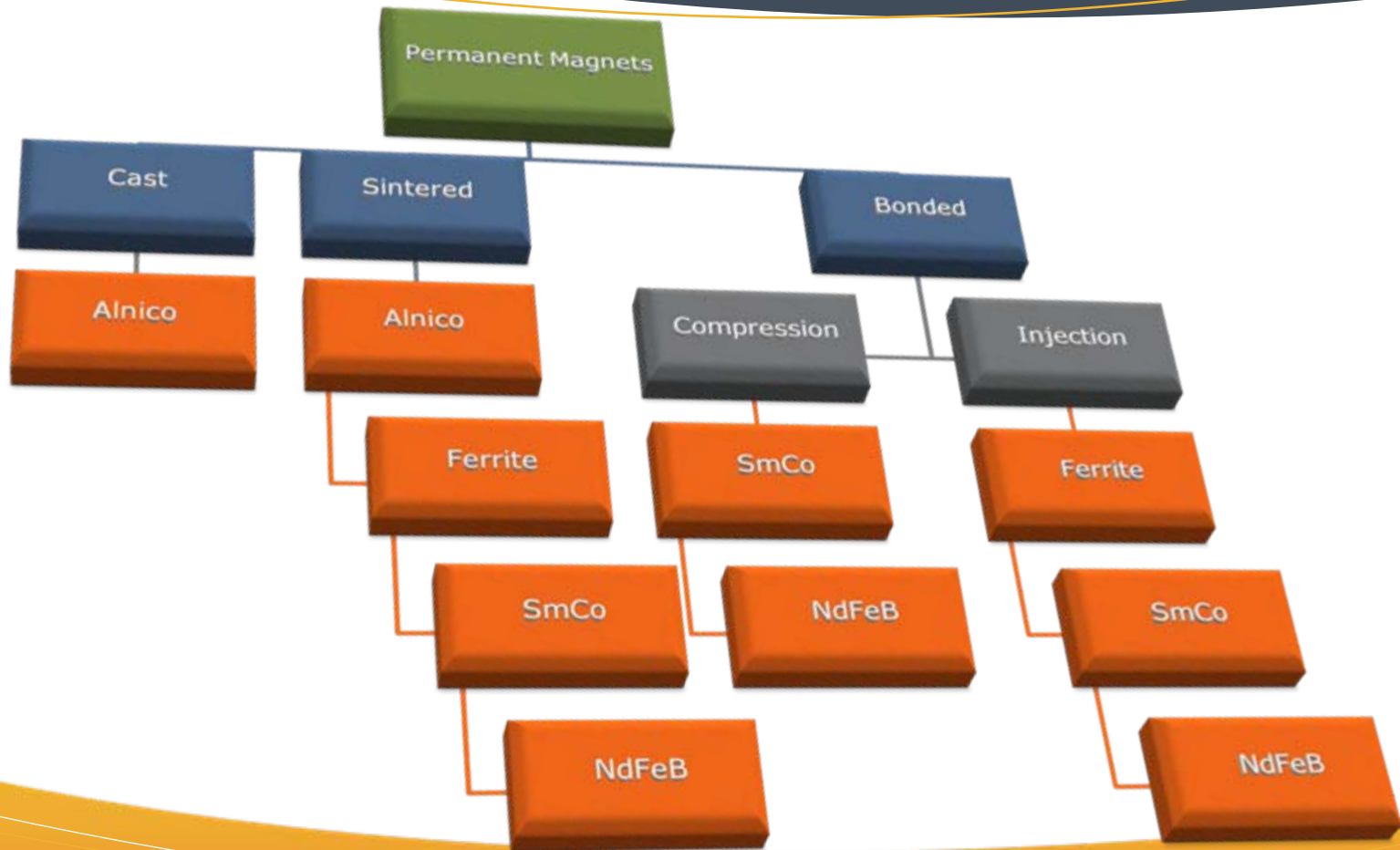
I would like to begin with the slide used to end my presentation at the May 2012 Asian Metal Conference in San Francisco



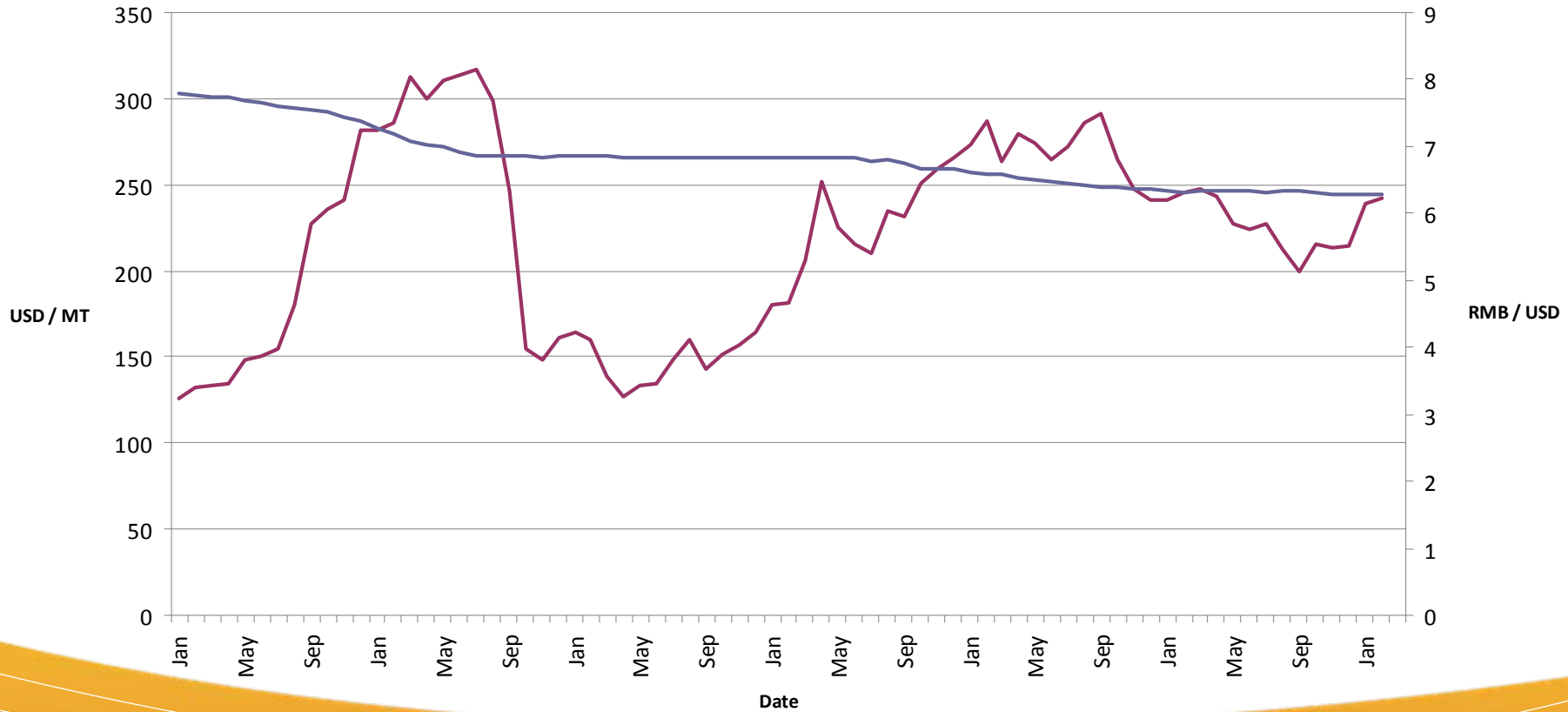
Comments by Marc Humphries in his CRS Report for Congress September 6, 2011

“Prices of rare earth oxides and metals are rising rapidly and most rare earth experts would agree that most recent restrictions on Chinese exports and lack of capacity elsewhere has led to the sharp price rise. With a surge in demand and export restrictions it will take time for the global supply to catch up. Prices may remain high in the short-term but, typically, tend to fall back to the industry’s marginal cost of production after supply increases. However, there are likely **structural shifts taking place in the global economy**. Well over half of the world’s population is now part of emerging economies, led by China and India and followed by Africa, South America and other parts of Asia. Their economies are expected to grow in the coming years **which could keep prices under pressure even as new supply comes on-stream**. It is unclear where rare earth prices will plateau because this rate of growth suggests a structural shift in demand. Emerging economies’ growth is usually more materials-intensive than developed economies because of the huge materials need for new infrastructure projects”

The Magnet Family



Iron Oxide & RMB History 2007-2013



Iron Oxide & RMB History 2007-2013

- From January 2010 to 2013 there has been a 66.6% increase in the price of iron oxide
- This caused a 17% increase in the price of ferrite magnets during this period
- However, this was the first price increase in almost 10 years
- And was not terribly exciting to the marketplace



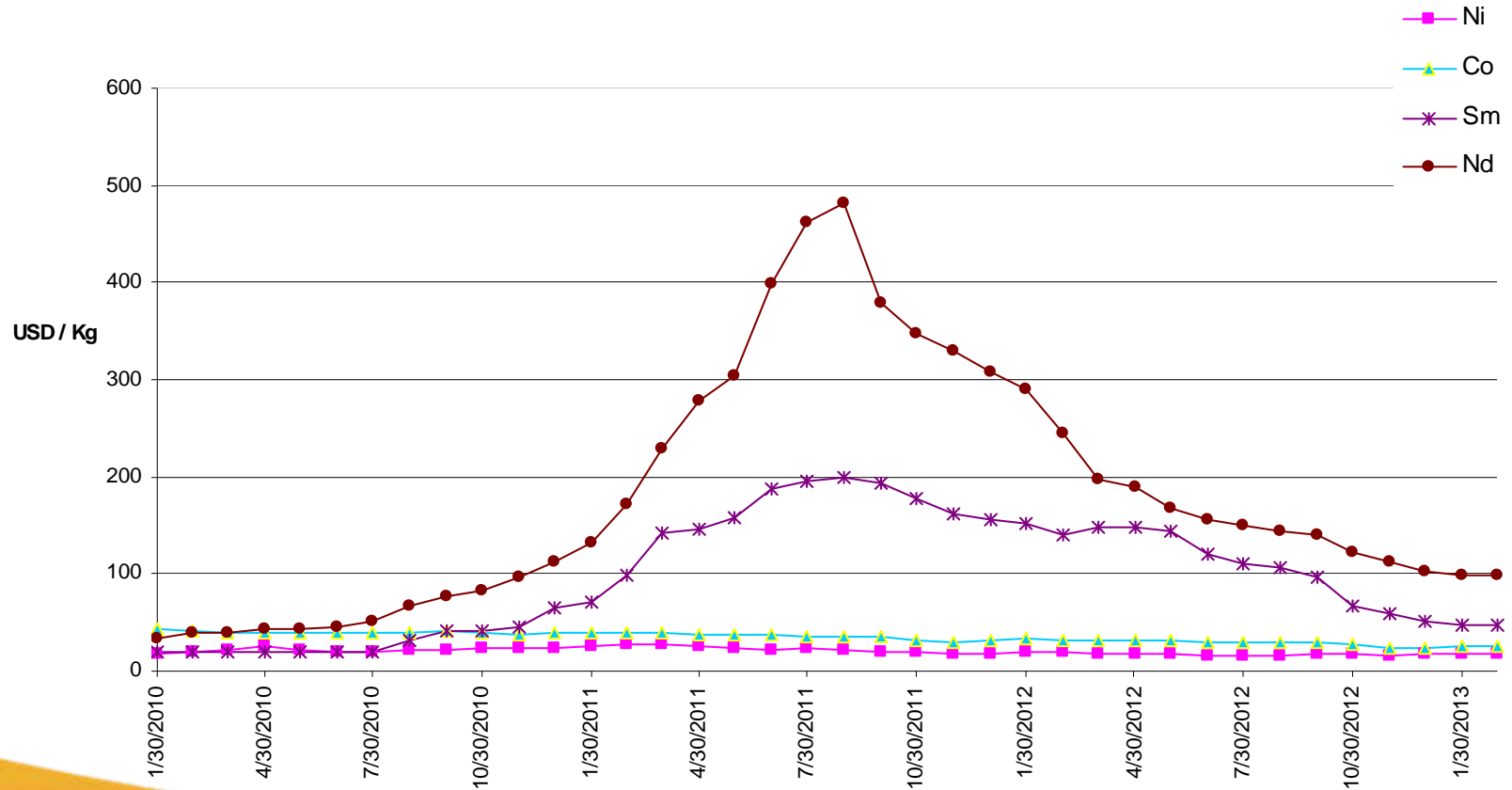
Rare Earth Elements Used in Magnets

- Praseodymium
- Neodymium
- Samarium
- Gadolinium
- Terbium
- Dysprosium

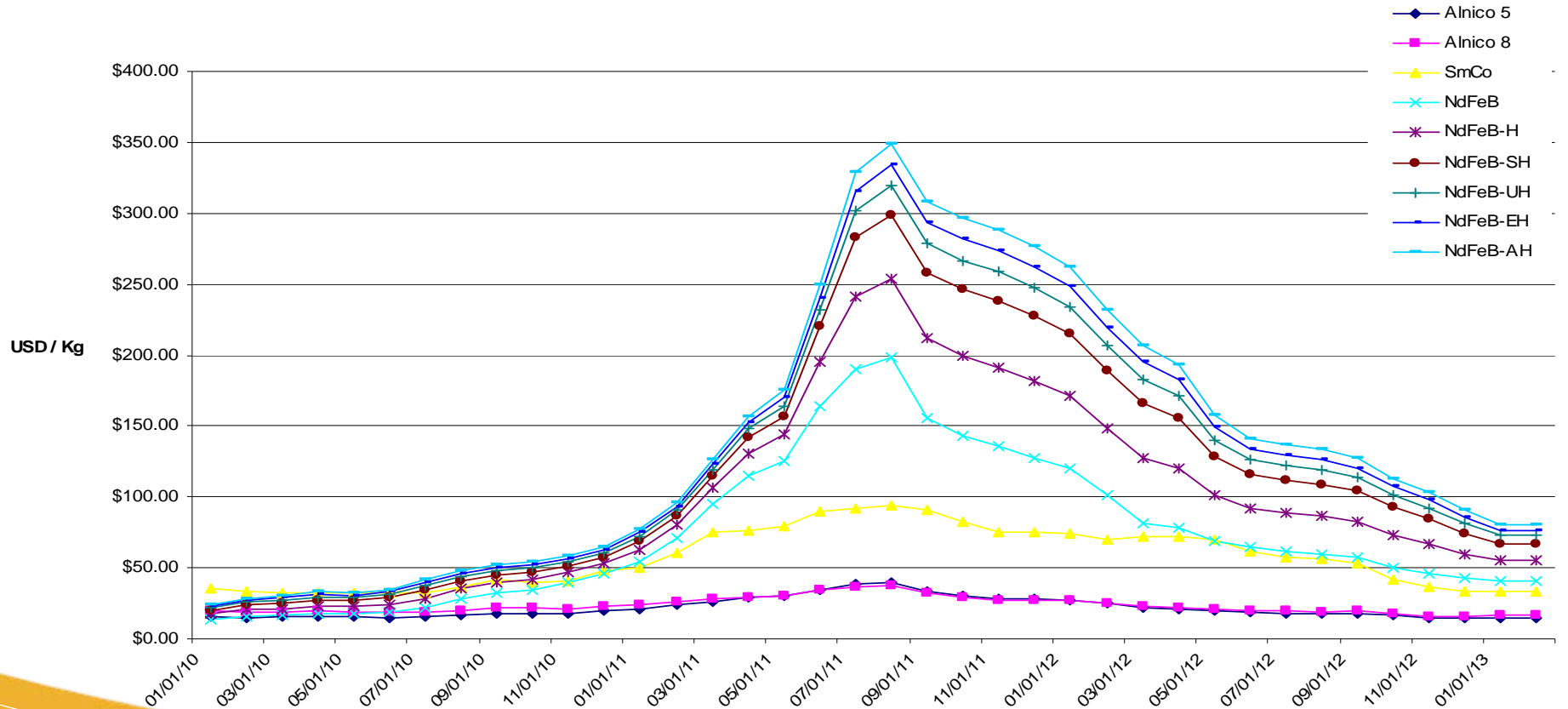
Magnet Material Prices per Kg 2010-2013

- However, the raw material costs for metal magnets increased dramatically
- Reaching their high point in mid 2011
- Dysprosium, not shown because of the scale, reached a high point of \$2200 per Kg
- And its effect on the magnet prices can be seen in the higher temperature grades of magnets

Metal Prices per Kg 2010-2013



Magnet Material Prices per Kg 2010-2013



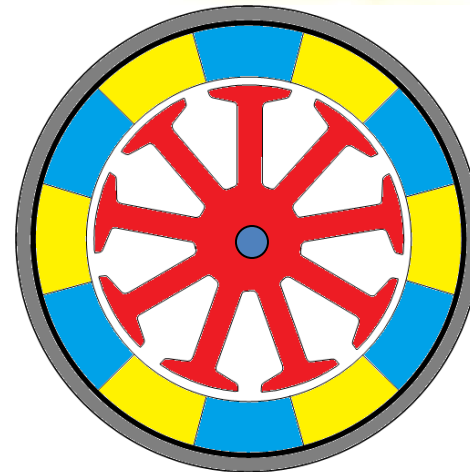
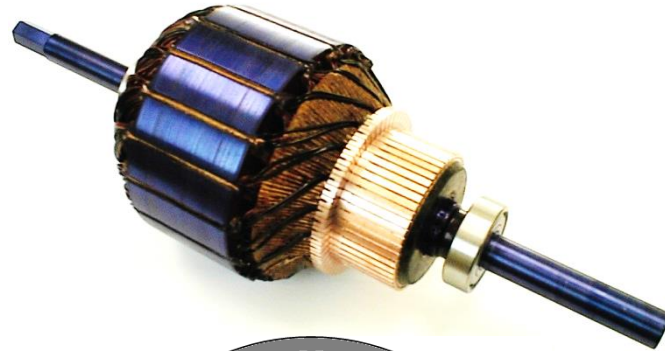
What happened next

- The increased material costs had its effect on the price of the magnets
- Consumers of the magnets decided it was time to return to ferrite designs to contain the costs

What did the motor manufacturers do?

- Manufacturers of large motors using ferrite magnets stayed with ferrite
- Manufacturers of large wind turbine generators using neodymium ceased production due to cost
- They could not revert to ferrite designs due to weight constraints
- Manufacturers of small motors that had converted from ferrite to neodymium remained due to other advantages

Motor Design Comparison



DC Motor and Loudspeaker Magnet Comparisons

Ferrite:



Rare Earth:



Did any customers make immediate changes from neodymium to samarium cobalt or ferrites?

- Customers tried to convert to ferrite or samarium cobalt
- Some loudspeaker customers switched from neodymium
- Some loudspeaker customers stopped purchasing
- Most customers could not make the change due to size and / or weight constraints imposed by the end user
- As the prices declined many customers abandoned their efforts to change designs

What is coming next

- There has been a rush for increased mine output in areas other than China
- However the time from mine to magnets is not short
- As the rare earth prices from China continue to decline, will the new producers be profitable and remain in the marketplace
- Recycling of materials – an ongoing effort for years but limited success. Also recycled material has lower properties
- Development of a new magnet material – has always been a goal but does not occur frequently or on the schedule desired by users

Vital Component in Product development and sustainable Procurement of resources

- Material Standards to Assist in Efficient Use of Available Resources
- Environmental considerations for Selection and Use
- Material Selection Standards and Guides
- Chemical and Physical identification, Characterization and Testing
- Alternative Material Selection and Effectiveness Testing
- Recycle, Reuse, and Recapture of Materials
- Labeling and End-of-Life Considerations
- Classification and Terminology
- Guides for Supply Chain Management and Risk Management

Luisa Moreno: “Brace yourself for three more years of heavy rare earth shortages”

- “The supply chain needs to be developed. The mining companies need to be talking to potential end-users. But complete vertical integration may not be the solution. One step at a time is a better strategy. Develop the mine first, be able to produce a concentrate and then learn to refine. Then continue talking to the end-users and alloy producers and magnet producers. Those are very complex materials that require a lot of knowledge – some of them are patented protected as well”
- “End – users downstream and miners upstream will gradually meet halfway for the development of a supply chain”

Bibliography

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- Fundamentals of Permanent Magnets, R.E.Wolf, presentation 2003
- Is there a Rare Earth Crisis? R.E.Wolf, presentation at Asian Metal Conference, May 2012
- Private communications with producers and
- The Gold Report interview with Luisa Moreno and Brian Sylvester 4/30/2013